Monitoring the Value of Water Quality and Condition Parameters Using the Open Sensor Aquarium

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Abstract. One technology that can be applied in hydroponic farming systems is sensing. Sensors used in this research are pH, electrical conductivity, water level, and temperature sensor. The First Come First Served (FCFS) algorithm is used to help scheduling data plotting. In order to be serviced by the processor, data entities in the queue must wait until all previous processes have been completed. The final test results show that the average success of the system succeeded in activating the actuator to operate the feeding was 92.5% and operating the heater to warm the water temperature was 83.33% for the 720-hour testing period. All sensing data also successfully plotted in graphical form for each of the results of sensing the pH value, water temperature, and electrical conductivity in water.

1. Introduction

Having a pet is a common hobby for humans, one pet is a type of fish. Conventional fish care requires the person in charge of monitoring or checking the environmental conditions of the fish in the aquarium. Therefore, to minimize the role of humans in watching over them, alternative solutions that can monitor the environmental conditions in which fish live are needed, namely monitoring the condition of pH, water temperature, water level, and electrical conductivity in water. This is needed so that the system can send notifications to fish owners to get further treatment.

Utilization of internet technology and sensors can be one solution for monitoring the condition of pets, especially when the owner is not at home at certain times. Now sensor technology is developing rapidly where this tool is able to detect physical and chemical changes which then transform it into electrical signals [1]. One of the uses of sensor technology that can be applied to fish pet care solutions is to integrate it with a microcontroller device to then use wireless transmission for sending data sensing to the cloud server. This integrated system is also called Wireless Sensor Network (WSN) technology. The radio signal at the WSN is interpreted by the receiver or electronic instrument to then convert it to the desired output [2]. The role of wireless sensor technology can be applied in human life to help humans get information quickly and more accurately.

In this research, a system named as Open Sensor Aquarium (OSA) allows actions to monitor environmental conditions in the aquarium such as water temperature, water pH, electrical conductivity in water, and water level. To then send the results of monitoring data using the GPRS communication...
line to the destination server. There is also a heater to warm the water temperature and feeder to feed fish.

In previous research, Shin and Angani proposed a new aquaculture system with an electric valve, the system was called a vertical aquarium management system. The purpose of the electric valve is to regulate the flow and maintain a constant water temperature in the aquarium. After reaching the water level and the required temperature level, the electric valve will be automatically closed to stop the flow of water. This electric valve is controlled by a level sensor and a temperature sensor attached to the tank [3]. Africa, et. al. doing research using electronic sensors for pH, temperature, and dissolved oxygen, while calculating ammonia factors, to allow users to measure the level of these parameters at the time, process, send data to the database and then use the data to automatically perform corrective action on the pH level, dangerous temperatures, dissolved oxygen and ammonia when notifying users via SMS [4]. Salim, et. al. has designed and implemented water quality monitoring using Raspberry Pi 3. This tool is made to monitor aquaculture water quality, which uses aeration in the form of microbubble. Some of the water quality parameters used in this monitoring are dissolved oxygen, acidity (pH), and temperature. Test results are also used for microbubble aeration checks. This device can be used to monitor water quality in laboratories, aquariums, and eel cultivation [5]. Nusantara, et. al. has built a smart aquarium for arowana fish and plays an important role in the maintenance of arowana fish. This research was made from a Raspberry Pi unit with several sensors installed. In this system there are feeding features, cleaning features and monitoring features. The feeding feature has the ability to remotely feed arowana fish. The cleaning feature has the ability to change water automatically. And the monitoring feature can measure water temperature [6]. While Lai, et. al. conducts research for aquarium sensing systems using RFID to monitor environmental parameters in the aquarium. This system includes tags, readers, antennas, impedance matching circuits, and embedded sensors. RFID tags are supported by readers through electromagnetic waves generated from readers. ISO 18000-6C RFID protocol was adopted. Sensor parameters are sent to the reader [7].

2. Material and Method
General architecture in this research describes the entire components used along with the flow of the process of sending sensing results, which is shown in Figure 1.
The general architecture of the system built consists of four main stages, namely the data input stage, the data processing stage, the visualization stage on the web dashboard, and the mechanical stage to respond to actions carried out automatically based on sensing results data.

2.1. Data Input Stage
At this stage several components are used with different functions, namely:

- CS-CO057, used to get the water level in the tank;
- DS18B20, used to measure the temperature of water in an aquarium;
- Analog pH sensor kit, used to measure the pH level of water in an aquarium;
- Analog electrical conductivity sensor, used to measure the ability of a solution to deliver electric current. The electric current in the solution is delivered by the ions contained in it. Ion has its own characteristics in delivering electric current, therefore the value Electrical conductivity only shows the concentration of total ions in solution. The number of ions in the solution is also affected by the dissolved solids in them. Getting more the large number of dissolved solids in the solution is the possible number of ions in solution also will be even greater, so the value of electrical conductivity will also be greater.
- Arduino Uno, which functions as a microcontroller;
- SIM900, which functions as a data transmission module using a GPRS connection.

2.2. Data Processing Stage
At this stage, analogue data from the sensor will be forwarded to the microcontroller to be processed into digital data. Digital data processing will be carried out by the Arduino Uno microcontroller board based on ATmega328. Arduino boat loader that bridges compiler software with a microcontroller. When the microcontroller board is used, it will call the program function in the module driver that has been connected from Arduino to the computer. Program function calls are made for the parameter data processing. When the driver module is connected to a computer, the jumper cable will be connected to a multi-channel data logger to define output in the form of water temperature, electrical conductivity in water, pH level of water, and level of water which is then forwarded to the next stage of data transmission using GPRS wireless transmission to the cloud server. The process of processing data to the server using the FCFS algorithm. This algorithm is used for the scheduling process, so that if the sensor on the OSA feels something symptomatic such as changes in pH in water, the system will perform an automatic execution according to the data that comes first to be served until it is finished processing rather than the data that comes after it.

2.3. Visualization Stage
At this stage the parameter data as a result of monitoring the condition of the aquarium is displayed in the form of visualization on the web dashboard and a notification system is also provided to the user to find out the conditions that occur quickly.

2.4. Mechanical Stage
At this stage there is a heater as an actuator that responds to changes in the temperature of the water and feeder as an actuator that feeds the fish every time specified.

3. Result and Discussion
The results of the system design that has been built are as follows:

3.1. System Hardware Design
The 30x20x26cm aquarium tank is paired with Arduino Uno along with sensors to detect water condition parameters in a specified time period and actuator as a mechanical function, as can be seen in Figure 2.
3.2. **Web Dashboard**

The web dashboard is a visualization page that is displayed to the user side so the user can find out the parameter values of the condition of the water in the tank. On this page there is a description of the sensor data displayed in a certain time span. The sensor data that appears is the parameter information for water level status (full / half / quarter / empty), water temperature sensor (Celsius), electrical conductivity in water (μS/mm), water pH as shown in Figure 3.

3.3. **System Testing**

To find out the functionality of the system that was built, tested for 720 hours or 30 days. Tests were carried out to determine the reliability of the system in responding to changes in water temperature parameter values in order to activate the heater when the temperature reached a point below 18°C after previously sending the water temperature data to the database, the timeliness of sending data sensing results to the database (based on time and based on triggers due to sensing changes), the relationship between the duration of feeding and the pH level of the water, and the relationship between the value of water conductivity and water temperature.

4. **Conclusion**

a. The average success of the system succeeded in activating the actuator to operate the feeding was 92.5% and operating the heater to warm the water temperature was 83.33% for the 720-
hour testing period. With a lower limit of 18°C to activate the heater function and feeding range for every 3 hours;
b. The conductivity value of water rises linearly with the increase in water temperature.

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