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SMART AQUARIUM SYSTEM

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ABSTRACT –

Nowadays, many people have fish as their pets at home. The fish have been fed by the aquarist in the aquarium tanks which demands a proper setup for maintenance. The problems faced are changes in water quality, feeding the fish, maintaining the temperature, controlling the lights, and difficulty in checking the conditions of an aquarium manually. The concept of a smart aquarium integrates modern technology to enhance the experience and efficiency of maintaining aquatic ecosystems. A smart aquarium utilizes sensors, IoT (Internet of Things) devices, and automated systems to monitor and control water parameters such as temperature, pH, salinity, and ammonia levels. It also incorporates features like automated feeding schedules, water quality alerts, and real-time data tracking through a connected app. Advanced models may include AI-powered health monitoring for aquatic life, energy-efficient lighting, and smart filtration systems to promote sustainability. By reducing manual intervention and providing actionable insights, a smart aquarium ensures optimal conditions for aquatic life while offering convenience and peace of mind to aquarium enthusiasts. This innovation represents a step forward in merging technology with environmental care, making aquariums more accessible, sustainable, and engaging for hobbyists and professionals alike.

INTRODUCTION

An aquarium is a vivarium (container) usually placed in a place with transparent sides (from glass or high-strength plastic), in which animals and aquatic plants (usually fish, but can also be found invertebrates, amphibians, marine mammals, and reptiles) are accommodated, and used for public display. Aquaponic is a modern farming system that combines planted farming, which produces plants and fish. The way aquaponics works is to use nutrient-rich water as a provider of food and organic nutrients to help plant growth, whereas plants cleanse, filter, and recycle the water environment, thus creating a symbiotic relationship between plants and fish. Junaid Khan[1], Onib-Ur-Rehman[2] [1] say that IoT technology is one of the technologies developed to make it easier for humans to monitor, and control an internet-based system. Internet of Things (IoT) is a structure in which objects, are provided with exclusive identity and the ability to move data over a network without requiring two directions both human to human and human to computer interaction. With this technology, it is expected to help monitor the plants and fish they cultivate.

LITERATURE SURVEY

Generally, Aquarists are not able to feed fish when they are out-of-station. The reasons are lack of food availability for fish, which may lead to poor water quality in fish pots. Thus, it is a must to monitor fish starvation, which are helpful for fish proprietors. The authors 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 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 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 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.

OBJECTIVE

The objective of a **smart aquarium** is to leverage technology to improve the management and monitoring of aquatic environments, ensuring the well-being of aquatic life while reducing manual effort for the owner.

Key objectives include:

- ***Automated Maintenance:***
  - Automate tasks like feeding, water filtration, and cleaning to minimize human intervention.
- ***Water Quality Monitoring:***
  - Continuously monitor key parameters like temperature, pH levels, ammonia, nitrate, and oxygen to maintain a healthy environment for aquatic life.
- ***Energy Efficiency:***
  - Optimize the use of resources like water, light, and electricity to make the system more sustainable and cost- effective.
- ***Remote Monitoring and Control:***
  - Enable users to control and monitor the aquarium remotely using a smartphone or computer app, allowing adjustments in real-time.
- ***Health and Behaviour Tracking:***
  - Detect abnormal behaviours or health issues in aquatic organisms to ensure timely intervention.
- ***Customizable Environments:***
  - Provide options for personalized settings, such as simulating natural lighting cycles, seasonal changes, or specific habitats.
- ***Integration with Smart Home Systems:***
  - Connect with other smart devices for seamless operation, such as syncing lighting schedules with home automation systems.
- ***Educational and Aesthetic Enhancement:***
  - Serve as an engaging tool for learning about aquatic ecosystems and enhancing the visual appeal of a living space.

By achieving these objectives, a smart aquarium simplifies aquarium management while promoting the health and longevity of aquatic life.

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 .

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 servo motor in a smart aquarium precisely controls the position of various components, such as automatic feeders, water valves, and light adjusters. 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

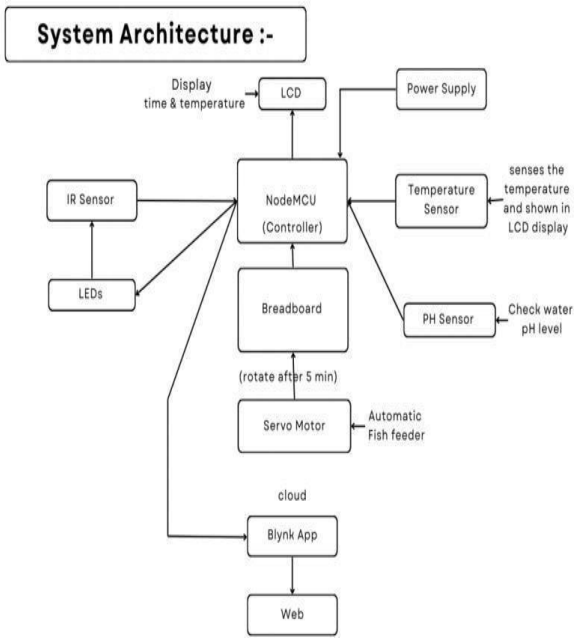


Figure 2

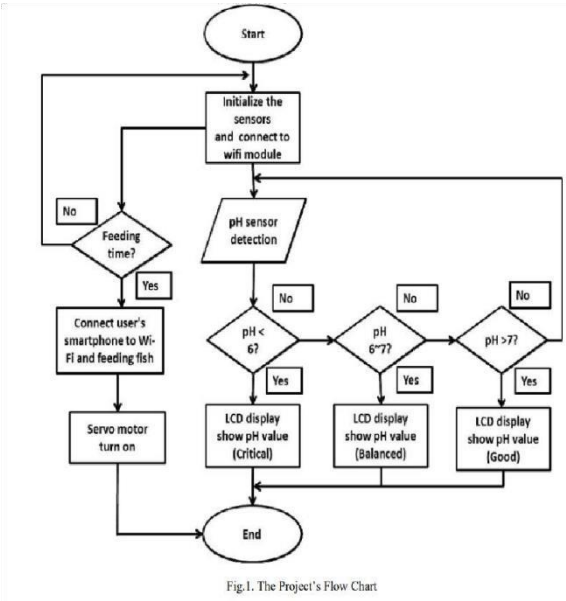


Fig.1. The Project's Flow Chart

HARDWARE COMPONENTS

Node MCU

Node MCU is used for 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.

Temperature Sensor

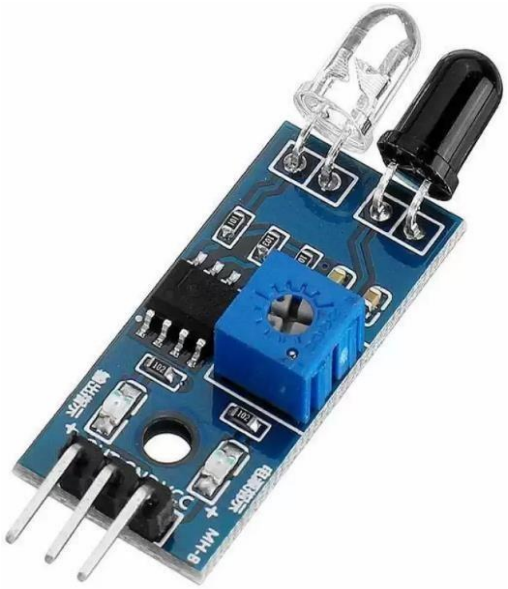
The temperature sensor is used to detect the temperature of the water in the aquarium. It has a built-in 12bit ADC. It is interfaced with Node MCU digital input. The one- wire bus is used for communication between sensors and Node MCU.

Servo Motor

A **servo motor** is a type of electromechanical device that provides precise control of angular or linear position, velocity, and acceleration. It consists of a motor coupled with a sensor that provides feedback, allowing the control system to adjust the movement based on the desired outcome.

IR Sensor

An IR (Infrared) Proximity Sensor is a device used to detect objects or obstacles without physical contact, using infrared light.



PH Sensor

A **pH sensor** is a device used to measure the acidity or alkalinity of a solution, giving a numeric value for the pH level.

LCD's (16*2)

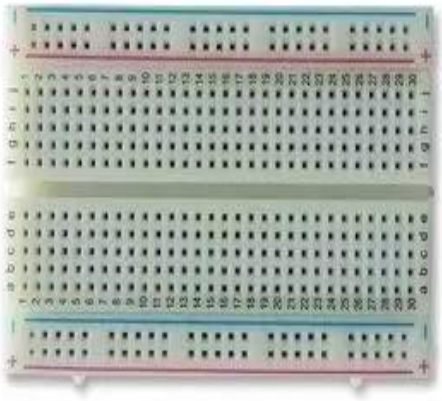
In a smart aquarium, LCDs (Liquid Crystal Displays) provide a clear, real-time display of essential information such as water temperature, pH levels, and system status, enabling users to easily monitor and manage the aquarium's conditions at a glance.

Resistor

In a smart aquarium, a resistor regulates the current flow to electronic components, ensuring they operate within safe limits. It helps prevent damage to sensors, actuators, and microcontrollers by limiting the current, thereby contributing to the reliability and longevity of the aquarium's electronic system.

Breadboard

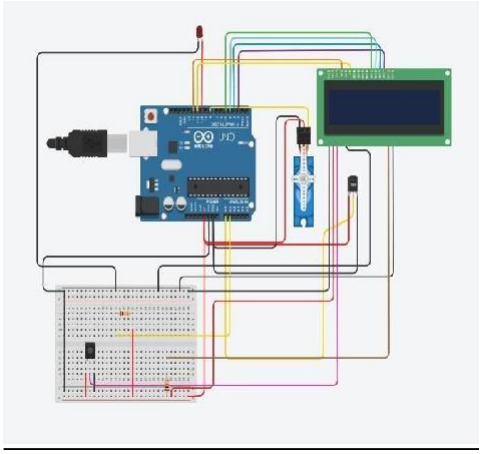
A breadboard allows for the temporary construction and testing of electronic circuits by providing a grid of interconnected holes where components and jumper wires can be easily inserted and connected without soldering.

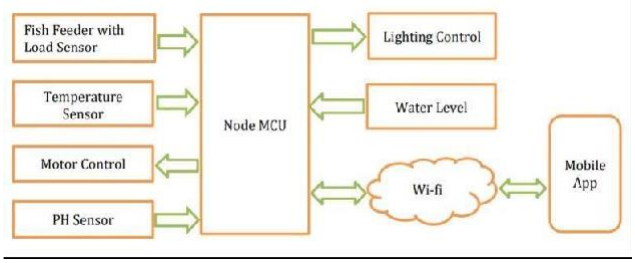


SOFTWARE DESCRIPTION

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

CIRCUIT DIAGRAM





RESULT

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

Enhanced Aquatic Health and Longevity

- **Stable Environment:** Consistent monitoring and automation maintain optimal water quality, reducing stress and promoting the health of fish, plants, and other aquatic organisms.
- **Timely Intervention:** Alerts for abnormal parameters (e.g., pH shifts, temperature changes) enable early detection and correction of issues, preventing fatalities.

Simplified Maintenance

- **Reduced Manual Effort:** Automated feeding, cleaning, and water changes eliminate routine manual tasks.
- **Ease of Use:** Remote monitoring and control allow adjustments without being physically present.

Greater Energy Efficiency

- **Optimized Resource Usage:** Smart systems use sensors to regulate lights, heaters, and filters based on actual needs, reducing energy and water waste.

Improved User Experience

- **Convenience:** Remote access via apps ensures that owners can monitor and manage their aquariums from anywhere.
- **Educational Value:** Real-time data and insights enhance understanding of aquatic ecosystems.

Aesthetic and Functional Enhancement

- **Customized Displays:** Smart lighting and environmental control create visually stunning setups, such as mimicking natural habitats or seasonal changes.
- **Integration with Smart Homes:** Aquariums can synchronize with other devices, adding sophistication to home automation systems.

Cost Savings Over Time

- **Lower Maintenance Costs:** Optimized resource usage and timely issue resolution reduce costs associated with equipment repairs or replacing aquatic life.

Eco-Friendly Operation:

- Minimizing water and energy waste contributes to more sustainable aquarium practices.

Peace of Mind:

- Owners can be confident that their aquatic pets are in a safe, well maintained environment, even during travel or busy periods.

CONCLUSION

The proposed system for the control of the aquarium using a mobile app has been implemented. This system enables the aquarist to control the aquarium through their mobile phones. The smart aquarium revolutionizes traditional aquarium care by integrating advanced technology to create a more efficient, sustainable, and user friendly experience. Through the use of IoT devices, sensors, and automation, it enables precise monitoring and maintenance of critical water parameters, ensuring a healthy environment for aquatic life. Features such as automated feeding, real-time alerts, and AI-powered insights reduce the burden of manual intervention while enhancing the overall care process. Additionally, its focus on energy efficiency and resource optimization aligns with modern sustainability goals. By combining convenience with advanced functionality, the smart aquarium is not only a valuable tool for hobbyists but also a significant innovation for aquaculture and aquatic ecosystem preservation. This fusion of technology and nature paves the way for a more connected and responsible approach to aquatic care.

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