International Journal For Advanced Research In Science & Technology
A peer reviewed international journal
www.ijarst.in
ISSN: 2457-0362

# REAL TIME CLOCK BASED MONITORING AND AUTOMATION FOR SUSTAINABLE

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**ABSTRACT -** Quezon Province, recognized for being the region's largest agricultural producer, boasts a thriving aquaculture industry, particularly in the cultivation of Nile tilapia. However, significant concerns regarding food safety, farm protection, and fish health persist within the aquaculture sector. One of the major issues facing fish farmers is the lack of effective monitoring, leading to overfeeding, water contamination, and poor-quality fish. This problem is particularly noticeable in the case of Nile tilapia farming, where the improper management of feed, especially in the absence of an automated system to control feeding, results in uneaten feed contaminating the water. This not only negatively impacts water quality but also leads to increased mortality rates and poor fish health. The need for an advanced, automated, and real-time monitoring system is critical in addressing these challenges. This study proposes a novel solution aimed at improving the management of fish farms through an integrated monitoring system that utilizes Blynk, an Internet of Things (IoT)-based application, to provide real-time alerts and notifications to fish farmers regarding the status of their fish farms. The system incorporates six key sensors to monitor various water quality parameters, including pH, temperature, turbidity, oxygen levels, water level, and Total Dissolved Solids (TDS). By continuously monitoring these vital metrics, the system provides farmers with precise data on the environmental conditions of their fish ponds, ensuring optimal water quality for tilapia growth. Moreover, the system integrates a fish feeder, allowing farmers to regulate feeding times, ensuring that the fish are fed appropriately, without excess feed contaminating the water. The study emphasizes the importance of incorporating the TDS sensor, which plays a crucial role in monitoring water quality and influencing fish growth. The research results indicate that the addition of the TDS sensor has a substantial impact on tilapia growth and health, as the sensor provides critical data on the water's salinity levels, which directly affects the fish's development. Furthermore, the study demonstrates that the proposed monitoring system is reliable and efficient, providing farmers with accurate data and continuous updates through the Blynk application. The system also alerts farmers to low-risk or high-risk behavior in their tilapia, helping them to take timely action to address potential issues, such as low oxygen levels or water contamination. This research underscores the importance of leveraging technology in aquaculture to ensure sustainable and efficient farming practices. The findings suggest that, while the current system is effective, there is room for further development, including the integration of imaging devices to track fish growth more accurately and the enhancement of the system to incorporate additional sensors and capabilities for more precise

monitoring. In the future, this system has the potential to revolutionize the way fish farms are managed, improving the overall health of the fish, increasing productivity, and ensuring environmental sustainability in the aquaculture industry. By providing farmers with real-time, actionable data, this IoT-based system offers a promising solution to the challenges facing the aquaculture sector in Quezon Province and beyond.

**I. INTRODUCTION** Infanta, located in Quezon Province, is renowned for having the largest brackish water fishery in the region, with aquaculture and ocean fishing contributing significantly to its economy. As a net fish exporter, Infanta plays a vital role in supporting the country's food security, especially during a time when capture fisheries nationwide are in decline. The expansion of aquaculture has become a critical solution to alleviating poverty and addressing food insecurity. However, as the industry grows, it faces numerous challenges, primarily environmental issues caused by climate change, poor governance, and unsustainable farming practices. In Infanta, fish farmers face difficulties such as overfishing, unpredictable weather patterns, fluctuating market prices, and labor shortages. These challenges are exacerbated by climate-related events, such as typhoons, floods, and extreme heat, which significantly impact fish farms and their productivity. As of 2022, the fisheries and aquaculture workforce in the Philippines is estimated at 1,113,000, and this number continues to grow. To address these concerns, the development of advanced monitoring and management systems for aquaculture operations is increasingly important. Environmental sensors that measure parameters like pH, temperature, and turbidity are essential in ensuring the health and productivity of fish in artificial farming systems. Unlike sensors for Total Dissolved Solids (TDS) and Dissolved Oxygen (DO), these parameters are vital for monitoring water quality, which directly affects the health of fish. To aid in improving the conditions for fish farming, this study explores the integration of IoT technology and environmental sensors to enhance the monitoring and management of aquaculture operations. By using the Arduino IDE programmed in C/C++ and leveraging the Blynk IoT platform, the system enables real-time data collection, visualization, and analysis of sensor readings. This allows farmers to track water quality and make informed decisions about fish care and feeding. The study focuses on the development of a cloud-based monitoring and notification system designed to improve the abiotic conditions in fish farms, incorporating five environmental sensors to ensure optimal water quality. The research includes several components: first, identifying a device capable of measuring and monitoring various parameters affecting fish growth; second, implementing a time-based and sensor-based feeding system to manage fish nutrition; and third, utilizing IoT to collect, store, and analyze data for continuous water quality monitoring. The Pacific Paradise Aqua Farm in Barangay Dinahican, Infanta, was used as a case study to explore the effectiveness of the proposed system, aiming to streamline and improve aquaculture operations. The study also seeks to enhance the accessibility and convenience of aquaculture practices by providing fishermen with a systematic monitoring device that informs them of necessary actions to improve water quality and fish health. The system's ability to notify users of issues in real-time is intended to improve the efficiency and effectiveness of aquaculture farming. Through this research, the study emphasizes the importance of IoT in the future of the Philippine aquaculture industry, promoting the development of urban agriculture and offering small and medium-sized fish farmers the opportunity to benefit from cutting-edge technologies. Ultimately, the study aims to support aquaculture sustainability and ensure that fish farming operations in Infanta are more resilient and profitable, enhancing both productivity and the livelihoods of local fish farmers.

## II. LITERATURE SURVEY

**A. Karim, S., Hussain, I., Hussain, A., Hassan, K., & Iqbal, S. (2021). IoT Based Smart Fish Farming Aquaculture Monitoring System. International Journal on Emerging Technologies, 12(2), 45–53.**

The paper by Karim et al. (2021) presents an IoT-based smart fish farming aquaculture monitoring system aimed at improving the efficiency and sustainability of fish farming operations. The study highlights the increasing importance of integrating technology into aquaculture to address common challenges such as water quality monitoring, resource management, and optimizing feeding strategies. The authors emphasize the role of the Internet of Things (IoT) in automating the monitoring of environmental parameters in fish farming, including water temperature, pH, turbidity, and dissolved oxygen levels. These parameters are crucial for ensuring the health and growth of fish, as improper water quality can lead to diseases and lower production rates. By leveraging IoT, the system continuously collects data from various sensors deployed in the fish tanks and transmits it to a central control unit. The collected data is then processed and analyzed, allowing fish farmers to monitor the conditions of their farms in real-time and make informed decisions. The integration of this system enhances operational efficiency, reduces manual labor, and provides farmers with insights into the overall performance of their aquaculture operations. The study also discusses the implementation of a mobile application that provides fish farmers with a user-friendly interface to access real-time data and receive alerts when any parameter goes beyond the pre-set threshold values. This enables prompt intervention, thereby preventing potential issues that could lead to crop losses or reduced fish health. The system also features automated feeding mechanisms that are triggered based on water quality readings, further optimizing resource usage and improving feed conversion rates. The research highlights the benefits of IoT-based monitoring systems in the context of sustainable aquaculture, as it allows for precise control of the farming environment while reducing waste and energy consumption. The study concludes by suggesting that the adoption of IoT technologies in aquaculture can play a pivotal role in enhancing the productivity and sustainability of the industry. By providing fish farmers with accurate, real-time data and automated systems, this approach has the potential to transform the way aquaculture operations are managed, making them more efficient, environmentally friendly, and cost-effective.

**B. Banjao, J. P. P., Villafuerte, K. S., & Villaverde, J. F. (2020, December 3). Development of Cloud-Based Monitoring of Abiotic Factors in Aquaponics using ESP32 and Internet of Things. 2020 IEEE 12th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management, HNICEM 2020.**

The paper by Banjao, Villafuerte, and Villaverde (2020) explores the development of a cloud-based monitoring system for abiotic factors in aquaponics using the ESP32 microcontroller and Internet of Things (IoT) technologies. Aquaponics, a sustainable farming method that integrates aquaculture and hydroponics, requires precise monitoring and control of environmental factors like pH, temperature, humidity, and nutrient levels to ensure optimal growth conditions for both plants and fish. The authors address the need for real-time, continuous monitoring of these factors in aquaponics systems, which can be complex due to the dynamic interactions between water quality, plant health, and fish well-being. They propose the use of the ESP32 microcontroller, which is equipped with Wi-Fi and Bluetooth capabilities, making it an ideal solution for IoT-based applications. This device collects data from various environmental sensors and transmits the information to a cloud-based platform for analysis and visualization. The system enables users to monitor and manage the aquaponics system remotely, which significantly enhances its efficiency and ease of operation. The cloud-based monitoring solution provides users with access to real-time data through a web interface or mobile application, allowing for prompt adjustments to the system when necessary. The system's ability to alert users to any deviations from desired environmental conditions further adds to its effectiveness in maintaining optimal growing conditions. Additionally, the paper discusses how integrating IoT technologies into aquaponics can help automate various processes, such as adjusting water pumps or controlling nutrient delivery, based on real-time sensor readings. This not only reduces the manual effort required for system management but also improves the overall sustainability of aquaponics farming. In conclusion, the research highlights the advantages of utilizing cloud-based IoT solutions for efficient aquaponics system management, offering a promising approach for modernizing agriculture and enhancing food production systems.

**C. Saha, S., Rajib, R. H., & Kabir, S. (2018). IoT Based Automated Fish Farm Aquaculture Monitoring System. 2018 International Conference on Innovations in Science, Engineering and Technology, ICISET 2018, 201– 206.**

In the paper by Saha, Rajib, and Kabir (2018), the authors present an IoT-based automated fish farm aquaculture monitoring system designed to improve the efficiency and sustainability of fish farming operations. The system incorporates various sensors to monitor key environmental factors in real-time, such as water temperature, pH levels, dissolved oxygen (DO), and turbidity, which are crucial for maintaining a healthy environment for fish growth. By continuously collecting data from these sensors, the system enables farmers to remotely monitor and manage their aquaculture systems, thus reducing the need for frequent manual inspections. The integration of IoT technologies ensures that the system can transmit the collected data to a cloud platform, where it can be visualized and analyzed by the farmer. This approach allows for immediate intervention when abnormal conditions are detected, helping to prevent potential problems such as oxygen depletion or water contamination that could negatively impact fish health. The system is built using a combination of sensors, microcontrollers, and wireless communication modules to provide real-time data to users via an intuitive interface. The authors also highlight the automation aspect of the system, where actions such as controlling water pumps, feeding fish, or adjusting aeration systems can be automatically triggered based on predefined conditions or sensor inputs. This level of automation helps optimize resource use, such as minimizing feed wastage and ensuring the right water quality parameters are maintained consistently. The proposed system also incorporates an alert mechanism that notifies farmers of any critical issues, allowing for quick response and minimizing the risk of significant losses. In conclusion, the paper demonstrates how IoT and automation can revolutionize the aquaculture industry by providing more precise control over farm conditions, improving productivity, and contributing to the sustainability of fish farming practices.

## III.IMPLEMENTATION

## BLOCK DIAGRAM

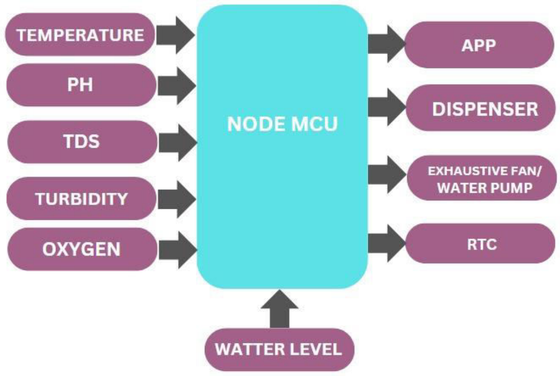


**Fig : Block Diagram**

## PH SCALE

A pH meter is a scientific instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or basicity expressed as pH.[2] The pH meter measures the difference in electrical potential between a pH electrode and a reference electrode, and so the pH meter is sometimes referred to as a "potentiometric pH meter". The difference in electrical potential relates to the acidity or pH of the solution.[3] The pH meter is used in many applications ranging from laboratory experimentation to quality control

## APPLICATIONS

The rate and outcome of chemical reactions taking place in water often depends on the acidity of the water, and it is therefore useful to know the acidity of the water, typically measured by means of a pH meter.[5] Knowledge of pH is useful or critical in many situations, including chemical laboratory analyses. pH meters are used for soil measurements in agriculture, water quality for municipal water supplies, swimming pools, environmental remediation; brewing of wine or beer; manufacturing, healthcare and clinical applications such as blood chemistry; and many other applications.Advances in the instrumentation and in detection have expanded the number of applications in which pH measurements can be conducted. The devices have been miniaturized, enabling direct measurement of pH inside of living cells.[6] In addition to measuring the pH of liquids, specially designed electrodes are available to measure the pH of semi-solid substances, such as foods. These have tips suitable for piercing semi-solids, have electrode materials compatible with ingredients in food, and are resistant to clogging

**ANALOG TDS SENSOR WATER CONDUCTIVITY**

Analog TDS Sensor Water Conductivity Sensor Module Board Kit is an Arduino-compatible TDS sensor/Meter Kit for measuring TDS value of the water. It can be applied to domestic water, hydroponic and other fields of water quality testing. This TDS sensor Arduino compatible supports 3.3 ~ 5.5V wide voltage input, and 0 ~ 2.3V analog voltage output, which makes it compatible with 5V or 3.3V control systems or boards. TDS sensor kit is compatible with Arduino controllers, plug and play, easy to use.

It can be applied to measure TDS value of the water, to reflect the cleanliness of the water. TDS (Total Dissolved Solids) indicates that how many milligrams of soluble solids dissolved in one liter of water. In general, the higher the TDS value, the more soluble solids dissolved in water, and the less clean the water is. Therefore, the TDS value can be used as one of the references for reflecting the cleanliness of water.

Measuring the TDS value in the water is to measure the total amount of various organic or inorganic substances dissolved in water, in the unit of ppm or milligrams per liter (mg/l). Its Electrode can measure conductive materials, such as suspended solids, heavy metals and conductive ions in water. The module comes with four 3.2mm fixed holes, easy to mount on any other devices. The TDS probe is waterproof, it can be immersed in water for long time measurement.

**DS380 FLUORESCENT DISSOLVED OXYGEN SENSOR**

Description:

DS380 series of fluorescent **dissolved oxygen sensors** use a new generation of fluorescence lifetime technology and high-performance fluorescent materials. No oxygen consumption, No flow rate limitation, no electrolyte, no maintenance and calibration, no interference from hydrogen sulfide, and excellent stability. Built-in temperature sensor, automatic temperature compensation. An RS485 output can be networked without a controller.

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ISSN: 2457-0362


**Fig: Disolved Oxyden sensor**

Features of Dissolved Oxygen Sensor:

1. **DO** Sensor, RS485 output, supports MODBUS, which can realize networking and system integration without a controller.
2. There is no electrolyte, no interference, and no need for frequent calibration.
3. No oxygen consumption, no flow rate limit.
4. **Built-in temperature sensor**, automatic temperature compensation.
5. The water filter membrane, will not be attached to pollutants in the water.
6. Good stability, high measurement accuracy, and fast response

**RPI –PICO**

A Raspberry Pi Pico is a low-cost microcontroller device. Microcontrollers are tiny computers, but they tend to lack large volume storage and peripheral devices that you can plug in (for example, keyboards or monitors).

A Raspberry Pi Pico has GPIO pins, much like a Raspberry Pi computer, which means it can be used to control and receive input from a variety of electronic devices

Raspberry Pi Foundation is well known for its series of single-board computers (Raspberry Pi series). But in **January 2021 they launched their first micro-controller board known as Raspberry Pi Pico**.

It is built around **the RP2040 Soc, a very fast yet cost-effective microcontroller chip packed with a dual-core ARM Cortex-M0+ processor.** M0+ is one of the most power-efficient ARM processorRaspberry Pi PICO board

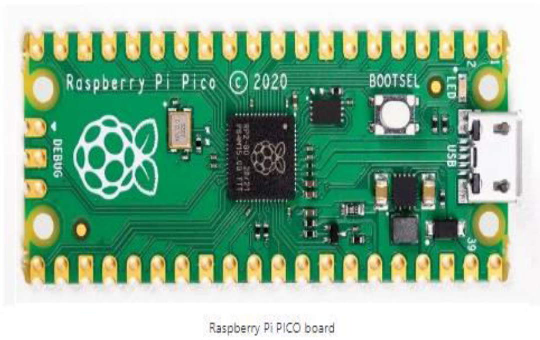


Fig: Raspberry Pi Pico Board

Raspberry **Pi Pico is a small, fast, and versatile board that at its heart consists of RP2040**, a brand-new product launched by Raspberry Foundation in the UK. It can be programmed using MicroPython or C language.

**IV.DESCRIPTION**

The paper titled *Application of Cloud-based Monitoring and Feeding System for Smart Aquaculture Farming* focuses on the development of a comprehensive cloud-based monitoring and feeding system designed to enhance the management of aquaculture farms through automation and real-time data monitoring. As the demand for sustainable and efficient food production rises, especially in the aquaculture industry, the paper highlights the need for advanced technology to optimize resource utilization, ensure the health of aquatic species, and improve overall farm productivity. The proposed system integrates a range of environmental sensors, including those for measuring water temperature, pH levels, turbidity, dissolved oxygen, and salinity, which are critical for maintaining optimal conditions in aquaculture farms. These sensors collect data in real-time and send it to a centralized cloud platform, enabling farmers to access the information remotely through an application or web interface. By utilizing the cloud, the system allows for constant monitoring of water quality, which is vital for the health and growth of fish or shrimp, while providing immediate alerts when parameters fall outside safe ranges. The cloud-based system also provides a historical data repository that farmers can analyze to make informed decisions about their farming operations. In addition to water quality monitoring, the system includes an automated fish feeder, which is connected to the cloud and can be controlled remotely. The automated feeding mechanism ensures that fish receive the right amount of feed at the right time, reducing waste and preventing overfeeding, which can lead to water pollution and increased operational costs. The feeding system is synchronized with sensor data, ensuring that feeding times and quantities are adjusted based on real-time environmental conditions. One of the significant advantages of the system is its scalability and flexibility. It can be deployed in various types of aquaculture environments, whether freshwater or marine, and adapted to different sizes of farms. The paper also discusses how the integration of cloud computing and Internet of Things (IoT) technologies provides a scalable, cost-effective solution for small to medium-sized farms that may not have access to advanced monitoring systems. The cloud-based nature of the system ensures that the data is securely stored and accessible from any location, allowing farm managers and owners to remotely track performance, troubleshoot issues, and make operational adjustments without being physically present on-site. Furthermore, the system's cloud interface enables multiple stakeholders, including farmers, researchers, and regulatory authorities, to collaborate and share valuable data for better decision-making. In the future, the paper suggests that the system could be enhanced with additional features such as integration with machine learning algorithms for predictive analysis, where the system can not only monitor but also forecast future trends in water quality and fish health. This will allow farmers to take preemptive actions before problems arise, further improving the efficiency and sustainability of aquaculture operations. Additionally, the use of artificial intelligence (AI) could help in automating routine maintenance tasks, making the system even more autonomous and efficient. Overall, the proposed cloud-based monitoring and feeding system promises to revolutionize aquaculture farming by providing real-time data insights, improving resource management, enhancing productivity, and supporting sustainable farming practices, ultimately contributing to the growth of the global aquaculture industry.

## CONCLUSION

In conclusion, the researchers successfully developed a prototype that incorporates a variety of technological components, offering a significant advancement in the management of fishponds in aquaculture settings. The main instrument utilized in the experiment is an ESP32 microcontroller, chosen for its versatility, reliability, and convenience in handling various sensor inputs and controlling the connected systems. The researchers incorporated a range of sensors—turbidity, pH, float switch, dissolved oxygen, temperature, and total dissolved solids (TDS)—all of which play a vital role in monitoring the health of the fishpond environment. These sensors, when combined with the smart feeder feature, enable more efficient and automated management of fish farms, ensuring the water quality remains optimal for fish growth. The integration of the Blynk app into the system allows for remote monitoring, enabling farm managers to stay updated on critical water quality parameters. The app notifies users in real time if any of the water quality metrics fall outside safe thresholds, providing alerts that are crucial for taking timely action. The AQUANTA monitoring system demonstrated the sensors' ability to continuously track important environmental variables and their effectiveness in alerting the user to potential dangers. Furthermore, the system was designed with the capability to send real-time notifications to the user's mobile device, ensuring quick responses to any adverse conditions in the fishpond. The researchers also used Python programming, integrated with the Arduino IDE, to develop the code that facilitates communication between the sensors, microcontroller, and app, ensuring smooth operation of the system. The results of the study indicate that the addition of the smart fish feeder actuator contributed significantly to the system's effectiveness by regulating the feeding process based on real-time data, reducing waste, and promoting healthier fish growth. The data collected from the sensors was found to be highly accurate, and the ongoing notifications provided by the Blynk application were crucial in improving the overall management of the fishponds. As a result, the system led to a noticeable increase in fish growth, highlighting its potential for improving aquaculture practices. The researchers also concluded that the prototype is both reliable and precise, effectively alerting users to any issues with the water quality while ensuring accurate sensor data acquisition. The success of the system in both monitoring water quality and managing feeding practices shows great promise for its implementation in real-world fish farms, potentially contributing to more sustainable and efficient aquaculture operations. Moving forward, the researchers suggest that future improvements could focus on enhancing the system's scalability, adding more sensors for a broader range of environmental factors, and further refining the user interface for easier interaction with the system. Ultimately, the study underscores the potential of IoT and cloud-based technologies in transforming fish farming practices, making them more efficient, cost-effective, and sustainable in the face of growing global food demands.

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