AQUACULTURE MAINTENANCE AND MONITORING SYSTEM FOR COLD WATER AQUARIUM

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ABSTRACT

This research is focused about the automation of water management and maintenance for cold water in aquarium. The researchers integrated different sensors in order to build a water management system for an aquarium. One of the sensor that the researchers used is the water level sensor for identifying if the water level in the aquarium that is being filled by the water pump is already in the right water level then it will stop from filling and if not, it will continue to fill the aquarium. The researchers also used the turbidity sensor that will be connected to the water pump, the turbidity sensor will open the water pump if the sensor detected that the clarity of water is less and the water will be pump out. Another sensor is water temperature. All the sensors are integrated to microcontroller to have the desired objectives of the research. The researchers used the PHP server for the user to monitor the data from all the sensors from the microcontroller. The data will be in table and it will be send to the PHP server where it is in data login. The data that can be monitored in the server is in every hour real time. This research is focused on the automation of water management and maintenance for cold water in an aquarium.

Keywords: *Aquaculture, PHP, Raspberry Pi2, Automation, Water level sensor, Temperature sensor*

INTRODUCTION

Background of the Study

Majority of the aquariums used on today's houses are monitored manually. Since human actions are very prone to errors and inaccuracy in relative to human nature, a change must occur in terms of how the management and monitoring is done, such as from manual to automatic. Gathering data about aquariums and life sources inside the environment must be done very accurate and clear since life forms depends on how well and good the environment is. Unacceptable change in the levels of the parameter values of the water may cause negative effect to the life of aquatic animals. This gives an idea for the proponents to automate the work of an aquaculture system. Various sensors are used in this project such as a water level sensor, temperature sensor, and a turbidity sensor. The sensors mentioned are used in water monitoring and management system.

Objectives of the Study

The general objective of this study is to develop a system that would maintain and monitor the cold-water aquarium for aquaculture.

Specifically, this study aims to:

- To develop a database that will hold the activities going inside the aquarium.
- To automate the water replacement cycle of the aquarium using microcontroller.
- To develop a system that will accurately maintain the aquaculture in the aquarium

Significance of the Study

This system can help lessen the work of cleaning the aquarium, because it automatically replaces the water inside the tank, and they can also avoid being wet in the process. This system can also help in monitoring the aquarium if for example the owners are on a trip or on a vacation, they can see and monitor the status of their aquarium through the internet.

Scope and Limitations

In this project, the proponents use a raspberry pi microcontroller as the main controller of the system. They also use IOT module that connects one device to another wirelessly to the internet. The proponent would also use a turbidity sensor to check the clearness of the water, this would determine if the water inside the tank needs to be replaced. Also, this project will use water level sensor for automatic water refilling of the tank, and also a temperature sensor to check and monitor the temperature of the aquarium.

There are limitations regarding this project. One of them is that the aquarium cannot be 100% cleaned because it only replaces the water. Also, this system can only be applied to cold water aquariums since this kind of aquarium is typically used in houses and by fish lovers and enthusiasts.

REVIEW OF RELATED LITERATURE

This chapter is about related literature and previous studies of other researchers and that the present researchers believed that this guide them in their present research. The standards that they have used is making the prototype are also considered in the previous research. This helped them to decide if they are going to use the exact standards or used an updated standard as of that moment.

Related Literatures

The system proposed by Adarsh Kaimal et al is to monitor the quality and level of the water inside an aquarium as well as to give feeds to the fish in the aquarium automatically. The proponents have developed a smart aquarium with pH control, water renewal and monitor lighting. The main purpose of the researchers for this project is to create and maintain a water management system for an aquarium. Every device on the system is connected to the PLC or Programmable Logic Controller where every input is being red by the PLC and gives signal to the appropriate actuator of the system. [1]

Another research entitled Design and Control of Aquarium Water Management System using Programmable Logic Controller (PLC). The project consists of sensors that are controlled in the PLC. Using Bluetooth or wireless wavelength it is able to control or connect the PLC to a Personal Computer. Without the PLC or sensor, the feedback of the system will affect the aquatic life in the aquarium. The PLC will be the brain where it can control or be connected to hardware application which will improve the water management system. [2]

The system proposal of Taufik Ibnu Salim et al, states that by using an aeration in the form of micro bubble could monitor the water quality of the aquaculture. The data processing is done by the raspberry pi 3 which uses python programming language to create the program acquisitions and the program viewer on the computer. The sensors used are for reading stability and monitoring performance. Some water quality that is monitored are the dissolved oxygen, pH quality and temperature. [3]

Based on the project entitled Automatic Water Level Control System, the proponents aim to develop a prototype of water level control. The mechanism of this project is though conductive method to measure the level. Each four level in tank has aluminum wires arranged in ¼, ½, 3/4, and the whole levels in tank, the end of the wires are contented to the Arduino. At the bottom of the tank there is a fifth wire and its resistor are full down resistors. In the dry end of the wire it is connected to 5V DC. So, when the water touches a particular wire it connects to the 5V DC and because water has small conductivity. The current flow will be converted into proportional voltage by the pull-down resistor. Through the voltage drop across the resistors in each level of the tank the data is receive by this how Arduino determined the water level in tank. The buzzer and pump are connected to the digital output pins of the Arduino. This is how their system for works it will start to the with the sensing in sump tank if it is empty the buzzer will on and if it is not empty it will sense water in tank with four sensors then it will go to the microcontroller which is Arduino, the decision making is based in

water level if tank full then motor off if motor on and results are displayed to their display unit. [4]

From the research paper entitled An IOT based reference architecture for smart water managing processes, the proponents based their standards on a platform independent service – oriented architecture called Object Linking and Embedding for Process Control Unified Architecture (OPC UA). From this standard, the proponents propose a smart water management model integrating IOT technologies along with business process coordination and decision support systems. [5]

According to a researched entitled Design and Implementation of Aquarium Remote Automation Monitoring and Control System, this study aims to improve the way on how human took care of their pet in applying the technology using internet of things pet monitor system. The system composition is composed of, control module, monitoring module, video server, center server platform and client server. The control module is assigned to in controlling the light equipment, oxygen and filtering equipment in aquarium. All orders in control units are send to the center server platform. Through the use of RS485 transparent protocol it can upload the data from the temperature sensor to the center server. There are two ways for system client to access system using personal computer and mobile phone. In PC, they develop an internet server based on the ASP technology on the center server, user can access it by IE explores through internet. For mobiles, they design an Android mobile operational system platform and can be access through WI-FI or GPRS network. For the safety of user, the system has user authentication and all operations will be access only allowed persons only. [6]

In a research paper titled Android Based Smart Water Pump Controller with Water Level Detection Technique, the author stated that water filling using a pump can be a lot of work because the tank needs to be manually checked by some personnel whether the tank is full or

not. Water management must be accurate since the tank should not be over flowing with water. The android application used here is to monitor the data in the tank, and can be used to turn ON or OFF the pump. The android is basically the controller of the whole system. [7]

Sukriti, Sanyam, and Indumathy stated that anIoT can be used for continuously monitoring or maintaining the water supply using the proposed mobile application. They also stated that the system reduces the wastage of water and minimizing the manual work of the users. The system uses a primitive alternative method that will alarm the user when the water is at a critical level and it will be sent to the user and the user can manually close the water tank. Using the Internet of Things, the proponents would connect one machine to another machine via wireless connection. [8]

According to the paper Water Tank Monitoring and Visualization System Using Smart-Phones, a water tank system consists of a tank, a valve and a pump. Each of the sensors from those different components outputs the data and sends it to the user's smart phone. The author has stated two ways to get the data wirelessly to the smart phone, it is either by the use of a TCP/IP socket communication or through PHP webpage. Since TCP/IP socket communications gives limits to monitoring and there could only be a one-to-one connection from the system to the user. PHP uses a webpage where multiple users can monitor the system and it can be accessed universally from any type of smartphone. [9]

The paper of Jui-Ho Chen along with his co-authors, stated that an automated water monitoring system would be establish for the fish farm environment simulation. The authors also stated that the user with a mobile phone could have complete control of the system especially android devices. The monitoring system consists of a temperature, dissolved oxygen, pH value and a water level sensing module. A low power MSP430 series MCU is used as the core for each sensing terminal device, it is also used to capture physical sensing device. Then

the Zigbee wireless sensor network bring all the data to the processing core where the Wi-Fi interface would get that data then deliver the signal to the user's phone. The power supply for the system could be in various ways like battery cells, solar power, or an electric supply so it will not be a high power consuming system. A UPS was used in the system to make the system more secure, low cost and low power consumption. [10]

Synthesis

According to this related review of literature for water level, the proponents decided to have an automatic refilling water system as one of the part of this research. Since it is automatic water refilling it is important to have a water level parameter in order to have right amount of water in the aquarium. According to the project Automatic Water Level Control System they have four levels with conductive method to measure water level, but since the proponents will have a water sensor, the proponents will just have high level, normal or in critical level to the desired level of water in the aquarium, which water sensor is connected to the Raspberry Pi.

Conceptual and Theoretical Framework

In this chapter, it shows the process the flow of the system for Aquaculture Maintenance and Monitoring System for cold water aquarium and how it works. It tackles the conceptual and theoretical framework of the research. This is based in the previous chapter which is review of related literature which is the research methods to develop the present research. The chapter include the proposed design and the software and hardware materials for the whole prototype.

Conceptual Framework

The study aims to have an automated water management and monitoring for aquarium. In order to build the system for water management the researchers used different sensor and microcontrollers that will be shown in this chapter.

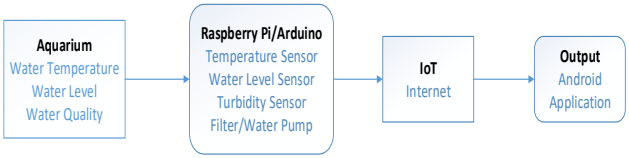

Figure 1. Basic Concept Diagram

Figure 1 shows the methodology of the system above. The hardware part of the system mostly consists of sensors that would measure the data such as the level, temperature and quality of the water inside the aquarium. The Raspberry Pi would be the core system of the project since all the gathered data is stored on the microcontrollers before it is sent through the Internet.

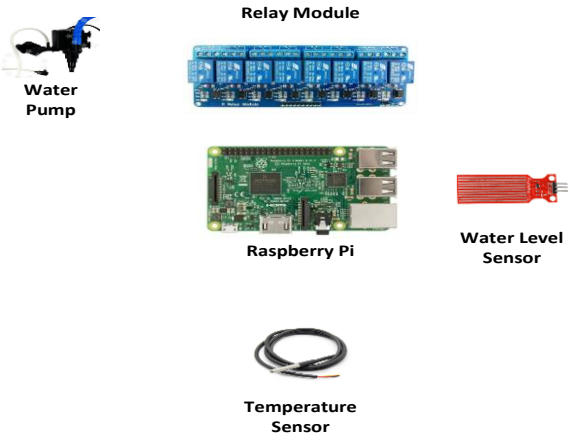

Figure 2. Internal Components of the System

Figure 2 shows that all sensors are connected to the microcontrollers and the water pump is connected to relay then relay is connected to microcontroller.

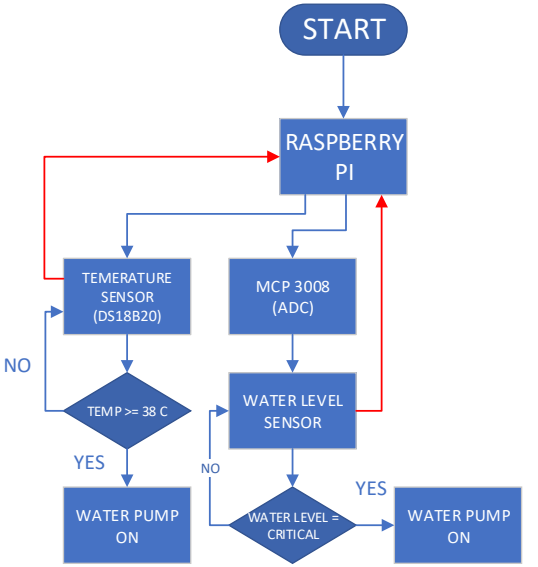

Figure 3. Flowchart for the Water Management

This figure shows how the sensors are connected to the microcontroller and how the sensors are connected with each other. The Raspberry pi will start then the temperature, water level sensor and turbidity will on. If the temperature sense that the temperature is higher or equal to 38 C then the water pump will on. Then if the water level sense that the water is in critical the water pump will also on.

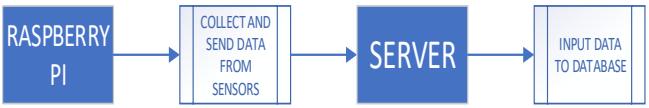

Figure 4. Flowchart of the Database

Figure 4 shows how the microcontroller and gathered data from sensors are inputted to the data base.

Proposed Design

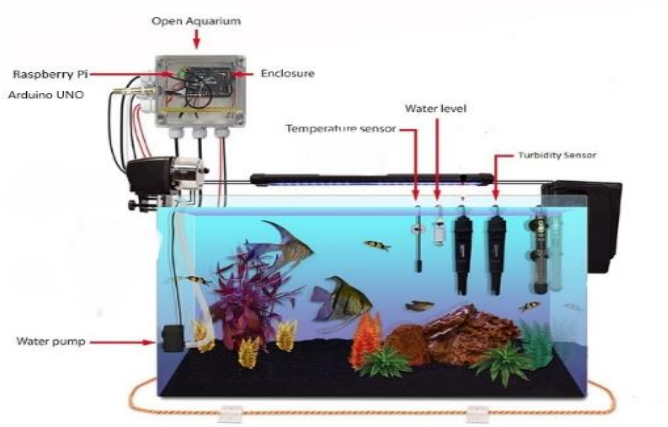

Figure 5. Proposed Design of the System

As shown on figure 5 the proposed design of the system. The Raspberry Pi microcontroller and the wirings of each device were configured to prevent getting wet but it is also covered with an enclosed box to increase protection for the core system. The sensors where inside the tank since it can be made water proof to get efficient data of the water levels and quality. The water pump is placed at 75% lower

part of the aquarium since it is still needed 25% of water for the fish to swim when the pump dishes out the water.

RESULTS AND DISCUSSION

Test 1 (November 29,2017)				
Date/Time	**Temperature**	**Water Level**	**Pump #1 Status**	**Pump #2 Status**
2017-11-29 10:30:24 (A.M.)	26.528 C	Normal	OFF	OFF
2017-11-29 11:30:25 (A.M.)	27.317 C	Above Normal	OFF	OFF
2017-11-29 12:30:27 (P.M.)	29.590 C	Critical	ON	OFF
2017-11-29 1:30:28 (P.M.)	30.735 C	Normal	ON	ON
2017-11-29 2:30:29 (P.M.)	28.189 C	Critical	ON	OFF
2017-11-29 3:30:31 (P.M.)	27.706	Normal	OFF	OFF

Table 1. Initial Testing and Results

Table 1 shows the results of the initial testing performed by the proponents.

Test 2 (November 30,2017)				
Date/Time	**Temperature**	**Water Level**	**Pump #1 Status**	**Pump #2 Status**
2017-11-30 11:30:24 (A.M.)	26.878 C	Normal	OFF	OFF
2017-11-30 12:30:25 (P.M.)	26.568 C	Normal	OFF	OFF
2017-11-30 1:30:27 (P.M.)	29.129 C	Critical	ON	OFF
2017-11-30 2:30:28 (P.M.)	30.189 C	Normal	OFF	OFF
2017-11-30 3:30:29 (P.M.)	28.981 C	Normal	OFF	OFF

Table 2. Final Testing and Results

Table 2 shows the results of the final testing of the system performed by the proponents

CONCLUSION

The system was made and developed by the researchers to manage and monitor the water in aquarium using microcontroller such as Raspberry Pi in order to make the automation happen. With the given parameter through the sensor's data the system worked properly and give an accurate result for the water management. With the positioning of the sensor's it is important that the sensors are attached with the water so that the record is proper. Since the system deals with the water there are still some components that need to be protected such as the microcontrollers that needs to be isolated and covered, another is some part of the sensor needs to be covered. Through the use of PHP server the user of this system can monitor the water management.

RECOMMENDATIONS

In recommendation for future innovators of this project, the proponents would like to suggest that another water level sensor and temperature sensor should be provided to give more accurate and conditional results. The added water level sensor must be used to measure the level of the water below normal level and the added temperature sensor must be used to measure the temperature which is below the standards given by the proponents and must be relative to the conditions to be made

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