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Fish Tank Monitoring System Using IoT

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ABSTRACT

In day to day life human experimentation is tiresome and also gives improper outcomes for estimating the environmental change. In this paper we discuss how to replace manual maintenance of aquariums with an automated system using IoT to automatically monitor, control, and provide real-time status of pressure, temperature, water level, and the light intensity to applications running on user smartphones. It also contains water level management, which will monitor the conditions such as overflow and underflow of water level. The aquarium will perform the lighting automatically.

Keywords: Internet of Things, Sensors, Arduino Uno, Aquarium.

I. INTRODUCTION

Fishkeeping is a hobby. Even though it is a hobby looking after a fish is as important as looking after other pet animals. In the wild, nature takes care of the fish's needs by providing them light, warmth, the supply of oxygen and food. So in the aquarium, it is our responsibility to provide them with all these essentials. For a fish, the food requirements vary from one to another and appropriate food should be fed. Lighting should be also provided in the tank. Also, the removal of the harmful compounds such as urine and feces should be taken care of. If different species of fishes are to be kept in the tank they need to be compatible with each other. Along with this checking the pH, temperature, the flow of the water that are compatible with the particular fish is very much equally important.

1.1Workflow of the Project

The development of system consists of 5 major steps as shown as in this diagram.The first step includes the design of the system. Then finding the related hardware and designing the circuit diagram. Then design the interface code and test on the system.

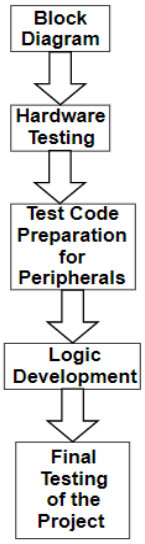

Figure 1: Steps in Fish Monitoring System

II. RELATED WORK

The author of [1] talks basically on the eating habits of the fishes. The fishes cannot be able to feed the other fish when they are removed from their home environment. There are two reasons why this cannot be done namely – feeding starvation and poor water quality of the fish aquariums. Therefore, it is required the constant monitoring of the fish fasting as it is useful for the fish proprietors. With the help of a fish proprietor and web application, there can be a table where the client can set the fish feed. The interface can be done by utilizing raspberry pie that will take the information from an associate site. The usefulness of the interface includes recording the nourishment of how well the fishes are doing away from its home environment.

With the help of angler's internet association, this project can also find out the mass of the tank with the help of a camera attached. This is to guarantee the client that the fishes are safe and in the tank at all times.

The author of [2] tells about the how water management of the pond is very crucial. There are various biological and physical characteristics of water to take into consideration. For the water quality, the factors taken into note are dissolved oxygen, watercolor, pH, turbidity, alkalinity, hardness, etc. For taking note and monitoring these characteristics, sensors are needed. The more the number of sensors, the more the cost and they are more difficult to manage. So [2] mentions that we require such a system that is cost-efficient as well give accurate results. From the features mentioned, not all need to be monitored. The main characteristics taken into consideration include temperature, ph, conductivity, and water quality. Temperature affects the biological as well as chemical procedures. Even a 10^{o} C increment in the temperature, will affect the rates of these procedures. Fishes are very poor to adapt to changes in its environment. Checking the temperatures for each of the fishes is very essential. Temperature acceptable ranges from 21^{o} C to 33^{o} C. Therefore, the temperature is considered to be one of the most important parameters.

pH is defined as the measure of hydrogen ion concentration. Generally, the pH increases in the day and decreases in the night time. pH varies from 6 to 7.5 in the morning before the rise of the sun but after the development of phytoplankton the pH rises to 10 and increases in the evening. pH is the second important consideration. Salinity is the saltiness in the quantity of water and substances that are dissolved in water are called solutes. It is difficult to measure all the concentrations of ions. Water conductivity depends upon ionic fixation and dissolved salts dissolved. Salinity is the third important consideration.

The color of the water is the fourth important consideration. It gives information about the turbidity. If the color is brown, it's due to clay and if greenish, then it's due to the plankton. Muddy water is very harmful for the fish as the gills will be obstructed and

lead to the death of the fish. Plankton over-generation leads to green color water. Bluish-green, brownish-green, or green color indicates a good fish population and also fish wellbeing.

The author of [3] summarized about the management of the fish tank. The aquaculturists check the time and take action accordingly. Actions include feeding the fish, draining as well as temperature level monitoring. The temperature level is very critical for the survival of fish in the aquarium, hence it needs constant monitoring. It also mentions that for large scale aquaculture requires measuring water quality parameters such as dissolved oxygen, temperature. With the help of a central unit, monitoring takes place on a mobile application. The system does not describe what will happen if abnormal conditions occur. The system is on a constant run for measuring and reporting any biological parameters changed that may hinder the growth of the fishes. In this system, automatic detection and removal of dirty water in the aquarium is also done.

The author of [4] talks about WSN used in projects related Internet of Things. Wireless network that has base stations and the number of nodes where the wireless sensors exist is called Wireless Sensor Network. One of the examples includes when related to security includes Zigbee. It consists of cameras, motion sensors, as well as glass-break sensors. They require no wired connection and easier to upgrade. Zigbee records videos and transfers them to the monitor in the house. It also takes care of light control inside the house too. In healthcare, also takes care of monitoring the vital patient information. Here, it will take the results from connected sensors to the patient.

2.1 Drawbacks of the existing system

1. Components can get corroded.
2. Difficult to get accurate results.
3. All the components are expensive to purchase.
4. Water level monitoring was not maintained in most of the systems.

2.2 PROPOSED SYSTEM

The project is a data feeding system where various parameters will be monitored using different sensors. The parameters like temperature, pH, water level, setting the brightness or darkness required for the tank. The proposed system is for fishes in a home aquarium where the temperature is the most important parameter and the suitable range is between 20-23 degrees Celsius and should be maintained. The track is kept by the temperature sensor where the updates should be going to the user. Similarly, for the pH, it is from 7.2 to 7.6 and measured by a pH sensor. The water level to be maintained should be 20 gallons and is monitored by ultrasonic sensors. When the parameters go out of range, the user gets a notification with the help of the GSM Module with a sim inserted into it.

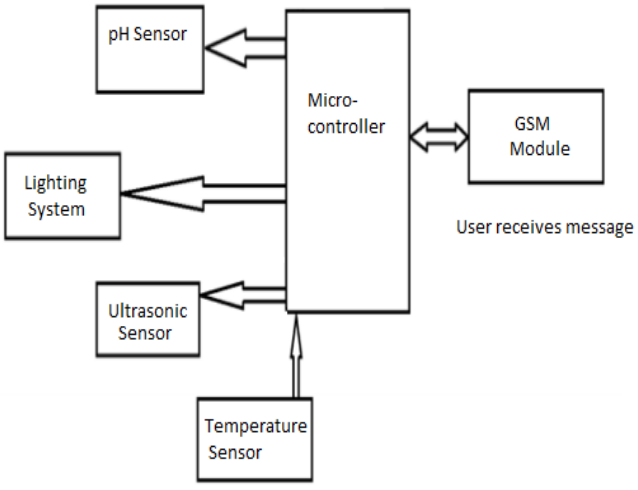

Figure 2: Block Diagram

2.3 Sensors Required

2.3.1 Ultrasonic Sensor

Ultrasonic determines what the distance to an object is by using sonar. It works on the principle of the Doppler Effect. It emits sound waves that are at a frequency hearable to humans. The sound that is reflected helps in the calculation of distance is done based on the time taken. When the measurement of a specific distance from the ultrasonic sensor is required, the formula used is:

Distance = ½ * T * C

where T = Time and C = Speed of Sound

Figure 3: Ultrasonic Sensor

2.3.2 Temperature Sensor

Temperature Sensor is sensed using a transistor but as water is involved, the requirement shifts to a waterproof temperature sensor. In wet environments, its very precise and for its working external parts are not needed. Its accuracy varies from -0.5°C to +0.5°C. The interfaces which work with this sensor includes OneWire.

Figure 3: Temperature Sensor

2.3.3 Analog pH Sensor

pH tells whether the solution used is acidic or basic. Analog pH sensors can be used in a variety of pH measurements and as a quick response as well as excellent thermal stability. It has good reproducibility and it can also eliminate the basic alkaline error. The applications range widely from agricultural farming to fish farming to activities in large industries. From the start, this sensor is calibrated at 24°C room temperature. Results are mostly directly proportional to the temperature of the solution being used.

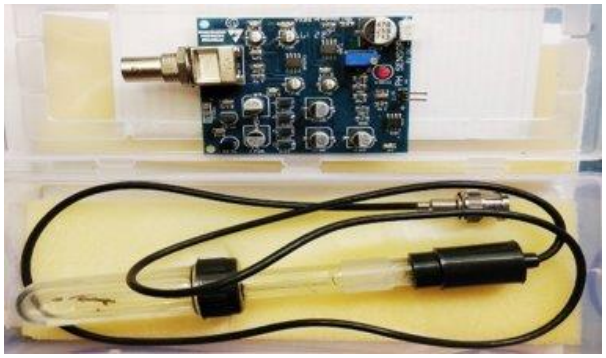

Figure 4: Analog pH Sensor with probe

2.3.4 LDR and LED Bulb

LDR stands for Light Dependent Resistor. The principle used by LDR is photoconductivity. It can also be considered as a switch. If light falls on its surface, then conductivity of the material is just reduced and the valence band electrons are excited

and photons of the incident light may have greater energy making the electrons jump into conduction.

Figure 5: Working of LDR and Bulb

LED Bulb is a light-emitting diode. It has a p–n junction diode which gets activated when light is emitted. Exactly when required voltage is been applied to its leads, electrons will able to recombine its electron holes within the device, which releases energy. As a result, photons are formed. Such an effect is defined as Electroluminescence. The color of the light is based on the semiconductor's energy bandgap.

Figure 6:LDRFigure 7: LED Bulb

2.3.5 USE CASE DIAGRAM

Use Case diagram includes actors like the user who gets the notifications and the various use cases that are in Fig 2. This diagram makes the entire process is easier to understand and interpret.

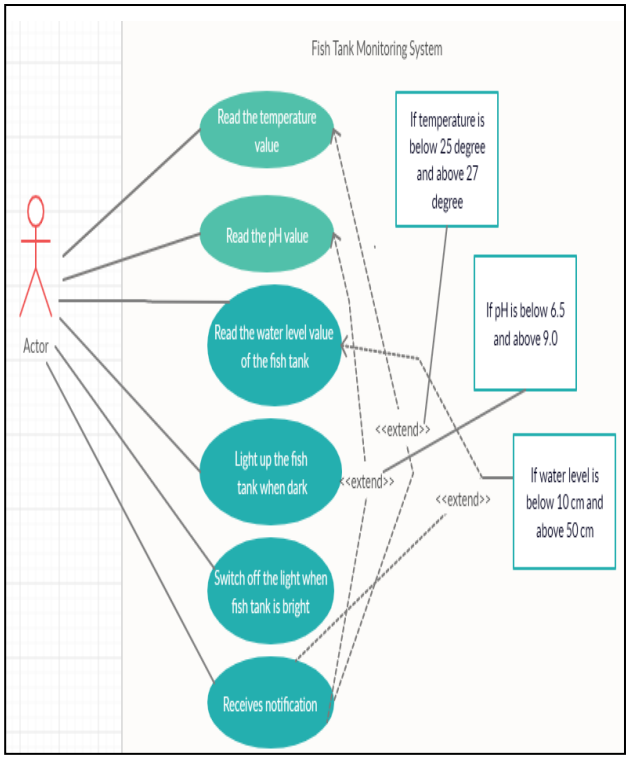

Figure 8: Use Case of Fish Tank Monitoring System

III. METHODOLOGY

The ways of measuring pH, temperature, are mostly stopped using a chemical test kit regardless of the scale or requirements. Monitoring the water level of the fish tank becomes an essential feature of the environment present in the fish tank. The existing systems depend on manually regulating the water level or water quality. Hence, the living species in the fish tank are at risk of extreme situations and leaving them exposed to dangerous levels of temperature and pH. The project aims to expel this scenario by composing a system that automatically measures the parameters, and notifies the user for further steps to be taken.

The manageable range for the water temperature in a fish tank is 25 degrees Celsius to 27 degrees Celsius. The current temperature of the water in the fish tank will be tracked by the system using temperature sensors. Similarly, the pH sensors will track the pH

levels. The ideal pH levels for the survival of fishes in an aquarium are from 6.5 to 9.0. A significant change in the water system with respect to any of the above-mentioned parameters will be monitored, and the user will be notified with a message. Also, there is a possibility for the user to fail in maintaining the water level that has to maintain in the fish tank. The ultrasonic sensor used will detect this failure and notify the user. Adding to this, the light sensor enrolled will detect the intensity of the existing light, and automatically work switcheds ON or OFF based on the light source fixed inside the fish tank. The user is asked to feed the fishes, by sending timely notifications, on the user requirements set by the owner. Therefore, the appetite of the fishes will be kept in check on time.

The system also results in minimizing the cost of monitoring such an ecosystem, by the wholesomeness of the system. Fish keepers or aquarists do not have to monitor their fish tank, on a regular basis. Here, the owner can hold control of the fish tank and maintain the timely requirements according to the notifications received without constant monitoring. The proposed system, therefore, become a savior by helping the users to protect the fishes and their environment in the tank for them to survive.

IV. RESULTS AND DISCUSSION

The testing of our project is shown in tabular manner in order to simplify the complexity instead of individually showing each test.

Test Case	Expected Output	Actual Output	Error Description	Action Taken
Ultrasonic Sensor	Less than 6 cm Greater than 11 cm	5 cm 12 cm	Overflow Condition Underflow Condition	User Notified
Ultrasonic Sensor	6 cm – 11 cm	9 cm	None	None
Temperature Sensor	Below 20°C Greater than 23°C	19°C 26°C	Temperature Critical	User Notified
Temperature Sensor	Between 20°C-23°C	21°C	None	None
pH Sensor	Below 7.2 Above 7.6	6.9 8.0	pH Critical	User Notified
pH Sensor	Between 7.2-7.6	7.4	None	None
LDR	1.0 or Higher	5.0	Darkness. Bulb ON	User Notified
LDR	0.0	0.0	None	None

Table 1: Test Cases and their outcomes

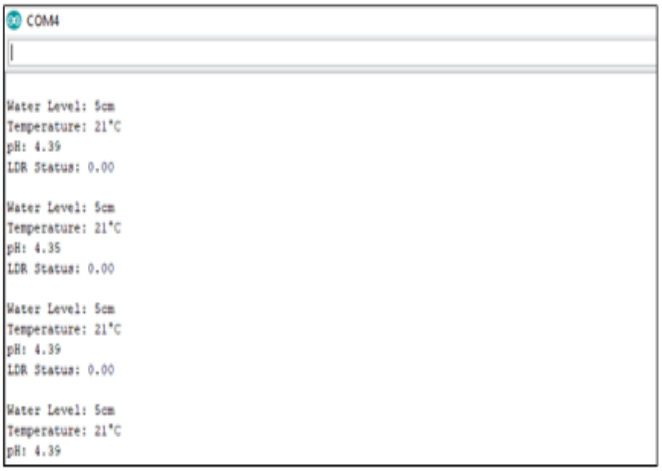

Figure 8: Values from Serial Monitor

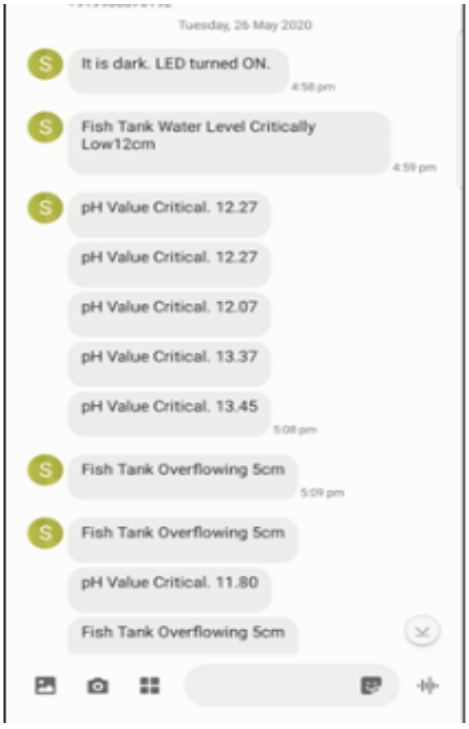

Figure 9: Notifications to User

V. CONCLUSION AND FUTURE WORK

The conclusion of this project is to improvise the monitoring and maintenance of fish tanks. User does not have to constantly monitor their fish tank. If the various parameters like pH (6.5 to 9.0), temperature (25 - 27 degree Celsius) and level of water is not in range, the user is notified. This system checks the intensity of natural light and if the intensity is less than the light bulb gets switched ON.

As the project is only a data-feeding project, in the future, it can become a data-controlling project. We can also add components like LCD screen for reading the values, motor for increasing the water level in the tank, and a fish feeder to make the system more effective and helpful for maintaining fish tanks. By creating an application for phones that will update about notifications.

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