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IoT-BASED FISH FEEDING AND MONITORING SYSTEM

Mrs. Chaya P[1], Dhanushree V[2], Dhanyatha S R[2], Disha S[2], Sowndarya S[2]

[1]*Assistant Professor,* [2]*Students, BE, Information Science and Engineering, GSSSIETW Mysuru, India*

dhanushreev09@gmail.com

ABSTRACT

In the domain of aquarium management, the efficiency of maintenance practices significantly impacts the health and growth of aquatic life. Traditional methods of monitoring aquarium conditions are typically manual, demanding considerable time and attention. This paper introduces a sophisticated Internet of Things (IoT) based system designed to automate and refine the management of aquarium environments. Utilizing advanced sensors and electronic controls, this system continuously monitors critical parameters such as pH levels, temperature, turbidity, and water levels, and automates fish feeding processes. The real-time data acquired by these sensors is transmitted to the user's smartphone, enabling remote observation and control. This innovative system not only ensures the maintenance of water quality by adjusting conditions to ideal standards automatically but also significantly reduces the manual labor traditionally associated with aquarium upkeep. By integrating IoT technology, this solution offers a smart, efficient, and user-friendly approach to aquarium management, promising enhanced stability in aquatic conditions and improved welfare for the inhabitants.

Keywords — Aquarium Automation, sensor networks, Internet of Things (IoT), pH monitoring, real time monitoring, Blynk IoT.

I. INTRODUCTION

In recent years, fish keeping has emerged as a beloved hobby enjoyed by individuals of all ages, serving not only as a decorative element in homes and offices but also as a source of tranquility and mental well-being. However, the meticulous care required to maintain optimal aquarium conditions can be a daunting task, particularly for those with limited time or expertise. Traditional methods of managing aquarium environments, involving manual adjustments and monitoring, are not only labor-intensive but also prone to human error, which can jeopardize the health of the aquatic ecosystem.

To address these challenges, advancements in Internet of Things (IoT) technology have paved the way for the progression of automated aquarium systems. These systems harness the power of IoT to revolutionize the way aquariums are maintained by automating critical tasks such as temperature regulation, water level monitoring, and fish feeding. The integration of smart sensors and connected devices allows for continuous monitoring of various parameters such as water temperature, pH levels. This data is transmitted in real-time to a user's smartphone, enabling convenient remote monitoring and control.

This paper introduces an innovative IoT-based fish feeding and monitoring system designed to optimize aquarium care. The system not only automates routine tasks but also ensures that the aquatic environment remains within ideal conditions, adjusting parameters dynamically as needed. By automating fish feeding, controlling water inflow and outflow, maintaining desired temperature levels, monitoring water quality, and managing lighting schedules, the system enhances the overall health and stability of the aquarium. This smart aquarium solution represents a significant leap forward in the field of aquaculture technology, offering a user-friendly, efficient, and effective means of fish keeping that aligns with contemporary needs for convenience and reliability.

A. Motivation

The motivation for developing an IoT-based fish feeding and monitoring system stems from the need to simplify and enhance the management of aquariums. This technology automates critical tasks such as feeding and water quality control, ensuring optimal conditions for fish health and reducing the manual effort required from aquarium owners. Automated feeding prevents issues like overfeeding, which can degrade water quality, while real-time monitoring allows for immediate adjustments to water conditions, maintaining a stable environment conducive to fish well-being. Additionally, the system's remote monitoring capabilities enable owners to manage their aquariums from anywhere, providing convenience and peace of mind. Overall, integrating IoT into aquarium care makes fish keeping more accessible and efficient, appealing to both experienced enthusiasts and new hobbyists alike.

B. Problem Statement

Maintaining an aquarium involves complex tasks such as water changes, precise feeding, temperature control, and lighting management, which can be burdensome for aquarists. The transition to automated systems aims to diminish the need for continuous manual monitoring and adjustment. This paper proposes a SMART aquarium system that automates these essential tasks using IoT technology. Key challenges addressed include overfeeding, which leads to water pollution due to decomposing excess food. Our solution employs a servomotor and a screw mechanism for controlled, remote feeding that ensures fish receive the right amount of food. Additionally, maintaining optimal water quality is critical, as it involves regulating temperature, pH, hardness, and dissolved oxygen levels—each of which significantly impacts fish health and development. The system provides real-time monitoring and adjustments, enhancing both the efficiency of fish care and the overall aquarium environment.

C. Objectives

- Design a system that schedules and dispenses fish feed in a way that aligns with the specific dietary needs and feeding habits of the fish species, ensuring they receive balanced nutrition for optimal health.
- Develop functionalities that automatically alert owners via their smartphones about critical changes or maintenance needs

in the aquarium, enhancing their engagement and simplifying the care process.

- Establish monitoring systems to consistently monitor vital signs of water quality, including temperature, pH, and oxygen concentration, guaranteeing that the aquatic habitat stays optimal for the well-being of fish.
- Enable full remote management capabilities, allowing owners to adjust feeding times, quantities, and water quality settings directly from their mobile devices, regardless of their physical location.

II. RELATED WORK

Y. Phanindra Sai , Zachariah C Alex The IOT-based technology that uses real-time status updates on the user's smartphone app to autonomously monitor and regulate the entire aquarium. It has water quality management, which keeps track of physical changes in the water and maintains it at optimal levels with the necessary adjustments. [1].

Farees Ahmed Zahid Shaikh, Utkaarsh Bhaskarwar outlined Temperature, pH, wifi, Internet of Things (IoT) connectivity, and API make up the suggested wireless multi-sensor water quality monitoring device for smart aquariums. Because of the ESP-32's numerous general-purpose I/O ports and the ability to define channels in IoT platforms, the system is expandable. [2].

R. Hafid Hardyanto ,Prahenusa Wahyu Ciptadi,Andik Asmara The aquarium's vegetation and fish are automated by the suggested system. An Internet of Things (IoT)-based smart aquarium system has sensors for light, humidity, and water level as well as a web-based interface for controlling the aquaponic system.[3].

Loo Chee Han, Ilanur Muhaini Binti Mohd Noor,Raed Abdula, Syed Mohd Bahrin, Through real-time IoT control, they have created a self-sustaining aquarium system in this system. It comprises of an Arduino-based automated water changing system, an IoT-based system for controlling water parameters including temperature, PH, lighting, and water level, and an automated fish feeding system that uses servo motors based on human input. These are tracked by BYLNK IoT. [4].

Narayanaswamy Ramaya , Deepa T P,Sherwin Kopparam Sridhar , Nirlipta Chatterjee , Rahul S.N , Basana The temperature, pH, water level, and the light or darkness that the tank requires are all monitored by the GSM module in this system. Users will receive notifications of any changes made to the aquarium. [5].

Mohammad Fahmi Suhaimi , Nurul Huda Mat Tahir , Safuan Naim Mohamad , Suzanna Ridzuan Aw The automated technology they've included in this suggested system would keep the water at the perfect temperature while keeping an eye on any structural changes. Every activity in the aquarium, including water level, feeding schedule, turbidity, pH, and temperature, is done automatically. The Internet of Things (IoT) monitoring system will continuously upload the aquarium's state to the database so that users can keep an eye on them online. [6].

III. METHODOLOGY

A. Data Initial Planning and Research

In this phase, the objectives, scope, and requirements of the project are clearly defined. Research is conducted to explore IoT-based fish feeding and monitoring system for an aquarium it is important to first understand what the system needs to achieve. This involves understanding what sensors are needed to keep track of the water quality, temperature, Water level and oxygen level.

B. Design

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C. Feeding and Monitoring System Integration

In this phase, Feeding system is based on servomotor. With the help of servomotor, we can able to feed the food to the fish. Temperature sensor checks the minimum and maximum temperature of the aquarium sensor monitors the condition of the water. Water level detector sensor uses to check the water level of aquarium it is low or high. Water is changed using inlet and outlet pump. The feeding and observation system gives the fish a more consistent and regulated habitat.

D. Wi-Fi Module Integration

A Wi-Fi module is connected with the microcontroller. This module allows the device to connect to your home wi-fi.

E. Data Monitoring

Data such as temperature level, Ph level, Water level etc., are collected with the help of the sensors from the mobile app.

F. Notifications and Alerts

In this phase, we can get the notification and alerts from Blyk IoT. In this app it will show us the temperature level, Ph level, water level, water inlet and outlet.

IV. IMPLEMENTATION DETAILS

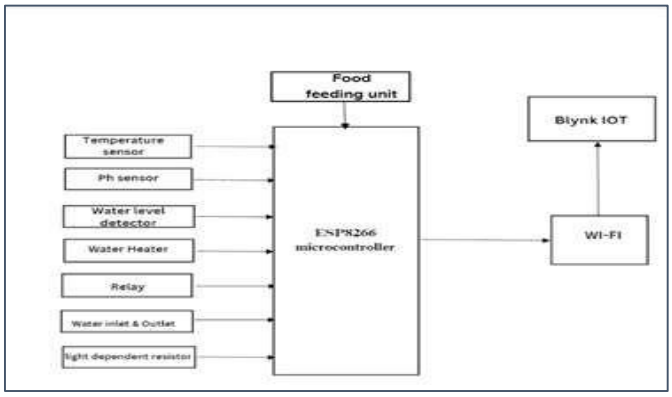

Fig 1: Block Diagram

In this block diagram it shows the implementation of IOT based Fish Feeding and Monitoring System. IOT based Fish Feeding and Monitoring System is implemented using various components like ESP8266 microcontroller, Temperature sensor, Water heater, Water Inlet and Outlet Pump. All the sensors are linked to the microcontroller which controls the sensor. Temperature sensor monitors temperature of the aquarium if temperature is less than 28 degrees Celsius the water heater will get on. Ph sensor will check the water condition. Water level detector checks water level it is high or low. Light sensor is used when the dark side occurs light will on automatically and we can change the water using water inlet and outlet pump. Temperature level, Ph level, Water level, water inlet and outlet monitored and controlled by the Blynk IOT. Blynk IOT allows us to adjust the system.

V. RESULTS AND DISCUSSIONS

Fig 2: Servo motor used for fish feeding

Figure 2 For automated control feeding in aquariums, stepper motors are primarily employed. An electric motor called a stepper has as its primary characteristic that its shaft rotates in steps, or by turning a predetermined number of degrees. This capability, which is made possible by the motor's internal design, enables measurement of the shaft's precise angular location without the need of a sensor by simply counting the number of steps taken. Additionally, because of this feature, it is applicable to a variety of purposes.

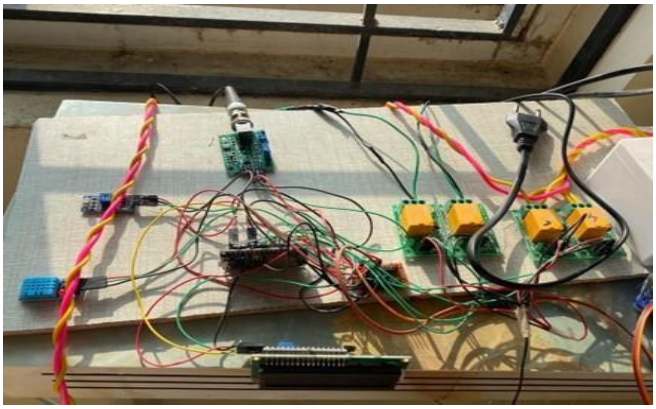

Fig 3: Sensors implemented in the aquarium

Figure 3:In essence, temperature sensors are utilized to indicate the aquarium's temperature so that the owner is aware of the required temperature. It is critical to verify the temperature in a fish aquarium since temperature sensors are crucial in many applications. Hydrogen ion concentration in a solution is determined using a Ph sensor. In many Ph sensors, glass Ph electrodes are employed. For measuring the solutions pH an electrode is essential. It use potential differences to assess solution voltages and contrast them with existing ones, operating on voltmeter concept. For fish, a pH of between 6.5 and 9.0 is an ideal range. The aquarium's lights are essentially turned Fig on and off automatically using a light sensor.

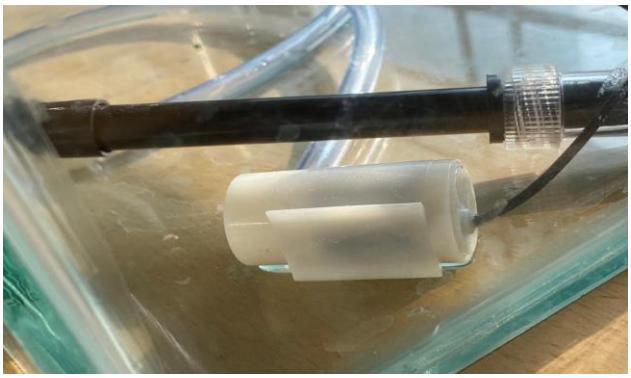

Fig 4: Submersible Pump for inlet and outlet

Figure 4 We have used Submersible Pump in our project for the inlet and outlet of the water. Once the pump is submersed into the water and if we turn on the inlet switch on the application water inlet will be turned on same like the inlet if we turn on the outlet switch the water inside the aquarium will be pumped outside.

Fig 5 :Full view of Fish feeding and monitoring system

VI. CONCLUSION AND FUTURE WORK

In conclusion, The Io dashboard in our project automatically manages the water temperature, aquarium ambient lighting, fish feeding, and water level sensing. We also provide automated lighting control, allowing light to be turned on and off by light sensors.

Any aquarium may employ the sound fundamental idea presented in this project. We can save time and put an end to our ongoing concerns about our fish and their aquariums by means of a smart aquarium.

The primary goal of this method is to improve aquarium owners' ability to maintain and keep an eye on their tanks. Users may receive real-time updates on the condition of the aquarium using this trustworthy monitoring tool. Furthermore, depending on preprogrammed instructions, the system made decisions all by itself without user interaction. With the use of temperature and pH sensors, the water quality is kept at the ideal level to aid in the growth of freshwater fish.

Future scope is to carry out further research in order to develop enhanced version of the proposed system thereby overcoming the drawbacks of the existing system which improves accessibility, safety and new features that enhances the existing application.

Currently this system has less effective sensors and actuators. So in future many more advance sensor such as salinity, oxygen level sensor and actuators should be added to the system in order to make the system more advance in monitoring the aquarium. In addition, the future aquarium monitoring system should be enhanced with artificial intelligence capabilities, such as detecting abnormal sensor patterns over specific periods or integrating computer vision technology detect and understand the behavior of one type of fish in the aquarium. Adding a web application to the system to enable the user to control them is also one of the future enhancements of this system.

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