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IOT BASED APPROACH ON AQUARIUM MONITORING SYSTEM WITH FISH FEEDER AUTOMATION

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Abstract— The monitoring system is known to be very useful for alleviating human activities and can been utilized in many ways. The idea to automate the monitoring system originated from a couple of problems. The time consuming process for manually checking and measuring every parameter at every part in an aquarium is one of the problem. The second problem is the lack of availability of time to keep the aquarium meeting the mandatory fish needs that need to be reviewed regularly. Along with these there are known that important parameters such as condition of pH water and the availability of food is essential to keep the habitat conducive for living. Therefore this paper proposed an aquarium monitoring system utilizing Internet of Thing (IoT) with automatic fish feeder. With the existence of IoT system, user can be continuously notified in real time. The monitoring system is utilized as a platform to remind the user to clean or filling food in the feeder when necessary. The system also equipped with automatic feeder fulfilling the fish mandatory needs. The result showed that the developed system able to display the current conditions of pH water value and the level of the fish food through Blynk application. This user friendly and compact fish tank design can be implemented almost anywhere.

I. Introduction

Nowadays, people who own aquariums are preoccupied with daily activities which made them unable to keep the fishes properly. They might be unable or miss to feed their fish on time and clean the aquarium frequently. If the fish tank does not clean frequently, waste products from the fishes would accumulate in the water, thus, making the water cloudy. This would in turn cause the water to be smelly with greenish mud releasing unpleasant odor to the surroundings. By time, the aquariums eventually become polluted with nitrates, nitrites, and ammonia. Due to high chemical content in the water and the improper feeding schedule, fishes in the aquarium might be suffocated and starve to death. To achieve proper growth and development, it is completely imperative to ensure that the fish are regularly fed [1]. By making it less laborious, the improvement of innovation such as automatic fish feeder in aquacultural practice is enhanced [2].

Several studies have proposed an automated fish feeder system using various types of measurement variables, methods and technologies. Hasim, et al. one of the researchers who developed application based fish feeding system using Raspi [3]. Meshram et al. proposed a fish feeding system using the IoT method that can be easily controlled from the mobile phone via mobile application [4]. Meanwhile, Uddin et al. created automatic fish feeders that combine mechanical and electronic systems using PLC (Programmable Logic Circuit), GSM (Global Mobile System) and motors to control the amount of pallet dropped quantity [5]. All the mentioned papers used timer as the time triggers to automatically feed the fishes.

Technology used to ease the fish farming has not only limited on feeding method but also the water quality control. Maintaining the quality of water for fish cultivation is significant since the quality of fish will be influenced by the aquaculture environment. Low water quality can contribute to fish disease and will have a direct effect on fish growth and harvesting yield. [6,7]. Simbeye and Yang suggested monitoring water quality using technology, namely by making monitoring and control systems for water quality using wireless sensor network technology [8]. Other researchers have put forward monitoring systems for pH levels and temperature regulation in fish farming using IoT. One of them is Qalit and Rahman, which produces a tribal control and catfish pH system [9]. Nocheski, and Naumoski performs water monitoring on fish farming using IoT, including temperature, light intensity and level [10]. Another method for controlling the water quality was suggested by Ichsan et al. [11]. They used graphical programming-based fuzzy logic control. Ramadhona and Hakim proposed a system that can monitor the state of water in the aquarium and displayed it using LCD. This monitoring system uses Arduino uno as micro controller, equipped with PH sensor, temperature sensor, salinity sensor, LCD, and buzzer. The readable data will appear on the LCD and the buzzer will sound when one of the moisture levels is not at a standard number. It also equipped with automated fish feeding system remotely to support this monitoring system [12].

The main aim of the project proposed in this paper is to develop an aquarium monitoring system that is able to notify the status of water condition and food level just by logging on to the database system. This system will keep informing user with real time data for proper action. Since food is the important elements for growth and production, therefore automatic fish feeder is equipped.

II. Methodology

The fish is feed automatically twice daily. Arduino uno is the main controller that required for the feeding operators to be automated. It is a programmable hardware that automatically switches on the servo motor based on the preprogrammed schedule at a given time interval. The servo motor in this module serves to open the valve of fish food container to control the amount of pallet dropped. Once the feeding time has come, the servo motor will be moved to allow the pallet dropped slowly.

There are two sensors used in the platform to measure the key parameters in the fish tank such as pH and level of fish food in the fish feeder. The level of food is obtained from the ultrasonic sensor which embedded on the cap of the food container as shown in Figure 1. Using sonar, the HC-SR04 ultrasonic sensor measures the distance to an object as bats do. It provides non-contact range detection with high precision and reliable readings. Comes with complete ultrasonic transmitter and receiver module, it initiates by emitting sound waves at a frequency through transmitter and wait for the sound to be reflected back. Time taken by the receiver module is the calculating distance. The sensor will be programmed to display three levels of food condition which are low, medium and high. This is intended to notify the users whenever the food should be refilled. The food container designed is 15 cm in length. Thus the maximum level of food is between range 8 cm to 10 cm, 4 cm to 8 cm is medium and 4 cm below is low.

Figure 1. HC-SR04 ultrasonic sensor

The aquarium water condition is monitored regularly by the pH sensor. Figure 2 shows the analog pH sensor which is connected to analog pin in Arduino. Initially the sensor is calibrated using known value of pH solution. Then it is immersed into the aquarium. Inside the thin glass bulb at the end of the probe there are two electrodes that measure voltage. One electrode is contained by a liquid that has a fixed acidity, or pH. The other electrode responds to the acidity of the water sample. A voltmeter in the probe measures the difference between the voltages of the two electrodes. The arduino then translates the voltage difference into pH and displays it on the Blnyk apps.

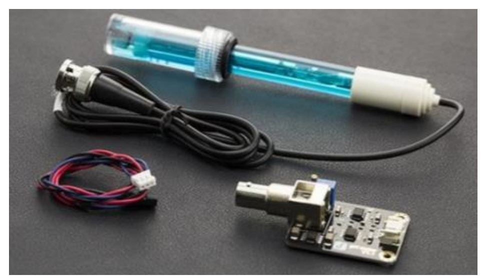

Figure 2. pH sensor

All the data retrieved from the pH sensor is then displayed through Blynk application as in Figure 3 below.

Figure 3. pH value on Blynk application

Figure 4 below shown the entire block diagram for the completed circuit hardware. Input from both sensor is processed by Arduino then transmitted through Wi-Fi shield for wireless communication and displayed in Blynk Application. The system implementation starts with establishing a connection between the sensors and Arduino. The pH sensor is connected to the analog pin while ultrasonic sensor is connected to the digital pin on Arduino. Arduino is connected directly to Wi-Fi shield used as connector to transmit all the processed data to Blynk application. Real time notification is continuously sent.

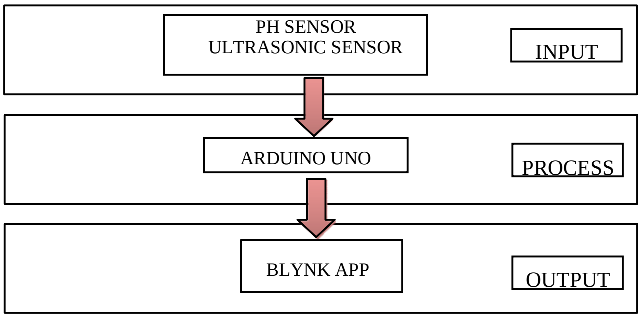

Figure 4. Block diagram of the project

The monitoring system is then embedded to the fish tank that has size of 50cm length, 30cm width and 40cm height. The design is compact and easily to be moved to different places. The aquarium will be filled up with the tap water that generally has a pH between 6.5 to 7.5 and experimented with the beginner friendly fish which is Guppy fish. Aquarium monitoring system has been designed as shown in Figure 5 to help users to nurture the aqua fish by automating fish feed and helps user in scheduling maintenance of the fish tanks.

Figure 5. Aquarium monitoring system hardware

III. Result and Discussion

This paper carried out two stages of analysis to find out the performance of the developed system. The stages consists of testing the condition of pH water and level of the fish food feeder.

A. pH Water Condition Analysis

pH value is one of the important parameter in this paper. Due to habitant of guppy fish in the aquarium there will be few common contributions towards water contamination which are carbon dioxide in the air dissolving in the tank, tannins leeching into the water from plant matter and waste digesting bacteria acidifying the tank through the nitrogen cycle. Therefore daily observation data has been collected and recorded in the Table 1. Since the suitable pH water for guppy fish is ranged within 6.8 to 7.8, if the value exceeding the range, 'out of range' will be displayed through Blynk apps. Based on collected data in Table 1 the apps notified the user that on the third day the aquarium should already be cleaned. The water should be treated to ensure that water remains healthy and inhabitable.

Table 1. pH water value

Day	pH	Condition
1	7.21	In range
2	7.39	In range
3	7.04	In range
4	7.99	Out of range
5	7.97	Out of range
6	8.93	Out of range
7	8.69	Out of range
8	8.96	Out of range
9	8.89	Out of range
10	8.93	Out of range

Figure 6 shows the graph of pH water level for ten consecutive days. Note the increasing pattern of the pH value due to addition of acids in the water.

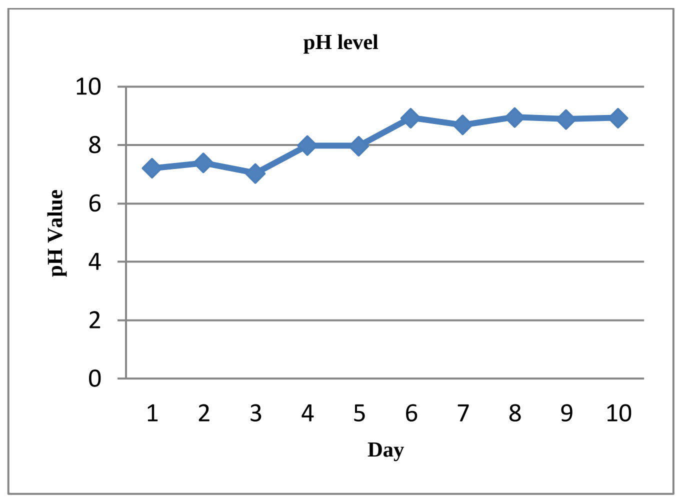

Figure 6. pH value for ten consecutive days

B. Fish Food level

The level of food is obtained from the ultrasonic sensor used to notify the users when the food should be refilled. The value obtained from the ultrasonic sensor is converted to distance in centimeter by Arduino and the data is accumulated in Table 2. Data is collected for 10 days subsequently. From day 1 to day 3, the level of fish food is decreasing but still in high level. Continuing with day 4 to day 7, the level of fish food has been decreased to medium level. Following to the next day which is day 8 to day 10, the level of fish food turned to low conditions which means the food need to be refilled promptly.

Table 2. The food level

Days	Distance (cm)	Condition
1	10.0	High
2	9.7	High
3	8.6	High
4	7.8	Medium
5	6.2	Medium
6	5.4	Medium
7	4.7	Medium
8	3.5	Low
9	2.3	Low
10	1.0	Low

Figure 7 interpreting the distance values of fish food level for 10 days. The value shown decreasing pattern as the fish is feed twice daily and continuously, decreasing the fish food level. By manual it is time consuming for a daily check. With these monitoring system user successfully notified by just a click away.

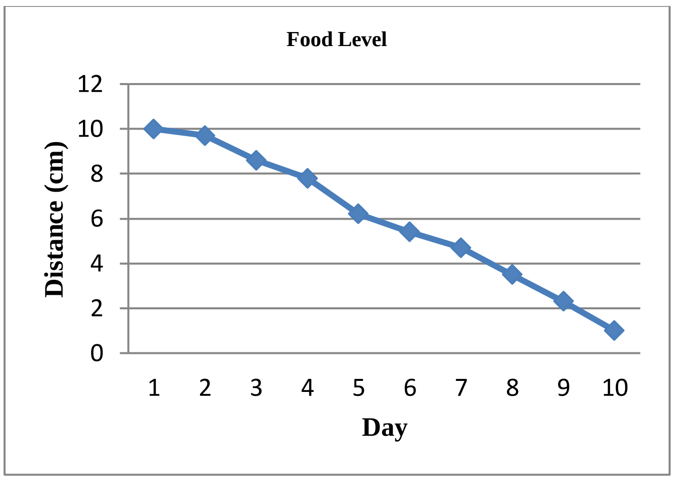

Figure 7. The food level for ten consecutive days

IV. Conclusion

In this system there are two sensors implemented, which is pH and ultrasonic sensor. Based on the result, both of the sensors are working perfectly in helping the users maintaining the aquarium pH water value and food level while ensuring the fish food is supplied constantly. Added mobile application through Blynk platform enables the user to monitor the retrieved data in real time. The complete system allows the user to attain fishkeeping ideal conditions. In future other sensors such as salinity and oxygen level sensor could be added to the system in order for the aquarium to be conducive for broader range of fish type which is more sensitive and have different needs.

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