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IOT System for Monitoring of Water Quality in Aquaculture

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Abstract

Monitoring water quality is crucial for the success and sustainability of aquaculture operations. This project proposes the development of an IoT System for Monitoring Water Quality in Aquaculture using NodeMCU, LCD with I2C, water level sensor, turbidity sensor, Relay, DC pump, and IoT server. The system continuously monitors key water quality parameters and transmits the data to an IoT server for real- time analysis and remote monitoring. This system aims to enhance the efficiency and effectiveness of aquaculture management by providing timely alerts and automated responses to maintain optimal water conditions.Introduction

I. Introduction:

The growing global population drives up food consumption. However, the area that can be used for agriculture and cattle farming has been steadily declining due to the intensification of the greenhouse effect and the depletion of world resources. Aquatic products are easy to capture rich in protein and can be farmed; therefore, humans are increasingly dependent on fishery resources Aquaculture water body's critical properties, including pH, dissolved oxygen, temperature, and turbidity, are continually monitored by IoT- based systems through the use of a network of linked sensors and devices. Aquaculture operators may obtain real-time data remotely and respond quickly to changes in water quality parameters by utilizing Internet of Things capabilities. This allows for proactive management. In addition to improving the general well-being and health of aquatic life, this also maximizes productivity and lowers the possibility of adverse environmental effects. Of them, temperature, water level, pH, and salinity are the most crucial factors that need to be watched over and managed. The techniques used to monitor aquaculture ponds are currently inefficient since they require a lot of effort and time, and they rely on the experience of the farmer. Pond conditions are often measured only after farmers have noticed irregularities in the water. One of the main factors influencing aquafarms' ability to produce aquatic products is water quality. People and ecosystems may be at risk for health problems due to poor water quality. Water from an aquafarm is manually sampled using traditional ways of assessing water quality, and it is then tested in a laboratory using devices or test

papers. These methods, however, take a long time and a great deal of labour. An Internet of Things (IoT)- based smart aquaculture system (ISAS) for tracking multiple water quality measures in an aquafarm is presented in this research. Three sensors— temperature, pH, and water level—are coupled to an Arduino development platform and wifi module in the Internet of Things-based smart aquaculture system

II. Literature Review:

water animals and plants to live (more or less) on land. It opened the most mysterious and inaccessible environment to casual inspection. It appealed to—and sometimes appeased—the divergent curiosities of scientific investigators, amateur collectors, and observers simply in search of entertainment. It could enhance cozy domesticity or offer a thrilling glimpse of the sublime perils of the oceanic deeps. Aquariums continue to fulfill most of these functions, and they have also maintained the Victorian trajectory of technical improvement. The most elaborate modern aquariums are enormous and can be modified to simulate a variety of freshwater and marine environments. (The fragile and artificial nature of these environments, no matter how realistic they seem to human observers, was demonstrated by the mass death of the inhabitants of the Aquarium of the

An IoT-Based Mini Aquarium System

Many people feed the pet fish in the aquarium tanks that need to be properly set up and maintained, or the fish will be destined to an unpleasant and short life. Therefore, it is critical to monitor water conditions closely and improve the water quality for the mini aquarium tanks. Based on an IoT solution called IoTtalk, this paper proposes the FishTalk system that utilizes the aquarium sensors to drive the actuators in real time. We describe the relationship between the aquarium sensors and the actuators and give concrete examples about the threshold setting. Our solution allows the designer to quickly deploy intelligent control for various water conditions. As an example, we implement an intelligent fish feeding mechanism such that the fish is neither over nor under fed, and at the same time, the fish owner can enjoy watching fish feeding remotely. We have also developed the analytic

tells how these elaborate devices for storage and display evolved. Most of Brunner's account focuses on the nineteenth century, the period when workable aquarium technology was developed and when aquariums enjoyed their first flush of popularity. But he traces their origins to several earlier periods. In the eighteenth century, he claims, superstitious dread of the sea began to give way to sublime appreciation and scientific investigation (although he acknowledges that some mystery and dread persisted, as evidenced by the popularity of books such as Jules Verne's 20,000 Leagues under the Sea). Brunner links the desire to possess and display aquatic organisms to the passion for collecting that derived from early modern cabinets of curiosity. Finally, he places aquarium fish in a tradition of pet- keeping that echoes practices recorded as long ago as classical antiquity and as far away as medieval China. Few of these early piscine captives survived long, and, beginning in the late seventeenth century, European naturalists searched for ways to enhance their survival. A series of improvements, including the adaptation of the simple but effective technology of the Wardian case (devised for transporting plants) and the use of industrially manufactured glass, meant that, by the mid- Victorian period, even relatively modest homes could display small but well- stocked aquariums. One reason that many inhabitants of such homes desired to maintain these fascinating yet time-consuming devices resulted from another widespread Victorian phenomenon: the craze for examining and collecting the plants and animals that lived on the margins of the sea. This enthusiasm was stoked by popular natural-history writing, especially that of Philip Henry Gosse (to whom Brunner devotes an entire chapter), and it led to several further ichthyological developments. Serious amateur aquarists formed societies and founded specialist magazines, following the pattern of amateurs in other branches of natural history. They joined professional naturalists in debating the relative merits of freshwater fish as opposed to marine fish, or (once the transportation of tropical fish became fairly reliable) of exotics as opposed to indigenous European or American species. The general public in Europe and North America also showed persistent interest in viewing captive live fish. By the late nineteenth century, large aquariums had been constructed in many major cities, either as part of established zoos or as free- standing tourist attractions. In addition to telling its story, The Ocean at Home chance to understand why Victorian observers found fish so appealing.

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Design and implementation of Automatic Aquarium System using IOT

Ornamental fish enthusiasts are sometimes busy with matters that take a long time to handle so they do not have time to care for their pet fish. Therefore, automation in maintaining fish in the aquarium is needed. This study aims to make it easier to maintain ornamental fish in the aquarium by automated feeding activities, replacing water, and adjusting water temperatures. This automation uses the prototype method so that it is easy to improve continuously. The data collection is done by collecting several articles related to the title taken by the author. NodeMCU is used as a temperature sensor data reader, pH, ultrasonic and servo data receiver, relay to turn on the valve, pump, heater, and fan. The results of the data will be sent wirelessly to smartphones via the Blynk application. The result of this study is a tool that can feed fish according to a predetermined schedule, replace water according to the acidity of the water's pH and adjust the temperature to its natural habitat. Thus, this automation tool will be useful for fans who are busy with their work, especially those who often go out of town for days.

IoT for aquaculture 4.0 smart and easy-to-deploy real-time water monitoring with IoT

While aquaculture and IoT have exponentially grown in the world in the last years, the combination of both domains still remains at its early stage. Although water monitoring is at the center of the aquaculture activity, its complexity can often push fish farmers to neglect it. We believe that developing user-friendly IoT tools for fish farming will lead to a new era of connected, responsible and efficient aquaculture. IoT for aquaculture needs to be smart, affordable, easy to deploy, reliable and highly efficient. Artificial Intelligence processing key data given by IoT can also provide new services addressing new challenges facing aquaculture (e.g be efficient but green). In this paper we describe results from European research projects that build the foundation of a new aquaculture

III. Proposed system:

The proposed system is a **smart water quality monitoring solution** specifically designed for **aquaculture applications**. It continuously monitors the **water level** and **turbidity** of the tank using appropriate sensors and provides both **local and remote feedback** through an **LCD display** and the **Blynk IoT platform**. A **NodeMCU microcontroller** serves as the central unit to process sensor data and control output devices.

When the water becomes too turbid (indicating poor quality), the system automatically **deactivates the**

DC water pump using a **relay** to prevent the circulation of contaminated water, protecting aquatic life. Real-time data is also pushed to the cloud, allowing users to monitor and respond to water conditions remotely via their smartphone.

IV. Block diagram:

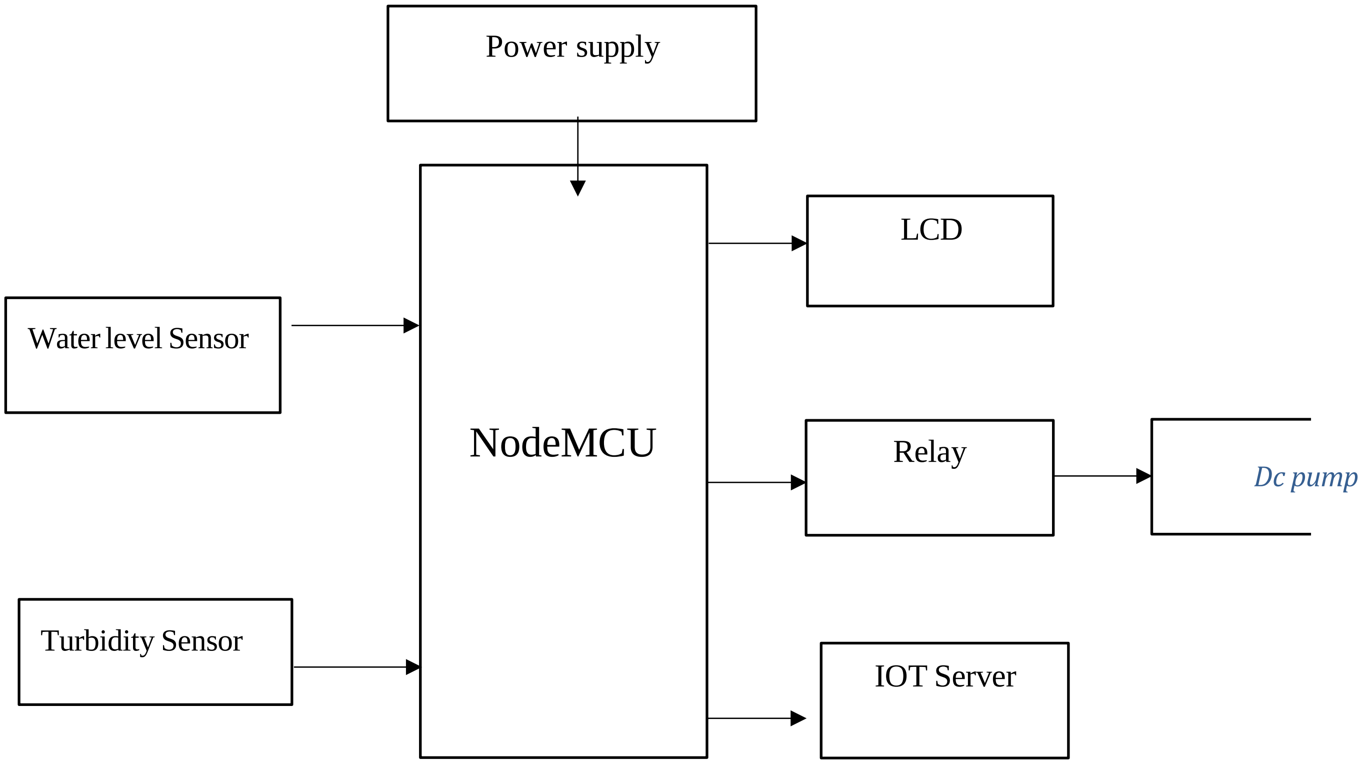

Fig - Block diagram iot system for monitoring of water quality in quaculture

V. Node MCU Microcontroller :

Technically speaking Node MCU is a firmware for ESP8266 developed using C Programming Language, Espressif NON-OS SDK and Lua scripting language. Traditionally, we write code for our Microcontrollers like Arduino, STM32, 8051 etc., either in C or C++ and compile it with a set of tools and generate a binary file. This binary file is then uploaded into the flash memory of the microcontroller and it gets executed. Things are quite different with Node MCU. You can consider the Node MCU firmware as an interpreter for Lua Scripts. So, if your ESP8266 is loaded with Node MCU Firmware, you can simply write your application in Lua and send it to the ESP8266.Node MCU Firmware will interpret the byte code and executes the commands. There is no compilation, no binary file etc. Just write a script and run it the team which developed Node MCU Firmware also developed a breakout board for ESP-12E module called the Node MCU Devkit. So, many of us are actually using the board called Node MCU and programming it with Arduino IDE and not the Lua Scripts.

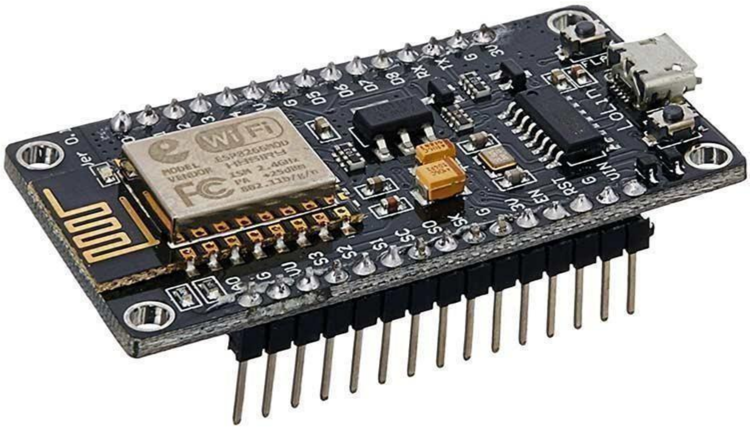

Fig 4.7: Node Mcu pic

Features of Node MCU:

- Input Voltage: 7-12V
- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V6
- Digital I/O Pins (DIO): 16
- Analog Input Pin (ADC): 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz

- Compact Size of node Mcu
- It can have three different protocols SPI,UART,I2C

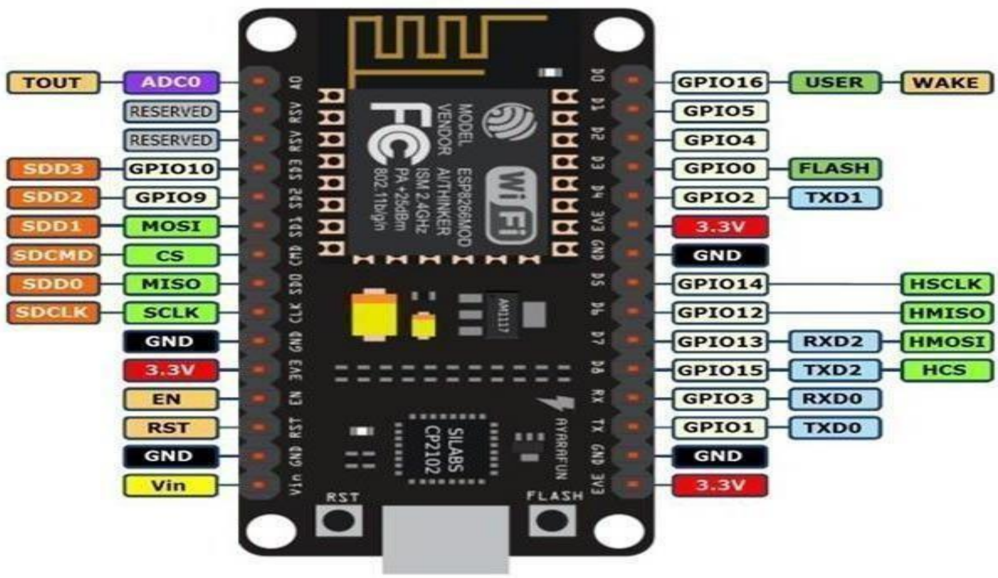

Fig :Node MCU pin Description

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VI. Turbidity Sensor

A turbidity sensor is an analytical device designed to measure the turbidity or cloudiness of a liquid. Turbidity is caused by suspended particles in the liquid, which scatter and absorb light, making the liquid appear cloudy. The sensor uses light transmission and detection techniques to quantify these particles, providing valuable data about the liquid's clarity

Fig-Turbidity Sensor

While regulatory compliance is important for municipal drinking water and water treatment plants, measuring turbidity can also help keep the cost of operations down. Taking regular turbidity measurements can optimize filter performance by establishing efficient filter backwash cycles. And in the case of filter breakthrough, turbidity readings can indicate a breach of particles before it becomes a costly problem requiring an appropriate regulatory response

VII. Water level sensor:

The sensor has ten exposed copper traces, five of which are power traces and the remaining five are sense traces. These traces are interlaced so that there is one sense trace between every two power traces.

Normally, power and sense traces are not connected, but when immersed in water, they are bridged.

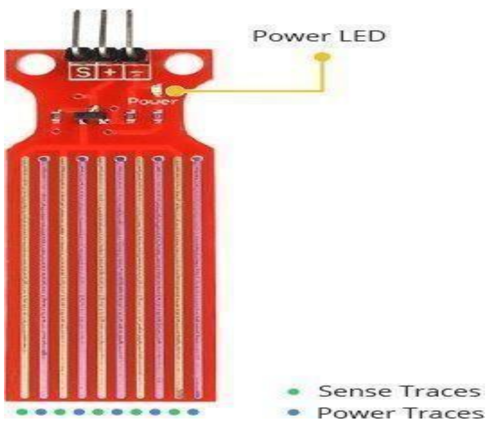

Fig-IR Sensor

This resistance varies inversely with the depth of immersion of the sensor in water: The more water the sensor is immersed in, the better the conductivity and the lower the resistance.

The less water the sensor is immersed in, the poorer the conductivity and the higher the resistance. The sensor generates an output voltage proportional to the resistance; by measuring this voltage.

VII. LCD:

LCD is a flat display technology, stands for "Liquid Crystal Display," which is generally used in computer monitors, instrument panels, cell phones, digital cameras, TVs, laptops, tablets, and calculators. It is a thin display device that offers support for large resolutions and better picture quality. The older CRT display technology has replaced by LCDs, and new display technologies like OLEDs have started to replace LCDs. An LCD display is most commonly found with Dell laptop computers and is available as an active-matrix, passive-matrix, or dual-scan display. The picture is an example of an LCD computer monitor.

The Liquid Crystal library allows you to control LCD displays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usually tell them by the 16-pin interface.

Fig :16X2 lcd

The LCD can be interfaced to the microprocessor 8085 using the programmable peripheral interface (PPI-8255) IC. To display letters and numbers. ASCII code for the letters A to Z, a to 7, and numbers 0 to 9 is sent to the data lines (D0 -D7). These codes may be sent to LCD data lines through one port of 8255 (PPI), port A is used as the output port and send the data to the LCD. The EN pin and RS pin are connected to port B of the 8255. Since it is used as a normal display R/W is made low by connecting
to the ground directly. Power supply connections are provided to Vcc and Vss pins. The Vee pin is connet

VIII. Schematic diagram:

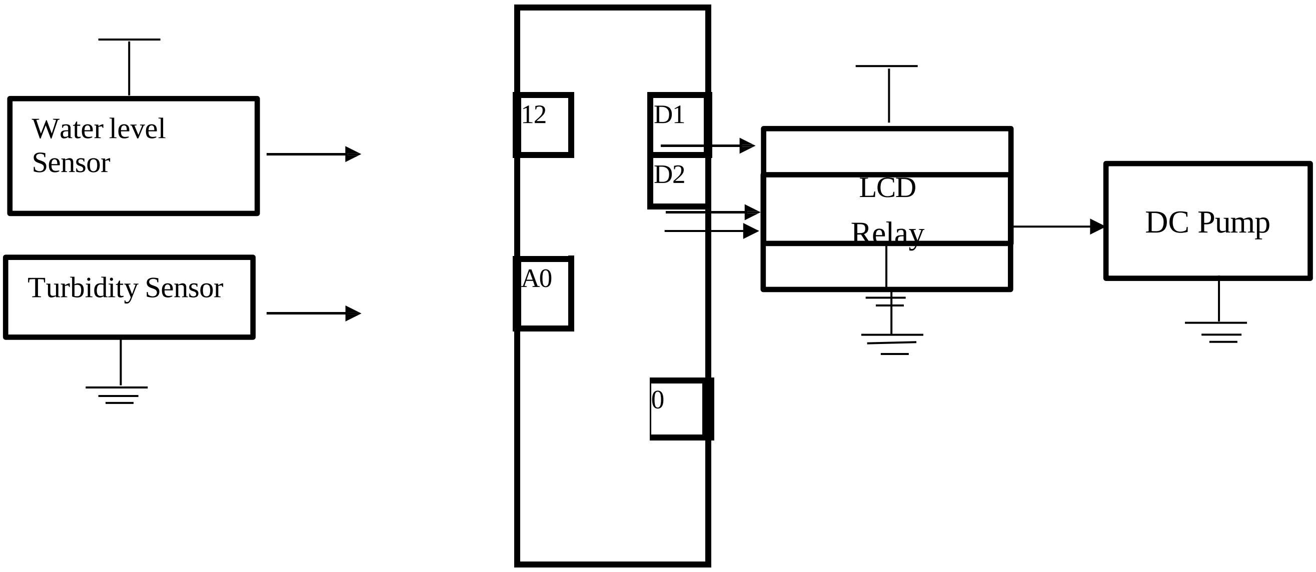

Fig : schematic diagram of node mcu of monitorting of water quality in aquaculture

IX. Result:

The implemented water quality monitoring system for aquaculture successfully monitore **water level** and **turbidity** in real-time using appropriate sensors. The data was accurately displayed on a **16x2 LCD** and transmitted to the **Blynk IoT platform** for remote access. When the water became turbid beyond a set threshold, the system **automatically deactivated the DC**

pump via the relay to prevent the circulation of impure wat

The IoT System for Monitoring Water Quality in Aquaculture provides an innovative and effective solution to address key challenges in aquaculture management. By integrating advanced sensors, NodeMCU, and IoT server technology, this system ensures real-time monitoring, remote accessibility, and automated responses to maintain optimal water conditions. These features significantly reduce manual effort and errors while enhancing the efficiency and sustainability of aquaculture operations. With its ability to provide timely alerts and control mechanisms such as the relay and DC pump, the system empowers aquaculture practitioners to make informed decisions and take proactive measures. This project exemplifies the transformative potential of IoT in revolutionizing traditional practices and ensuring the long-term success of aquaculture endeavors.

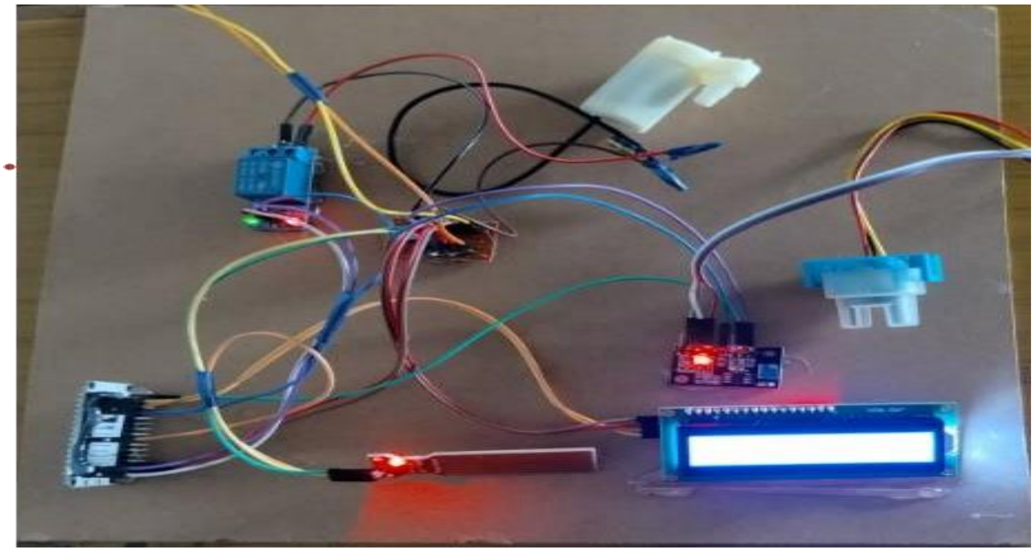

Fig-Hardware kit when on condition

The successful development of the smart iot system for water management in aquaculture Have the following outcomes:

- **Accurate Monitoring:**
  The system successfully measured **water turbidity** and **water level** in real-time with good accuracy.
- **Automatic Control:**
  When turbidity increased, the system **automatically stopped the pump** using a relay, helping to prevent circulation of dirty water.
- **Real-Time Alerts:**
  Integration with the **Blynk IoT platform** enabled **remote monitoring** and instant alerts, improving user convenience.
- **User-Friendly Display:**
  The **16x2 LCD** provided clear on-site visibility of current water conditions without needing a mobile device.
- **Aquatic Health Safety:**
  By preventing the use of dirty water, the system helped **maintain healthier conditions** for fish and aquatic life.

- **Energy and Resource Efficiency:**
  The system only ran the pump when water quality was safe, reducing **power consumption** and **water wastage**.
- **Low-Cost and Scalable:**
  The use of **NodeMCU and basic sensors** makes the project **cost-effective** and easy to expand for larger tanks or commercial setups.

X. FUTURE SCOPE:

[1] Integration of Additional Sensors:

Add sensors for pH, temperature, dissolved oxygen (DO), and ammonia levels to monitor more water quality parameters crucial for fish health

[2] Solar powered operation
Make the system eco-friendly and deployable in remote areas by powering it using solar panels.

[3] Fish Behavior Analysis (Advanced)
Use underwater cameras and AI to analyze fish activity and feeding patterns, enhancing smart farm automation.

[4] Mobile App and real-time Alerts
Expand from Blynk to a custom mobile app with real-time alerts, charts, and remote control of pump and filtration systems.

[5] Automated Water Filtration and Exchange
Implement an automatic water filtration system or drain/refill mechanism based on turbidity

XI. REFERENCES:

[1] Math, R.K.M., & Dharwadkar, N.V. IoT Based Low-cost Weather Station and Monitoring System for Precision Agriculture in India. in the Proceedings of 2018 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Bangalore, India. pp. 1-2, (2018).

[2] Varghese, L., Deepak, G., & Santhanavijayan, A. An IoT Analytics Approach for Weather Forecasting using Raspberry Pi 3 Model B+. In the Proceedings of 2019 Fifteenth International Conference on Information Processing (ICINPRO). Kerala, India, pp. 1-5, (2019)

[3] Dhawan, A., & Kumar, A. An Approach for Implementing Innovative WeatherMonitoring System with DHT11 Sensor and Arduino Uno Tool based on IoT, in the Proceedings of International Conference on Computational Science and Computing, New Delhi, India, January 22-24, 2021.pp. 1- 2, (2021)

[4] Dabhi, A., & Jethva, D. Design and Development of E-Sense: IoT-based Environment Monitoring System. In the Proceedings of 2020 11th International Conference Computing, Communication and Networking Technologies (ICCCNT) Kharagpur, India. pp. 1-5, (2020)

[5]T. Sai, Y.-T., Kuo, Y.-W., Hwang, C., & Tsao, Y.-C. An implementation of IoT-based weather monitoring system. in the Proceedings of 2019 IEEE International Conferences on Ubiquitous Computing & Communications (IUCC) and Data Science and Computational Intelligence (DSCI) and Smart Computing, Networking and Services (SmartCNS), Fukuoka, Japan