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IoT Based Water Pollution Monitoring RC Boat

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Abstract: *The Water pollution poses a serious threat to aquatic ecosystems and human health, necessitating effective real time monitoring solutions. This project presents an IoT-based water pollution monitoring system integrated into a remote controlled (RC) boat, designed to collect and analyse water quality data from various water bodies. The boat is equipped with sensors to measure key parameters such as pH, turbidity, temperature, and dissolved oxygen levels. The collected data is transmitted wirelessly to a cloud platform via IoT modules, allowing for real-time monitoring, data logging, and remote access. This mobile and cost-effective solution enhances the accessibility of water quality monitoring, particularly in hard- to-reach or hazardous areas. The system can assist environmental agencies and researchers in making data-driven decisions to address water pollution challenges*

Keywords: IoT, Water Pollution, RC Boat, Real-Time Monitoring, Water Quality Sensors, pH, Turbidity, Dissolved Oxygen, Environmental Monitoring, Smart Water System

I. INTRODUCTION

Water pollution is a major global issue that threatens the environment, human health, and entire ecosystems. As industrialization and urban growth continue to accelerate, the problem is becoming more severe, highlighting the urgent need for effective and innovative solutions. One promising approach to tackling this challenge is the "IoT-based Water Pollution Monitoring RC Boat" project. The core idea behind this project is to combine Internet of Things (IoT) technology with a remote-controlled boat to monitor water quality in real time. This approach not only offers a modern and efficient alternative to traditional methods but also enhances the ability to detect pollution early and respond quickly. Using RC boats makes it easy to access and monitor large bodies of water like lakes, rivers, and reservoirs. By equipping these boats with sensors, the system can collect critical data on water parameters such as temperature, pH levels, and turbidity. These parameters are key indicators of water quality and are essential for understanding the health of aquatic environments.

Traditionally, water quality monitoring has involved collecting water samples manually and sending them to labs for analysis. While effective to some extent, this process is slow, resource-heavy, and limited in coverage. It also depends heavily on human effort, which can lead to delays and inconsistencies in results. Moreover, older equipment and time-consuming procedures can impact the accuracy and timeliness of the findings. This is where sensors come in as a powerful solution. Sensors can instantly convert environmental conditions into electrical signals, which can be processed and transmitted in real time. They are known for their high sensitivity, fast response times, and reliability. Because of these features, sensors are perfect for continuous, automated monitoring of water quality. To make this system even more efficient, it uses GSM- based communication via SMS to send realtime data to a central monitoring system or user interface. This enables remote monitoring, making it easier to track pollution levels without the need for physical sample collection or on-site analysis.

Overall, the project not only introduces a smart way to monitor water quality but also encourages awareness about environmental protection and the role of technology in solving realworld problems. By implementing automation, remote sensing, and networked communication, the system saves time, manpower, and costs — all while offering faster and more accurate pollution tracking. This innovative solution is a step forward in using technology to support sustainable development and environmental conservation.

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II. LITERATURE REVIEW

The IoT-enabled RC boat for water pollution monitoring is an intelligent and mobile system developed to evaluate water quality in real time. It is equipped with sensors that can detect key parameters such as pH, turbidity, TDS (Total Dissolved Solids), and others. The collected data is transmitted wirelessly to a cloud server or mobile device, allowing users to monitor conditions remotely. This technology is especially useful for environmental studies and is ideal for detecting pollution in areas that are difficult to access manually.

Recent technological advancements have brought forth innovative approaches to monitor water quality in real time, especially through the integration of IoT with remote-controlled (RC) boats. One of the early studies in this area, published in the International Journal of Advanced Research in Science, Communication and Technology, proposed a system where a remote controlled boat is equipped with pH and turbidity sensors to monitor lakes and reservoirs. The system also integrates GPS tracking and IoT-based data transmission, offering effective coverage of large water bodies and timely pollution detection (IJARSCT, 2022) [1]. Building upon similar goals, a paper on ResearchGate introduced an autonomous water- monitoring boat that supports both manual and automatic operation. It focuses on key water parameters like temperature, turbidity, and pH, and leverages IoT to transmit real-time data for immediate analysis, which is crucial for quick decision- making during pollution events (ResearchGate, 2023) [2]. In another significant contribution, the International Journal for Research in Applied Science & Engineering Technology discussed the development of a smart IoT-based monitoring system. This RC boat collects water data—specifically temperature, pH, and turbidity—and uploads it to a cloud platform for seamless, remote monitoring and analysis. The aim is to provide a scalable and efficient solution for managing water quality across wide geographic areas (IJRASET, 2022) [3].

The integration of ESP32 microcontrollers with essential sensors was highlighted in a study published in JETIR, which focused on making water quality monitoring portable and user-friendly. With real-time data being sent directly to mobile devices, users can assess water conditions anytime, anywhere, enabling proactive environmental monitoring (JETIR, 2023) [4]. A more advanced system incorporating GSM and GPS technologies was presented in the International Journal of Innovative Research in Science, Engineering and Technology. This setup not only tracks water parameters like pH, turbidity, conductivity, and temperature, but also ensures precise geolocation and reliable data transmission through GSM, making it ideal for large-scale deployments (IJIRSET, 2023) [5]. In a related study, Yatender Singh and colleagues designed an RC boat that is controlled via a mobile application. Their system, presented in the International Journal of Novel Research and Development, gathers real-time data on temperature, pH, and turbidity and sends it to a central server for further processing. The mobile interface adds ease of use and accessibility, especially for field researchers (IJNRD, 2023) [6]. Another notable design published in IRJMETS involved a Wi-Fi camera and wireless RF modules to support a two-part monitoring system— one on the boat and one on the user's controller. This unique setup measures pH, conductivity, turbidity, and temperature, while offering visual feedback and interactive controls through an LCD and Android mobile, enhancing usability and monitoring precision (IRJMETS, 2022) [7]. Finally, the Journal of Modern Science and Development introduced a system using autonomous RC boats that travel across wide water bodies to collect and send water quality data online via IoT. This approach emphasizes sustainability and large-area coverage, aiming to maintain clean water by continuously evaluating pollution trends and allowing early interventions (JMSD, 2025) [8].

III. PROPOSED METHODOLOGY

The system tests various water samples by immersing sensors to measure pH, turbidity, and conductivity, displaying the data on an LCD and forwarding it to a server PC via an RF transceiver. The system compares the obtained values with predefined threshold ranges to assess water quality. For example, the pure water sample showed a pH of 7.9, low turbidity, and high conductivity, indicating it is suitable for drinking. In contrast, salt water had a pH of 9, high turbidity, and low conductivity, making it unsuitable for consumption. Pond water had high turbidity due to soil and dust, while lemon liquor showed acidic properties with a pH of 5 and conductivity of 12. These results, averaged over time, help determine the suitability of the water for specific purposes, with pure water being used as the baseline for comparison.

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The overall methodology of system as below.

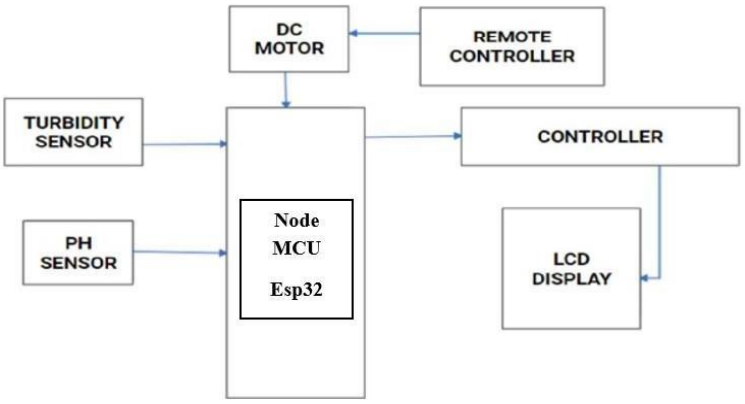

Fig 1: proposed methodology od system

Basically there are 5 stages (1) System Design and Planning, (2) Hardware Integration, (3) Software Development, (4) Testing and Calibration and last stages is (5) Improvements and Optimization.

Stages are as follows:

System Design and Planning
- Identify components required for the system, including: ESP32 microcontroller, pH sensor, TDS sensor Turbidity sensor, L298N motor driver, DC motors I2C LCD display, power supply module,
- Define system architecture and data flow.
- Plan sensor placement for optimal water contac curacy.

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Hardware Integration
- Integrate pH, TDS, and turbidity sensors wit the ESP32 to collect woter quality parameters.
- Calibrate each sensor using standard reference solution for accuracy.
- Connect DC motors to L298N motor driver.
- Connect the I2C LCD display to ESP32 to showral-time sensor readings onboard.

↓

Software Development
- Develop code using Arduino IDE or PlatformIO for ESP32 to read sensor values.
- Format and transmit datar-to the Blynk loT platform.
- Configure Blynk app to receive and display sensol ı data.
- Include real-time data logging and basic validation (range checks, fiitering).

↓

Testing and Calibration
- Perform initial dry run tests to validate motorcontrol and sensor communication.
- Conduct field tests in a controlled water body to:
  - Test boat navigation
  - Validate sensor accuracy against known water quality benchmarks
- Check real-time data display on the Blynk app and onboard LCD

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Improvements and Optimization
- Analyze collected data to evaluate water control in various locations.
- Use graphs or char ıs for visual representationcy.
- Optimize boat design for stability and efficiency.

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IV. CONCLUSION

The Monitoring of Turbidity, pH & Conductivity of Water makes use of water detection sensor with many advantages. The system can monitor water quality automatically, and it is low in cost and does not require people on duty, So the water quality testing is likely to be more economical, convenient and fast. The system has good flexibility. Only by replacing the corresponding sensors and changing the relevant software programs, this system can be used to monitor other water quality parameters.

Another important fact of this system is the easy installation of the system where the base station can be placed at the local residence close to the target area and the monitoring task can be done by any person with minimal training at the beginning of the system installation. The operation is simple. The system can be expanded to monitor hydrologic, air pollution, industrial and agricultural production and so on. It has widespread application and extension value.

REFERENCES

[1]. "IoT Based Water Pollution Monitoring RC Boat", *International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)*, Volume 2, Issue 7, May 2022., This paper discusses the development of a remote-controlled boat equipped with pH and turbidity sensors, designed to monitor water quality in lakes and reservoirs. The system includes GPS for location tracking and utilizes IoT for data transmission.

[2]. "IoT-Based Water Pollution Detection Boat with Real-Time Monitoring", Published on *ResearchGate*, March 2023., This study presents an autonomous boat capable of real-time monitoring of water parameters such as temperature, turbidity, and pH. The boat can operate autonomously or via remote control, collecting and transmitting data for analysis.

[3]. "IoT Based Water Pollution Monitoring RC Boat", *International Journal for Research in Applied Science & Engineering Technology (IJRASET)*, Volume 10, Issue V, May 2022. This research outlines a smart water quality monitoring system utilizing IoT technology. The system employs sensors to measure parameters like pH, turbidity, and temperature, with data transmitted to a cloud platform for real-time monitoring.

[4]. "IoT Based Water Pollution Monitoring RC Boat", *Journal of Emerging Technologies and Innovative Research (JETIR)*, Volume 10, Issue 5, May 2023., This paper describes the integration of an ESP32 microcontroller with sensors such as pH, temperature, and turbidity sensors. The system collects data and transmits it to mobile devices, facilitating remote monitoring of water quality.

[5]. "IoT Enabled RC Boat Water Pollution Monitoring Using GSM & GPS", *International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)*, Volume 13, Issue 5, May 2023., This study explores the integration of IoT sensors into an RC boat to monitor water temperature, electrical conductivity, turbidity, and pH levels. The system utilizes GSM and GPS technologies for data transmission and precise location tracking.

[6]. Design and Implementation of IoT Water Pollution RC Boat, *Authors*: Yatender Singh, Subham Keshri, Prabhat Gupta, Md Ajaj, Amit Kumar, *Published in*: International Journal of Novel Research and Development (IJNRD), Volume 8, Issue 5, May 2023 *Abstract*: This paper presents the design and implementation of an IoT-based remote-controlled boat equipped with sensors to measure water quality parameters such as temperature, pH, and turbidity. The boat is controlled via a mobile application, allowing users to obtain real-time information about various factors impacting water quality in specific locations. The collected data is transmitted to a central server for analysis and processing. *Link*: IJNRD Paper

[7]. IoT-Based Water Quality Monitoring System Using RC Boat, *Published in*: International Research Journal of Modernization in Engineering Technology and Science (IRJMETS), April 2022 *Abstract*: This study proposes a wireless remote-controlled boat equipped with sensors to measure water turbidity, pH, conductivity, and temperature. The system is divided into two parts: the boat with sensors and a wireless Wi-Fi camera, and a remote with an LCD, Wi-Fi module, and an Android mobile. Both parts are connected using wireless RF modules, enabling real-time monitoring and data transmission. *Link*: IRJMETS Paper

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[8]. IoT and Autonomous RC Boats for Water Quality Assessment *Published in*: Journal of Modern Science and Development, 2025, *Abstract*: This paper proposes a method to assess the quality of water in vast water bodies using a remote-controlled (RC) boat. The RC environmental monitoring boat collects water quality data and sends it online via the Internet of Things (IoT), facilitating the maintenance of clean water based on the received data. *Link*: JMSD Article