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# Revolutionizing Aquatic Life: A Comprehensive System for Monitoring, Controlling and Optimizing Aquarium Environments with the Power of IoT Technology

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***Abstract:*** *Many individuals today keep fish as pets in their homes. The aquarist has been feeding the fish in the aquarium tanks, necessitating a suitable arrangement for upkeep. Changes in water quality, feeding fish, regulating temperature and lighting, and difficulty manually assessing an aquarium's conditions are some of the issues encountered. Therefore,It's important to improve the water quality and regularly check the physical parameters. So, this project suggests a system that has sensors and can be operated in real-time. It monitors the water's pH level, turbidity, and temperature. It also detects fish eating. To keep track of the aquarium's condition and transmit updates to the user's web application, an IoT-based system is put in place. In order to ensure that the fish are not overfed or underfed, intelligent aquarium management has been incorporated using a temperature sensor, pH sensor, and turbidity sensor. This reduces the amount of manual labour needed to maintain the aquarium.*

***Index Terms- : IoT (Internet of Things),Reliable, Intelligent, Aquatic, Monitoring, smart***

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## I. INTRODUCTION

Over the past 20 years, there have been a constant increase in pet ownership. The most popular pet right now, after dogs and cats, is freshwater fish. Fish aquarium management is a complex and challenging chore in and of itself. You have to accomplish a number of actions when you have to clean your aquarium or feed the fish. After an hour, you must manually feed your aquarium simultaneously turning off the air pump and powerhead. All equipment in the existing system, especially lights, heaters, and filters, must be handled manually via electrical switches. To do this, one must approach the tank and manually operate the electrical switches to turn on and off the machinery. It is considerably more difficult to maintain an aquarium since the fish need to be fed twice daily, even if this requires the owner to go up to the fish tank and personally feed the fish. When the owner is away, he occasionally loses control of the aquarium and is unable to feed the fish. The idea we came up with is a Smart Aquarium. Compared to current solutions on the market, the project will be more effective. In addition to being more efficient, it will also be less expensive. The audience for the project is a group of people who want to keep fish in their homes or offices but don't have time to care for them or are worried about having to keep asking their neighbors to take care of the fish when they're not there. An automated fish care system is the focus of the project. Its automated functions will take the place of manual maintenance for fish aquariums. The Smart aquarium system is a straightforward system that enables a user to monitor a variety of water conditions, including temperature, pH level, and turbidity. In addition, it lets the user use a fan and bulb to control the temperature and feed fish.

## II. LITERATURE SURVEY

The pertinent literature is reviewed in this section. It explains the many methods applied to the work.

A.Smart Aquarium Based Microcontroller by Budi PrijoSembodo and NovendraGeofanda Prata. The scientists Budi PrijoSembodoet al.[1] developed a smart aquarium system with an Arduino-based feeding system that manages the servo motor as an open and close system for the exit of fish food into the aquarium.The servo motor can automatically distribute fish food that was controlled by Arduino, and it has a feed output of

12.5 grammes that was adjusted to the condition of the 7 ornamental fish and the daily feed requirements of the ornamental fish in the aquarium. The servo motor can automatically feed fish according to the daily meal requirements in the morning at 7.00 Western Indonesian Time and at night at 19.00 Western Indonesian Time with a 3-second delay.This LDR (Light Dependent Resistor) type light sensor will send a signal to the relay, which turned on the 220-volt lamp, if the light intensity is below 028.7 Lux, which was after half-past 6 p.m., and if the light intensity is above 203.4 Lux, which was after 6 a.m., the 220-volt lamp will be turned off.Using a signal from the Arduino, the water pump is managed by the Arduino as an automated water drainer and filler dependent on the clarity of the aquarium's water. Whereas the filling water pump can remove 28 litres of water in four minutes, the drain water pump can remove 30 litres in two.

B.Smart system for maintaining aquascape environment using internet of things-based light and temperature controller by Daniel PatrickoHutabarat, Rudy Susanto, Bryan Prasetya, Barry Linando, Senanayake MudiyanselageNamalAroshaDaniel PatrickoHutabarat et al.'s[2] main goal was to build a smart system using an internet of things (IoT) application for a plant tank.The technology will be used in this investigation to regulate the temperature and light intensity. The hardware needed to create this system includes the ESP32 microcontroller, the BH1750FVI light sensor, the high power led (HPL) bulb as the light source, the DS18B20 temperature sensor, the heater, and the 220 VAC fan that controls the temperature.The user can use the application created for this study to input data into the system. The user then connects to the system through the internet by downloading the prepared application to their smartphone. Another function being created for this smart system is the simplicity of adding and removing devices from the system.

The created system consistently maintains the temperature within the prescribed range and can provide light intensity with a 96% accuracy rate.

C. Smart Aquarium Design Using Raspberry Pi and Android Based by Khairunisa, Mardeni, YudaIrawanThe researchers Khairunisaet al. [3] designed a smart aquarium device in order to feed fishes automatically, namely using AndroidBased Raspberry Pi.The administration of the aquarium's decorative lights and automatic fish feeding were just two of the many functions carried out by this aquarium. The fish feeding valve was moved by a servo motor, which also served as a relay for an aquarium ornamental light that could be turned on and off. Fish feeders can automatically feed the fish if the user forgets to do so. The servo motor rotates the fish feeding valve, and the feeding process is finished automatically. Five times the procedure was tested, and each time it passed with flying colours.After four tests, the on/off procedure for decorative lamps is employed, with an overall success rate of 80%. Android later sends the information to the database, and the Raspberry Pi reads it.

D. IoT Based Automatic Aquarium Monitoring System for Freshwater Fish by Mohammad Fahmi Suhaimi, Nurul Huda Mat Tahir, SafuanNaim Mohamad, Suzanna Ridzuan Aw. The project developed by the authors Mohammad Fahmi Suhaimiet al. [4] is based on a computer-controlled system that monitors physical changes in the water and maintains it in good condition.The aquarium will carry out all tasks automatically, including controlling the water level, feeding, pH, turbidity, and temperature.The IoT monitoring system sent updates about the aquarium's condition to a database that users could access online.The data for the freshwater fish monitoring system was then gathered using the temperature sensor module and pH sensor module. The Arduino ESP8266 was used as a controller to manage the data collected from the sensor. All of the project's sensor modules and the Arduino circuit are wired within the electrical box.Thinger.io served as the project's IoT platform. Also, when sensors found an issue, they transmitted a notification to the IoT platform, which was then flagged as an alarm and continuously watched over.

E. Aquarium Monitoring System Based on Internet of Things by Wen-Tsai Sung, Shuo-Chen Tasi, and Sung-Jung Hsiao. The researchers Wen-Tsai Sung et al.[5] developed an IoT-based remote monitoring solution for aquarium environments. The MediaTek LinkIt 7697 served as the system's primary control development platform. Remote monitoring components for this system include temperature, illuminance, water level, and passive infrared sensor modules.The system communicates with and computes the physical sensing signals collected using a wireless sensor network (WSN). Using BlocklyDuino, a web-based visual programming editor for Arduino, the code was compiled and delivered to the LinkIt 7697's integrated Wi-Fi communication module.The back-end computer displayed the results on the Cloud Sandbox platform. The real-time viewing of the environmental data gathered by each sensor was made possible by this platform. The system must maintain a cosy environment for the fish in the tank.

## III.METHODOLOGY

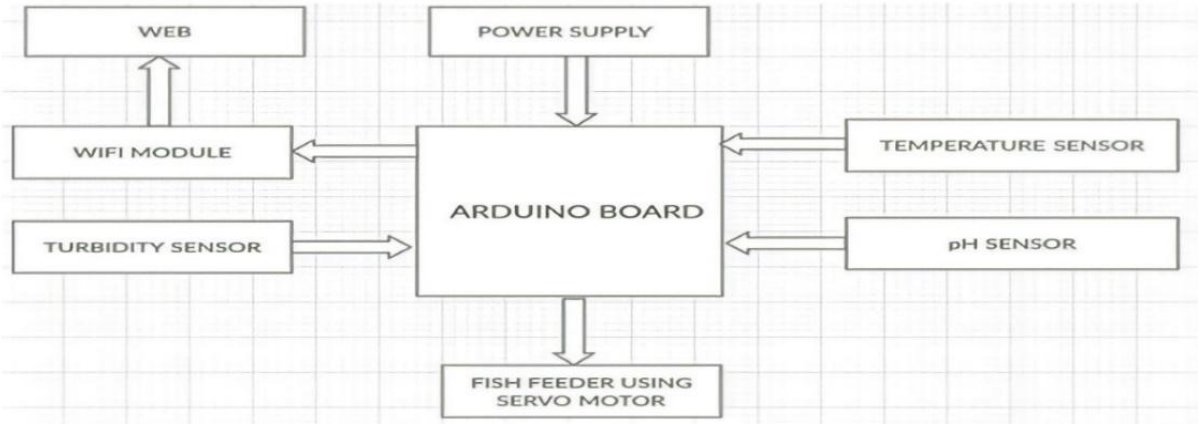


Fig. 1 Block diagram of Smart Aquarium

The block diagram of the smart aquarium is displayed in the above figure. the following hardware and software make up this:

**A. pH Sensor**
Hydrogen ion concentration in a solution is determined using a pH sensor. In many pH sensors, glass pH electrodes are employed. The electrode is essential for measuring a solution's pH. It utilises potential differences to assess solution voltages and contrast them with existing ones, operating on the voltmeter concept. For fish, a pH of between 6.5 and 9.0 is an ideal range.

**B. Temperature Sensor**
Temperature sensor plays an important role in many applications in the case of fish aquarium it is necessary to check the temperature. Temperature sensors are usually thermocouple or RTD. We have used a thermistor-based temperature sensor that is capable of monitoring water temperature. It works on the inverse time characteristics phenomena. The resistance of the thermistor decreases when temperature increases and gives the signal of a rise in temperature.

**C. LCD 20x4**
This LCD screen has four rows of white text on a blue background that are each 20 characters wide. It is used to digitally show the results.It typically has an Arduino connection for output display. Its one row, 0.1 pitch connection connector makes breadboarding and wiring simple. A grounded resistor and a resistor with a single LED backlight are both supplied. It can be powered directly by 5V. With a variable resistor or PWM, you can change the brightness.

**D. Servo Motor**
The applied signal to the control pin serves as the foundation for servo motor operation. Pulse width modulation is the basis of how it functions. A gear mechanism, variable resistors, and a dc motor make up a servo motor's construction. Depending on the adjustment, it can rotate either 180 degrees or 360 degrees. It responds quickly to a high pulse and moves back and forth.

**E. ESP8266 Wi-Fi Module**
An independent system on chip (SOC) called the ESP8266 Wi-Fi Module can assist any microcontroller in making an Internet connection.The ESP8266 is capable of offloading all Wi-Fi organising functions from one application processor to another application processor or facilitating an application. Each ESP8266 module already has an AT direction set firmware installed, so you can connect it to your Arduino device and obtain roughly the same amount of Wi-Fi capacity as a Wi-Fi Shield does. The APSD for VoIP applications and the Bluetooth coexistence interface are supported by the ESP8266. It has an internal self-adjusting RF that allows it to function in any environment and eliminates the need for external RF components. Several projects use ESP8266 to connect through Wi-Fi and the Internet.

**F. Bulb**
In order to raise the temperature of the water in an aquarium tank, a bulb is utilised. They are available in a

range of sizes, voltages, and wattages. Because mini-fish tanks are too small to utilise heaters, we have used a bulb in this instance instead. We designed the bulb such that it will turn on if the water's temperature dips and work to maintain the tank's ideal temperature.

**G. Arduino IDE**

Open-source software called Arduino IDE is mostly used for authoring and compiling code into Arduino Modules. Because it is an official Arduino programme, code compilation is so simple that even the average individual with no prior technical expertise may get started learning. It operates on the Java Platform, which is readily available for operating systems like MAC, Windows, and Linux and has built-in functions and commands that are essential for debugging, modifying, and compiling the code in the environment. There are numerous Arduino modules available, including the Uno, Mega, Leonardo, Micro, and many others. On the board of each of them is a microcontroller that is actually programmed and takes data in the form of code.

**H. TinkerCad**

Because of its simplicity and use, TinkerCad is a popular free online 3D modelling tool that runs in a web browser. It has gained popularity since its release in 2011 as a tool for developing models for 3D printing and as a basic introduction to constructive solid geometry in educational institutions. Model construction in TinkerCad is done using a streamlined constructive solid geometry approach.

Primitive shapes that are "solid" or "holey" are the building blocks of a design. By combining solids and holes, new shapes can be made, and these new shapes can then be given the solid or hole property. A user can produce unique form generators using the built-in JavaScript editor in addition to the usual library of primitive shapes.

**I. Working of Temperature Sensors**

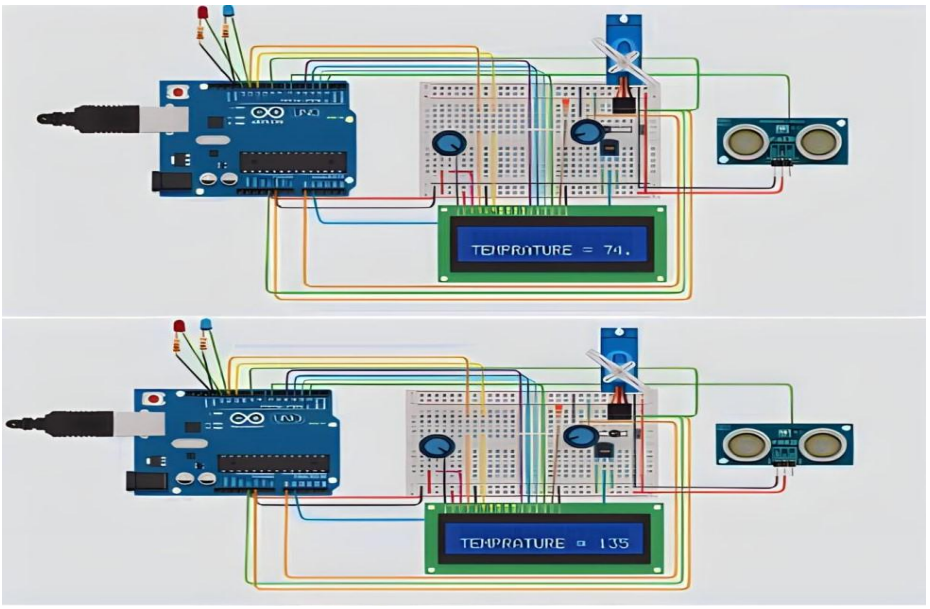


Fig. 2 Working of Temperature Sensor

The LCD Screen and Temperature Sensor are coupled in the aforementioned figures. The Sensor measures the water's temperature and shows it on the screen. The LCD Screen adjusts its display in accordance with changes in water temperature. The LCD Screen's display also changes when the water's temperature drops in the same way.

**II. Working of Ultrasonic Sensor**

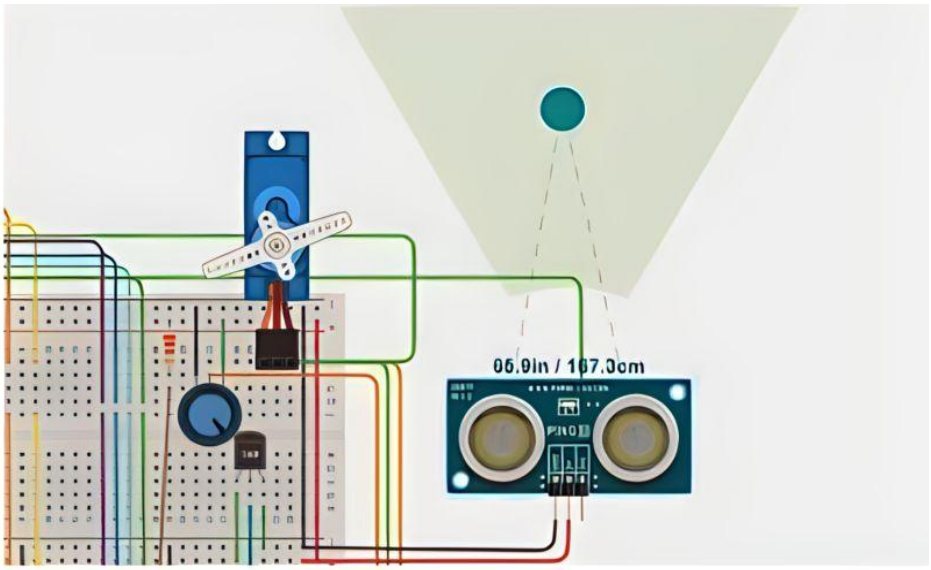


Fig. 3 Working of Ultrasonic Sensor

The circuit has the Ultrasonic Distance Sensor linked to it. Another LED and the servo motor are linked to it. The Blue LED will glow when the Ultrasonic Distance Sensor is within range, indicating that there are live fish present in the tank. The circuit's servo motor is utilised to feed the fish in the tank. The Servo Motor will also move in accordance with the Ultrasonic Sensor's range.

## IV.CONCLUSION

The goal behind the project was to develop a system that could automatically take care of the fish and allow for remote control of these devices via the cloud. Most tasks are now completed automatically, including keeping a constant pH, water level, and temperature. This project successfully implements the use of an IoT platform to monitor these variables, view the data, and even manually control some aspects online. The mechanical design and installation of the fish feeding system, which is an original invention, was another crucial component. There are other designs, but they are complicated; this project achieves simplicity, efficiency, time savings, and cost savings. It is a rather simple design, but it effectively accomplishes the task.With the help of this project, we will be able to put our knowledge of management into practise and contribute to creating the optimal aquarium habitat for fish.

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