

IOT-BASED UNDERWATER ECOSYSTEM FOR PISCICULTURE MONITORING SYSTEM

K.Sree Akarsh

SATHYABAMA INSTITUTE OF
SCIENCE AND TECHNOLOGY
Chennai
sreeakarshkommaddi@gmail.com

K. Krishna Prasad

SATHYABAMA INSTITUTE OF
SCIENCE AND TECHNOLOGY
Chennai
Krishnaprasadkrishna333@gmail.com

Dr. Naresh Kumar Thapa

Assistant Professor
SATHYABAMA INSTITUTE OF
SCIENCE AND TECHNOLOGY
Chennai
k.nareshkumarthapa@gmail.com

Abstract— The sustainability and productivity of pisciculture are significantly influenced by water quality, as it directly impacts fish health, growth rates, and overall aquatic ecosystem balance. This paper presents the design and implementation of an Internet of Things (IoT)-based water monitoring system aimed at enhancing the management and optimization of water conditions in pisciculture. The proposed system utilizes a network of sensors to continuously monitor key parameters such as pH, temperature, and Turbidity in real time. These parameters serve as critical indicators of water quality, and their fluctuations can lead to adverse effects on fish health and yield. By integrating IoT technology, the system enables seamless data processing and analysis, allowing fish farmers to make informed and proactive decisions. Pisciculture plays a significant role in the aquaculture industry, requiring precise environmental monitoring to ensure optimal fish growth and yield. This paper presents an IoT-based monitoring system integrating various sensors to measure critical water parameters such as Temperature, pH, Turbidity, Ammonia and Total dissolved solids (TDS). The system leverages Arduino Uno for data processing and GSM technology for cloud communication, enabling real-time monitoring and control through a mobile application. The proposed system ensures optimal water quality conditions, reducing fish mortality and improving yield efficiency. The implementation includes cloud-based data storage and real-time alert mechanisms that notify users of any deviations from optimal water conditions, thereby minimizing risks associated with water quality deterioration. The results demonstrate the system's capability to maintain water quality within optimal thresholds, reducing the likelihood of fish mortality and improving overall operational efficiency.

Keywords—Ammonia sensor, Pisciculture, Sensors, GSM technology, Real-time Data Processing, Motor

I. INTRODUCTION

This pisciculture or fish cultivating, is a training that has turned out to be progressively well known as a method for creating food economically as fishing from ocean is far away from the cutoff points. One of the essential worries in pisciculture is the water quality. Unfortunate water quality can prompt infection episodes and stress in fish populaces, as well as effect the development and endurance of the fish. Congestion can worsen this issue, as it can prompt unfortunate water quality and sickness flare-ups [5]. It is one more to Take care of fish challenge in pisciculture. Giving the perfect sum and kind of food can be a test, as overloading can lead to abundance supplements in the water, while depriving can bring about malnourished fish [6]. Illness flare-ups are

moreover a main issue in fish cultivation. Fish are vulnerable to a scope of illnesses, and when they are brought up in close quarters, infection episodes can immediately spread all through a populace. Natural effect is one more issue to be thought of. The arrival of abundance supplements and waste from fish homesteads can affect water quality in encompassing environments, and got away from fish can likewise influence wild populaces by presenting illness for assets. By and large, fruitful pisciculture requires cautious the board to guarantee ideal water quality, sustenance, what's more, infectious prevention, as well as thought of natural effect and monetary dangers [8]. While there are difficulties engaged with fish cultivating, it tends to be a supportable and beneficial method for creating food when overseen appropriately [9]. The Information assortment and observing are fundamental for fruitful pisciculture, gathering and breaking down information on different part of fish cultivating, ranchers can settle on informed choices that work on the wellbeing and development of their fish increment efficiency, and decrease the time taken to get lab reports. One of the principal advantages of information assortment and checking is the capacity to follow water quality. Likewise, information assortment can support illness anticipation also, control. By checking fish wellbeing and conduct, ranchers can distinguish early indications of illness flare-ups and make a move to forestall the spread of sickness. Information on illness frequency and death rates can likewise help ranchers arrive at informed conclusions about illness the board procedures. At last, information assortment can help ranchers enhance creation and diminish costs. By following development rates, feed transformation rates and mortality rates, ranchers can distinguish regions for development and change their administration practices to increment productivity. The Information utilized were taken from fisheries by recording the upsides of each variety of fish suggested by the legislature of India for the business development of fishes for utilization. For each type of fish, the ideal states of development differ in like manner to their particular needs. The Data used were taken from fisheries by recording the values of each breed of fish recommended by the government of India for the commercial growth of fishes for consumption. For each breed of fish, the optimal growth conditions vary accordingly to their specific needs. By and large, IoT-based submerged environment observing frameworks address a critical headway in hydroponics innovation. By upgrading ongoing observing, streamlining asset use, and empowering proactive administration, these frameworks work on the proficiency, supportability, and

efficiency of fish cultivating tasks. As IoT innovation keeps on developing, its effect on pisciculture is ready to develop, driving further advancements and enhancements in the business. The Data used were taken from fisheries by recording the values of each breed of fish recommended by the government of India for the commercial growth of fishes for consumption.

II. LITERATURE SURVEY

Fish farming, also known as pisciculture, has emerged as a crucial component of aquaculture, offering a sustainable way to satisfy the growing need for fish. But preserving the ideal undersea environment for fish growth is a difficult undertaking that calls for constant environmental parameter monitoring and control. Fish health and growth rates can be negatively impacted by changes in water quality, which include temperature, pH, turbidity. Manual supervision is a major component of traditional fish farming techniques, which is time-consuming intensive, and prone to human mistake. Aquaculture has gone through a revolution owing to the Internet of Things (IoT), which has made it possible to automate water quality management and monitor conditions in real time. IoT-based systems use cloud-based platforms for data processing, analysis, and alarm production, and they use a variety of sensors to gather information on important environmental parameters. This study offers an integrated approach to preserving an ideal underwater habitat and reviews the literature on current developments in IoT-based pisciculture monitoring systems. Studies by Jayasree et al. (2019) and Venkatesh et al. (2020) demonstrated the way IoT devices associated with wireless communication modules such as Zigbee, LoRa WAN, and GSM are used for transmitting data to cloud platforms, and thus enabling remote monitoring and control through mobile applications. These systems not only allow fish growers keep an eye on water conditions but also provide quick alerts when values surpass safe limits, so helping to prevent diseases and mass fish death. A research study by Saha et al. (2018) demonstrated the ease with which low-cost sensor nodes and cloud-based analytics combine to predict declines in water quality and offer useful information. Long-range communication systems like LoRa have also been used to address environmental factors and wireless signal attenuation challenges in underwater monitoring, as suggested by Ahmed et al. (2021), making these systems more reliable in addition to cost-effective. By reducing resource wastage and maintaining ecological balance, these smart monitoring systems contribute to preserving the environment, so it helps fish health, yield, and farmer profitability. In general, the literature highlights the importance of IoT-based underwater ecosystem monitoring systems for pisciculture advancement, offering a sustainable, automated, and efficient solution for modern aquaculture management.

III. METHODOLOGY

Fig. 1 shows the work process chart, which shows how the suggested system operates. To detect vital characteristics that are crucial for fish growth, a variety of sensors are used, such as the Ammonia Sensor, Turbidity Sensor, and TDS (Total Dissolved Solids) Sensor. These variables include turbidity, dissolved solids, temperature, and pH level. Among these, temperature, pH, and dissolved oxygen are particularly crucial for fish development because even little variations in these factors can result in stunted growth or higher mortality rates. These characteristics must be continuously monitored and controlled because even slight changes can have a big impact on the yield's quality and quantity. Constant

monitoring is required to maintain ideal water conditions and lessen the negative impact of environmental changes on fish growth. Specialized sensors for temperature, turbidity, dissolved solids, and pH are used to collect data. The temperature and pH sensors are made up of waterproof probes that can identify changes in the water's characteristics. Turbidity sensors are employed to acquire accurate readings of dissolved solids. Since these sensors work in a damp environment, the right measures must be taken to avoid malfunctions brought on by moisture and humidity.

Architecture of the System:

The suggested system uses the number of sensors to keep an eye in the quality of the water, an Arduino microcontroller to process data, and GSM connectivity to send data to the cloud. Fig.1 shows a flowchart depicting the operation flow of the system.

A. Sensor Module

The sensor module includes Ammonia, Temperature, TDS, Turbidity and pH sensors. These sensors provide data to the Arduino Uno for processing after continuously measuring various aspects of water quality.

B. Information Processing

After processing sensor data, the Arduino microcontroller decides if the measured values are within allowable bounds. The system takes the necessary remedial action if the parameters diverge from safe bounds.

C. Actuation and Decision Making

The system verifies the sensors values as illustrated in the flowchart (*Fig.1*):

The values are shown on an LCD screen if the water quality is normal. Corrective actions, such turning on water motor to regulate water flow, are initiated if anomalies are found. The GSM module simultaneously transmits real-time data to the cloud for remotes access.

D. Cloud-Based Monitoring and Alerts

Users of the Think View program can monitor in real time and receive warnings when there are significant deviations in certain parameters. Remote access to water quality data allows for the prompt intervention

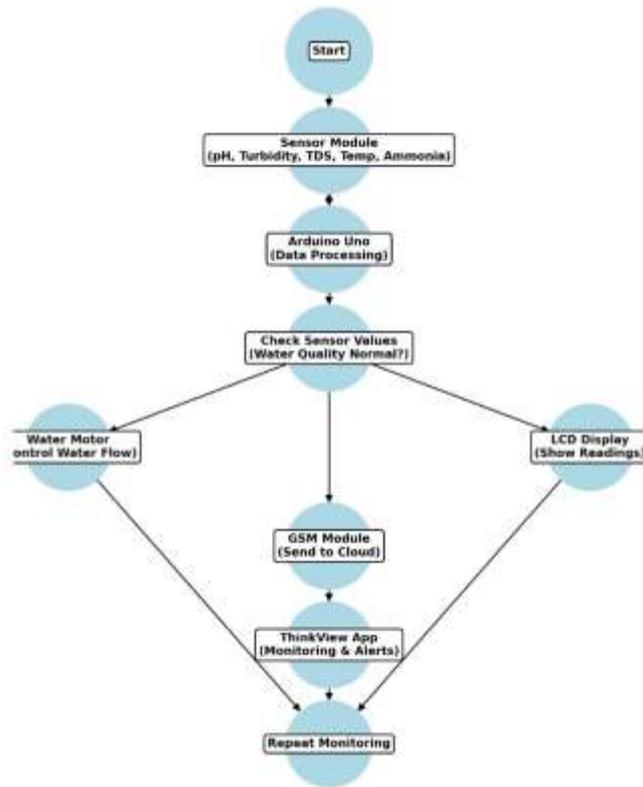
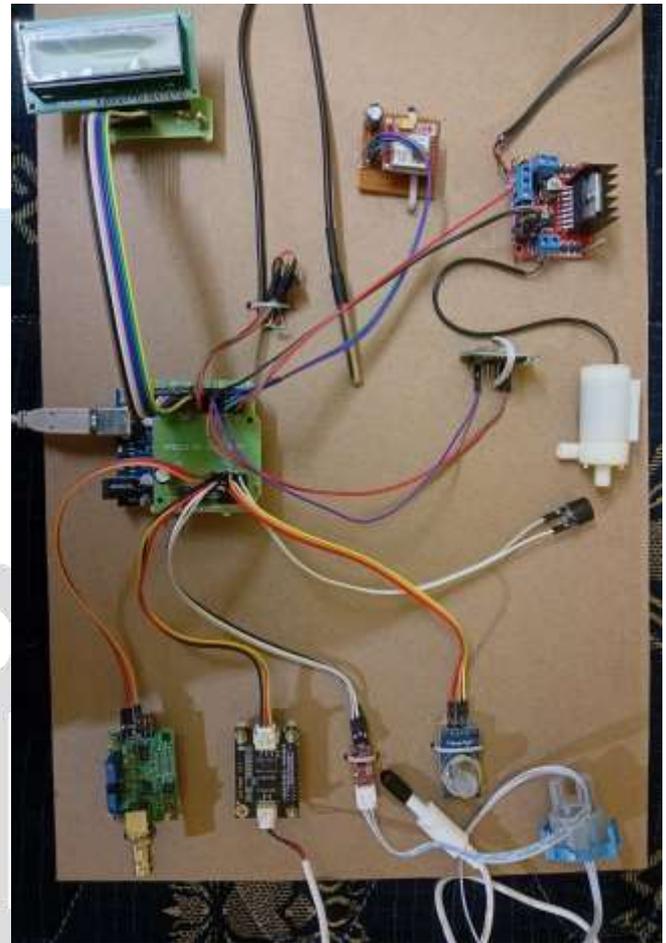


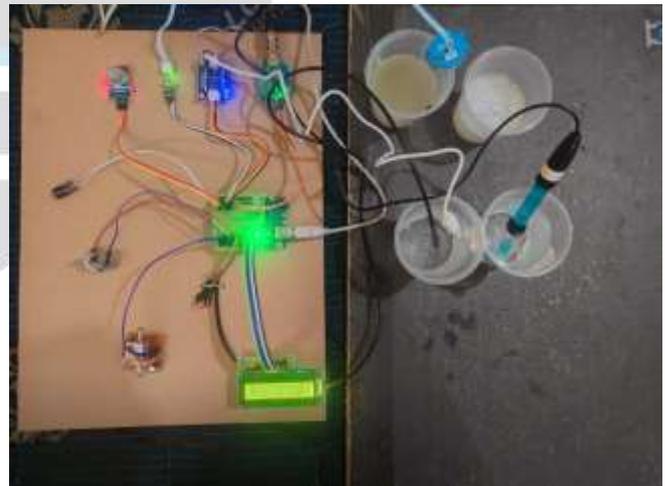
fig. 1 Work process Diagram.

Working of the System:

A sensor module consists of pH, turbidity, TDS, temperature, and ammonia sensors is used to continuously monitor the water quality at the start of the Internet of Things-based pisciculture monitoring system. These sensors are immersed in the water tank or fish pond, gathering data in real time about the water conditions that are essential for the growth of healthy fish. The Arduino Uno microcontroller, the system's central processing unit, receives all of the raw data from these sensors. Processing the incoming data, the Arduino determines whether each parameter falls within the specified safe range required for fish survival. The system decides what to do next after analyzing the sensor values. The readings are shown on an LCD screen, giving the user immediate visibility of the water condition, if all the parameters are normal. In order to facilitate remote access and monitoring, the Arduino simultaneously transmits the data to the cloud via a GSM module. The information is sent to the cloud-based Think View App, which enables fish farmers to monitor water quality remotely and get immediate notifications when any parameter deviates from acceptable bounds. The Arduino automatically turns on a water motor that is connected to a filtration or aeration system if the system determines that any of the water parameters—such as elevated turbidity, dangerous TDS, or high ammonia levels—are outside of the permitted range. The automation of the system is exemplified by this motorized operation, which starts remedial processes like raising oxygen levels or cleaning the water without human involvement. Following completion of the required Fish farming is made more efficient and sustainable by this automated cycle, which also minimizes human labor and prevents fish mortality while offering constant, real-time monitoring of the underwater ecosystem.



Connection with some samples:



IV. RESULTS AND DISCUSSIONS

Some samples of cloud-based application
 (THINK VIEW):

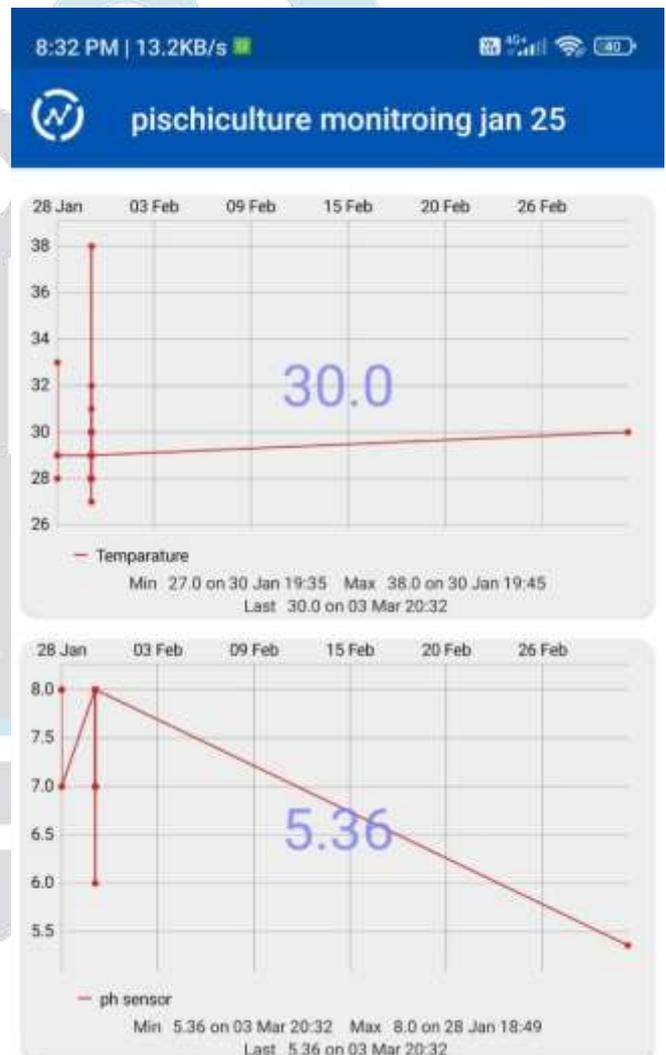


TDS (TOTAL DISSOLVED SOLIDS) analysis -

1. Last value recorded is 0.0 ppm.
2. A TDS of 0.0 ppm is unusual and could indicate a sign of an isolated or malfunctioning sensor.
3. 300 to 500 ppm is the ideal TDS range for pisciculture.

Ammonia analysis -

1. Last value recorded is 25.0 ppm.
2. Fish are highly toxic to ammonia, and even small amount can be harmful.
3. For fish safety, the ideal ammonia level is less than 0.02ppm.



Since, the above picture represents the attained values of the various sensors such as Turbidity sensor, TDS sensor and Ammonia sensor used for monitoring the pisciculture system. These parameters are crucial for maintaining a healthy aquatic environment and ensuring the growth and survival of fish stock. Here, we have another picture the remaining sensors such as Temperature sensor and pH sensor used for monitoring the pisciculture system.

In-Detailed sensory analysis:

Turbidity analysis -

1. Last value recorded is 32.0 NTU.
2. The observed range is 23.0 to 51.0 NTU.
3. Although turbidity is at a moderate level, it needs to be analyzed, considering levels above 50 NTU

Temperature Analysis -

1. Last value recorded is 30.0°C. The observed temperatures stretch in between 27.0°C to 38.0°C.
2. Many fish species can safely deal with the current temperature.
3. The fish might have been stressed by a peak temperature of 38.0°C.

pH Level Analysis –

1. Last value recorded is 5.36. The observed range is 5.36 to 8.0.
2. The water is now acidic because of a sudden drop in pH level.
3. Fish opt for a pH range of 6.5 to 8.5.

Overall Conclusion –

Thus, all sensory modules perform their respective operation in order to maintain the good and healthy aquatic environment for the proper fish growth and stock, and provides a better functional progress for the monitoring system.

V. CONCLUSION

Our project is a fast, secure, portable, easily accessible application providing services for the farmers with basic requirement of knowledge and training about the application, guiding to use this application effectively and efficiently. A key advancement in automating water quality management in fish farming is the Internet of Things-based Underwater Ecosystem for Pisciculture Monitoring System. Through a cloud-connected application, the system provides real-time monitoring and quick informs through the integration of ammonia, temperature, turbidity, and TDS sensors with an Arduino microcontroller. The flowchart demonstrates an efficient process that ensures optimal aquatic health by initiating automatic actions such as motorized filtration or aeration in reaction to abnormal water conditions. The system's capacity to identify crucial parameters and preserve a steady environment is strengthened by the graphical data.

This approach boosts overall productivity and fish survival rates while lowering manual intervention. In addition, it facilitates quick corrections which support sustainable aquaculture practices. All things looked at, the project showcases a reliable and successful approach to contemporary pisciculture management. This system's continuous water quality monitoring helps avoid unexpected fish deaths brought on by harmful substances or unfavorable water conditions. The Think View app allows farmers to access data remotely, which makes the system convenient and always available. By eliminating the need for continual manual supervision and labor costs, automation frees up fish farmers to concentrate on other areas of their business. This project is a significant contribution to smart aquaculture and the future of sustainable fish farming because it not only increases efficiency but also maintains environmental balance

13) **Li, Y., et al. (2022).** Smart Aquaculture Monitoring System Using IoT and AI. *International Journal of Distributed Sensor Networks*, 18(3), 1-11.

14) **Sharma, A. & Jasuja, A. (2018).** A Survey on Smart Water Quality Monitoring System Using IoT. *International Journal of Computer Applications*, 179(7), 8-11.

REFERENCES

- 1) **Bharathi, M. & Rani, T. S. (2020).** IoT based Smart Aquaculture Monitoring System. *International Journal of Engineering Research & Technology (IJERT)*, Vol. 9 Issue 6.
- 2) **Huang, H., & Lu, D. (2018).** IoT-based Real-time Monitoring System for Aquaculture Water Quality. *Procedia Computer Science*, 131, 1032–1038.
- 3) **Nayak, P., & Mishra, D. (2020).** IoT Based Automated Fish Farming System. *International Journal of Scientific & Technology Research (IJSTR)*, Volume 9, Issue 4.
- 4) **Prabakaran, K., & Sundararajan, V. (2017).** Monitoring water quality using IoT and wireless sensor networks. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, 2(1), 2456-3307.
- 5) **Ravindra, S. S., & Raghunandan, H. N. (2021).** Smart Water Quality Monitoring System for Aquaculture Using IoT. *International Journal of Engineering Research & Technology (IJERT)*, Vol. 10 Issue 02.
- 6) **Wu, X., et al. (2019).** Design of Water Quality Monitoring System for Aquaculture Based on IoT. *IOP Conference Series: Earth and Environmental Science*.
- 7) **M. Ahmed, M. Arif, & M. Hossain (2020).** IoT based Smart Aquaculture Monitoring System Using Arduino. *International Journal of Advanced Computer Science and Applications (IJACSA)*, Vol. 11, No. 2.
- 8) **Palanivel, K., & Somasundaram, K. (2017).** Design and Development of Automatic Water Quality Monitoring System for Aquaculture Using Raspberry Pi. *Measurement*, 119, 93-100.
- 9) **Cao, H., et al. (2019).** Wireless Sensor Networks for Water Quality Monitoring. *International Journal of Distributed Sensor Networks*, 15(9).
- 10) **Jayanthi, P., et al. (2018).** Real-time Monitoring of Water Quality Parameters for Aquaculture Using IoT. *International Journal of Pure and Applied Mathematics*, Volume 118, No. 24.
- 11) **FAO (2018).** The State of World Fisheries and Aquaculture 2018. *Food and Agriculture Organization of the United Nations*.
- 12) **Pani, S. K., et al. (2021).** Water Quality Monitoring System Using IoT for Fish Farming. *Materials Today: Proceedings*, Elsevier.