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Article *in* Advances in Parallel Computing · November 2020

DOI: 10.3233/APC200196

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Smart Aquarium Management System

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Abstract. In modern days, many people have fish as their pets at home. The fishes have been fed by the aquarist in the aquarium tanks which demands a proper setup for maintenance. The problems faced are change in water quality, feeding the fish, maintaining the temperature, controlling the lights and difficult to check the conditions of an aquarium manually. Therefore, it's necessary to monitor the physical parameters closely and enhance the water condition. So, this project proposes a system which is equipped with sensors to be operated in real time. It performs temperature monitoring, water pH level detection, aeration system and water renewal operations. An IoT based system is implemented to monitor and deliver the status of the aquarium to user's mobile application. Thus, an intelligent aquarium management has been implemented so that the fish is neither over nor under fed and thereby reducing the manual effort required in maintenance of aquarium.

Keywords. Aquarium, Internet of Things, Fish feeding, Mobile Application, Turbidity Sensor.

1. Introduction

Nowadays, there is a steady increase in fish keepers. It seems to be very difficult for aquarist to look after the aquarium. The aquarium should be maintained properly to make the life of fish so healthy. The existing system makes the aquarists to manually monitor and control the parameters of an aquarium like feeding of fish, light, heater, oxygen motor, etc. Fishes had to be fed twice a day and during the absence of fish keepers, they have no control over the aquarium thus fishes can't be fed by the aquarists.
We came up with our project namely Smart Aquarium Management System. It is a low-cost system with better efficiency. It can be placed in any aquarium to replace the manual maintenance procedure by its automated process.

2. Literature Survey

Generally, Aquarists are not able to feed fish when they are out-of-station [1]. The reasons are lack of food availability for fish, which may lead to poor water quality in

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fish pots. Thus, it is a must to monitor fish starvation, which are helpful for fish proprietors. The authors of [2] have implemented an IoT based system that is implemented to monitor and deliver the status of the aquarium to user's mobile application. It contains water quality management in which it monitors the physical variation in the aquarium and will level up to the ideal conditions. The system will perform operations like temperature and turbidity level control, light monitor and fish feeding, automatically. The authors of [3] have mentioned that the aqua-culturist track the pond conditions and takes necessary steps, in time domain. They perform temperature level monitoring, fish feeding, draining and recharge of water in aquariums. Here, the fish feeding is performed 3-5 times a day and draining and recharge of water is regulated based on the water condition. The authors of [4] have presented a Smart electronic system for pond management in freshwater aquaculture. The system regulates the hydro biological parameters, which plays a vital role in fish growth. However, it's not mentioned how the saline water is detected and drained off. Their work includes automatic detection and salinity removal unit in aquariums. The authors of [5] have proposed an embedded system using wireless network application and water quality assessment unit for large scale aquaculture. All these systems are interlinked to a central unit for monitoring and data transfer using mobile application. The proposed method does not include how the system responds when abnormal conditions are detected.

3. Objective

- To manually control motor activity, lighting and heat system.
- To design an aquarium controller with an automated fish feed system.
- To monitor fish movement, temperature, water pH level and aeration system.
- To alert the user in case of undesired variation in physical aspects of the aquarium.
- To feed the user with data regarding the conditions in the aquarium via mobile application.

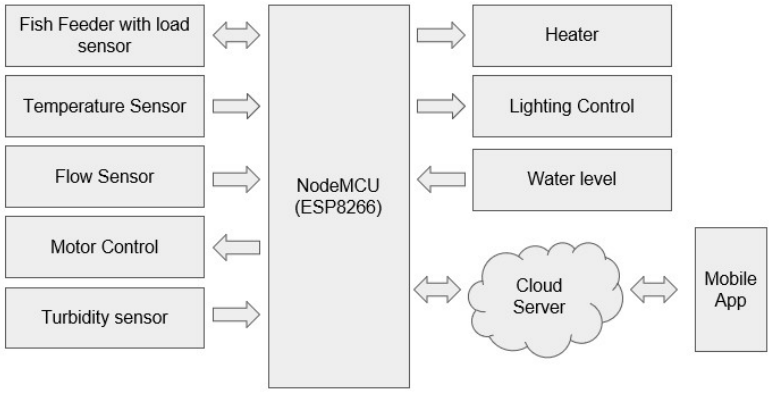
4. Problem Statement

Aquarists face several problems to support the healthy living of fish in aquariums. The feeding of fish is a difficult task for the fish keepers during their absence or whenever they travel out-of-station. Moreover, the temperature and salinity of water needs to be inspected frequently for the healthy living of fish. Suspended particles of fish have to be removed if it exceeds the limit so water has to be changed if it exists in a state of high turbidity. The oxygen flow inside the water has to be monitored for the easy breathing of fish. So, A system has to be developed for continuous monitoring, controlling and taking care of the fish.

5. Proposed Method

The main objective of the project is to setup an aquarium which can be monitored using actuators and sensors via the internet. The fish feed dispenser is setup using the servo motor and load cell where it can be monitored and controlled in mobile application. Temperature sensor is interfaced to keep track on the temperature of water. A lighting system is introduced, with manual turn on/off option to be controlled at specific time. Flow sensor is added to detect the water flow rate, which is automatically operated depending on the water level of the tank. Turbidity sensor is used to check the water quality and update to the mobile application.

Figure 1. Block Diagram



6. Hardware Description

6.1 NodeMcU

NodeMcU is used for the purpose of fish feeding, tracking and controlling the parameters in the aquarium. It is an open-source firmware and development board that helps to build models for IoT based products. The ESP8266 Wi-Fi SoC from Espressif Systems is used to run this firmware in the Lua scripting language.

6.2 Temperature Sensor

DS18B20 is the temperature sensor [7-8] which is used to detect the temperature of the water in the aquarium. It has a built in 12bit ADC. It is interfaced to NodeMcU digital input. One-wire bus is used for communication between sensors and NodeMcU.

6.3 Loadcell and HX711

Load Cell is used to measure the amount of food to be fed to the fish. It acts as a transducer that converts a load or force into an electronic signal. HX711 is a precision 24-bit analog to-digital converter (ADC) designed for weigh scales to interface

directly with a bridge sensor. The changes in electrical resistance delivered by the Load Cell is amplified in HX711 so that NodeMcU can read the data. It is used to read the data from the Load Cell, amplify the signals and then forward it to the NodeMcU for processing.

6.4 Relay

A relay is electrically operated switches that electromechanically opens and close the circuit network. Normally open (NO), indicates an open contact and Normally Closed (NC), indicates a closed contact when the relay is not powered. When the input pin is grounded, NO will be open and NC will be closed. When input pin is not grounded, the status of NO is closed and NC is opened.

6.5 Flow Sensor

Flow sensor is a device used to measure the flow of air from the air pump inside the aquarium. It helps to determine the flow of oxygen in the fish tank. This sensor is a part of the flow meter that helps to measure the flow rate of water.

6.6 Oxygen Pump

Oxygen pump simply bubbles air through the aquarium tank to maintain an adequate concentration of oxygen in the tank.

6.7 Turbidity Sensor

Turbidity sensors are used to assess the turbidity content in water. These sensors observe the light that is scattered from suspended particles in water. The water turbidity level increases as the amount of Total suspended solids (TSS) in water increases.

7. Software Description

7.1 Mobile Application

Mobile App is used for the purpose of monitoring and control of Aquarium by the Aquarist. This App is made interfaced with the cloud server to remotely monitor and control the aquarium. It provides the user about the status of the aquarium.

8. Result

The proposed system for the control of aquarium using mobile app has been implemented. This system enables the aquarist to control the aquarium through their mobile phones.

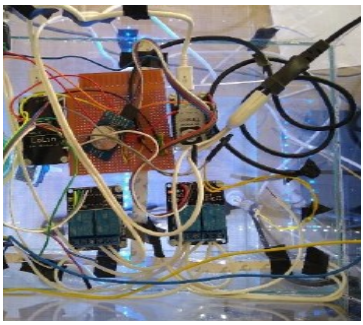


Figure 2. Aquarium Setup

Figure 3. Mobile App

9. Conclusion

Smart Aquarium Management System have been successfully proposed and it can be easily implemented for making the life of aquarists more comfortable. It is a user-friendly system which can be accessed remotely using mobile phones. The aquarium parameters like water temperature, fish feeding, lighting control, oxygen flow, etc. can be controlled remotely from mobile phones through internet. This system works well and can be implemented on any aquarium. Thus, the system overcomes the disadvantages of the existing system.

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