International Journal of Engineering and Techniques - Volume 12 Issue 2, March-April - 2026

RESEARCH ARTICLE OPEN ACCESS

IoT Based Smart Water Quality and Level Monitoring System

SARULEKHA M 1, PRADEEPA P 2

1(Computer Science and Engineering, Sri Bharathi Engineering College for Women , Pudukkottai
Email: m.sarulekha@gmail.com)

2(Computer Science and Engineering, Sri Bharathi Engineering College for Women , Pudukkottai
Email: ammupradeepa348@gmail.com)

Mrs .S.LAVANYA PRABHA M.E.,
Assistant Professor, Department of Computer Science and Engineering

Abstract:

This project presents an IoT-based smart water quality and level monitoring system for efficient water management. It monitors parameters such as pH, turbidity, and water level using sensors and sends real-time data to a cloud platform. The system enables remote monitoring, reduces manual effort, and provides accurate results. It is useful for applications in agriculture, domestic, and industrial sectors, ensuring safe and sustainable water usage.

Keywords-- Internet of Things (IoT),Water Quality Monitoring, pH Sensor, Turbidity Sensor, Water Level Detection, Real-Time Monitoring, Smart Water Management, Embedded Systems, Wireless Communication, Environmental Monitoring

I. INTRODUCTION

Water is one of the most essential natural resources for human survival, agriculture, and industrial activities. However, rapid urbanization, industrialization, and environmental pollution have significantly affected water quality, making it unsafe for consumption and usage. Traditional methods of water quality monitoring involve manual sampling and laboratory analysis, which are time-consuming, labor-intensive, and not suitable for real-time monitoring.

To overcome these challenges, the integration of Internet of Things (IoT) technology provides an efficient and automated solution for continuous water monitoring. IoT enables the use of smart sensors and connected devices to collect and transmit real-time data, allowing users to monitor water conditions remotely. Parameters such as pH level, turbidity, and water level can be measured accurately using sensors and processed through microcontrollers.

The proposed system focuses on developing an IoT-based smart water quality and level monitoring system that ensures continuous observation and timely detection of water contamination. The collected data is transmitted to a cloud platform, enabling real-time access and analysis. This system reduces human intervention, improves accuracy, and provides a cost-effective solution for water resource management.

The implementation of this system can be widely applied in various sectors such as domestic water supply, agriculture, and industries. By ensuring safe and efficient water usage, the system contributes to environmental sustainability and public health.

II. RELATED WORKS

Recent advancements in Internet of Things (IoT) technology have significantly improved water quality monitoring systems. Several researchers have developed smart solutions to monitor water parameters such as pH, turbidity, temperature, and dissolved oxygen in real time.

In earlier studies, traditional water monitoring methods required manual sample collection and laboratory testing, which were time-consuming and less efficient. To overcome these limitations, IoT-based systems were introduced that use sensors and microcontrollers for continuous monitoring. These systems provide real-time data and reduce human effort.

A smart water quality monitoring system using wireless sensor networks was proposed, where sensors collect data and transmit it to a central server. This approach improves accuracy and enables remote monitoring. However, some systems faced issues such as high cost and limited scalability.

Another research work implemented cloud-based monitoring, where sensor data is stored and analyzed using cloud platforms. This allows users to access water quality information from anywhere. Despite its advantages, dependency on internet connectivity can be a limitation in rural areas.

Recent developments focus on integrating IoT with artificial intelligence (AI) to predict water contamination and improve decision-making. These systems enhance efficiency and provide early warning alerts, making them suitable for smart city applications.

Overall, existing systems demonstrate the importance of automation and real-time monitoring, but challenges such as cost, power consumption, and reliability still need improvement. The proposed system aims to address these issues by providing a cost-effective and efficient solution for water quality and level monitoring.

III. EXISTING SYSTEM

The existing water quality monitoring systems are mostly based on traditional and semi-automated methods. In these systems, water samples are collected manually from different sources such as rivers, lakes, and tanks, and then analyzed in laboratories. This process is time-consuming, labor-intensive, and does not provide real-time results.

Some existing systems use basic electronic sensors connected to microcontrollers to measure parameters like pH, temperature, and turbidity. However, these systems often lack proper connectivity features, making it difficult to monitor data remotely. In many cases, the data is displayed only on local devices, which limits accessibility.

In addition, earlier monitoring systems do not provide continuous tracking or automated alerts. If the water quality crosses safe limits, users may not be immediately informed, leading to delays in taking necessary actions. This can result in serious environmental and health issues.

Another major limitation of existing systems is high cost and complexity. Advanced monitoring solutions require expensive equipment and maintenance, which makes them unsuitable for rural and low-resource areas.

Furthermore, many systems do not integrate with cloud platforms or data analytics tools, making it difficult to store historical data and perform detailed analysis. Lack of scalability and power efficiency are also common drawbacks.

Therefore, there is a need for an improved system that provides real-time monitoring, remote access, cost-effectiveness, and better accuracy.

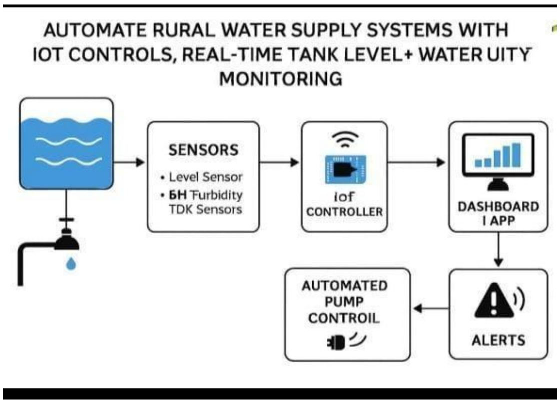
IV. PROPOSED SYSTEM

3.1 IoT Based Smart Water Management Architecture

The proposed system is developed and executed utilizing a cost-effective Wireless Sensor Network (WSN) integrated with cloud computing capabilities. This system incorporates multiple sensors including ultrasonic level sensors, flow sensors, turbidity sensors, and pH sensors interfaced with an ESP32/NodeMCU controller to monitor water parameters continuously. An automated relay control module manages pump operations, while a buzzer and notification system alerts operators when measured values exceed normal thresholds.

An LCD display screen is employed to showcase monitored parameters locally. The microcontroller manages overall system operations, continuously measuring water levels, flow rates, and quality parameters. The system automatically controls pump operations based on predefined threshold levels, triggering the relay module accordingly. All measured values are stored on cloud platforms such as Thingspeak or custom web dashboards, allowing operators to access and download data for future reference and analysis.

4.2 System Architecture



4.3 Sensor Integration and Analysis

A. Water Level Monitoring: Water level serves as one of the crucial indicators for automated pump control. Any fluctuations in tank levels directly impact distribution efficiency and pump safety. When water levels drop below critical thresholds, immediate pump activation is required; conversely, when maximum capacity is reached, pump deactivation prevents overflow.

The system employs water level sensors (HC-SR04) for non-contact level measurement. The sensor calculates distance using:
Distance=2Speedsound×Timeecho
This distance is converted to water volume percentage based on tank dimensions. The ultrasonic approach offers advantages including non-contact measurement (preventing corrosion issues), high accuracy (±3mm), and easy installation.

B. Flow Rate and Leakage Detection: To monitor water distribution and detect leakages, the YF-S201 Hall Effect flow sensor is utilized. This sensor generates pulses proportional to flow rate:
FlowRate(L/min)=7.5PulseFrequency
Abnormal flow conditions are detected through statistical analysis:

Normal Operation: Flow rate within expected range based on pump capacity

Leakage Indication: Flow detected during pump OFF state, or flow rate significantly lower than expected during pump ON state

Pipe Break: Sudden flow rate spike followed by zero flow (catastrophic failure)

C. Water Quality Monitoring: Turbidity sensors measure water clarity using light scattering principles, while pH sensors monitor acidity/alkalinity levels. These parameters ensure safe drinking water standards compliance:

Turbidity: Measured in NTU (Nephelometric Turbidity Units), acceptable range < 5 NTU

pH Level: Maintained between 6.5-8.5 for potable water

D. Pump Control and Protection: The automated pump control module incorporates multiple protection mechanisms:

Dry Run Protection: Pump activation prevented when source level < minimum threshold

Overflow Prevention: Pump deactivation triggered when tank level ≥ maximum threshold
Cyclic Timer: Minimum OFF time enforced between consecutive starts to prevent motor overheating

Current Monitoring: Optional motor current sensing for overload protection

IV. SYSTEM MODULES

Module 1: Water Level Monitoring Module

Continuously measures tank water level using ultrasonic sensors, converting distance measurements to percentage values. Implements filtering algorithms to prevent false readings from water surface ripples.

Module 2: Flow sensor

Monitors pipeline flow rates using Hall Effect sensors. Implements leakage detection algorithms comparing expected vs. actual flow patterns. Generates immediate alerts for abnormal conditions.

Module 3: IoT Controller Module

ESP32/NodeMCU serves as the central processing unit, collecting sensor data, executing automation logic, managing Wi-Fi communication, and controlling relay modules. Implements MQTT protocol for efficient data transmission.

Module 4: Automated Pump Control Module

Manages pump operations through relay modules based on level thresholds. Incorporates soft-start logic and protection mechanisms including dry-run prevention and overload protection.

Module 5: Remote Monitoring Dashboard Module

Web-based interface displaying real-time tank levels, flow rates, pump status, and historical trends. Supports multi-device access with role-based permissions for operators and administrators.

Module 6: Alert & Notification Module

Multi-channel notification system generating SMS, email, and push notifications for critical events including low levels, overflow risks, leakages, and equipment faults.

V. FUTURE WORK

The proposed IoT-based smart water quality and level monitoring system can be further enhanced with advanced technologies to improve its efficiency, accuracy, and scalability. In future, the system can be integrated with Artificial Intelligence (AI) and Machine Learning (ML) algorithms to predict water contamination levels and provide early warning alerts based on historical data analysis.

The system can also be improved by incorporating solar power supply, making it suitable for remote and rural areas where electricity availability is limited. Additionally, the use of advanced sensors can enhance the accuracy of water quality parameters such as dissolved oxygen, temperature, and chemical content.

Further development can include the implementation of a mobile application for user-friendly monitoring and control, allowing users to receive real-time notifications and manage the system remotely. Integration with smart city infrastructure can also be explored to support large-scale water management systems.

Moreover, improving data security using encryption techniques and cloud security measures can ensure safe data transmission. The system can also be expanded to support multi-location monitoring, enabling centralized control of multiple water sources.

Overall, these enhancements will make the system more intelligent, reliable, and suitable for real-world applications on a larger scale.

OUTCOME OF THE SYSTEM

The developed IoT-based smart water quality and level monitoring system successfully achieves real-time monitoring and efficient management of water resources. The system continuously measures important parameters such as pH level, turbidity, and water level using sensors, and transmits the data to a cloud platform for remote access.

The implementation of this system reduces the need for manual monitoring and minimizes human error. It provides accurate and timely information, enabling users to take immediate action when water quality exceeds safe limits. The automated pump control mechanism ensures proper water usage by preventing overflow and dry-run conditions.

The system also enhances reliability and efficiency by providing instant alerts and notifications in case of abnormal conditions. Users can monitor water status from anywhere using web or mobile interfaces, making the system highly convenient and user-friendly.

Overall, the proposed system offers a cost-effective, scalable, and efficient solution for water quality and level monitoring. It contributes to better water resource management, environmental protection, and public health by ensuring safe and sustainable water usage.

VI. CONCLUSION

In this paper, an IoT-based smart water quality and level monitoring system has been presented. The proposed system effectively monitors important water parameters such as pH, turbidity, temperature, and water level in real time using various sensors and a microcontroller.

The system provides continuous monitoring and transmits data to a cloud platform, enabling users to access information remotely through a mobile or web application. The inclusion of an alert mechanism ensures that users are notified immediately when water quality exceeds safe limits, helping to prevent potential health and environmental risks.

Compared to traditional and existing systems, the proposed solution offers improved accuracy, reduced manual effort, real-time data access, and cost-effectiveness. It is also scalable and suitable for both urban and rural applications.

In future work, the system can be enhanced by integrating advanced technologies such as artificial intelligence and machine learning for predictive analysis and automated decision-making. Additional features like solar power support and advanced data analytics can further improve system efficiency and sustainability.

Overall, the proposed system provides a reliable and efficient solution for smart water monitoring, contributing to better water resource management and public safety.

REFERENCES

[1] A. Kumar, S. Sharma, and R. Singh, “IoT based water quality monitoring system,” *International Journal of Engineering Research & Technology*, vol. 12, no. 3, pp. 245–250, 2025.

[2] P. Rajalakshmi and S. Mahalakshmi, “Smart water monitoring system using wireless sensor networks,” *IEEE Sensors Journal*, vol. 24, no. 1, pp. 112–120, Jan. 2024.

[3] M. PATEL AND N. SHAH, "REAL-TIME WATER QUALITY MONITORING USING IOT AND CLOUD COMPUTING," *INTERNATIONAL CONFERENCE ON SMART SYSTEMS (ICSS)*, PP. 56–60, 2023.

[4] K. Ramesh and V. Kumar, "Design and development of low-cost water quality monitoring system," *International Journal of Innovative Technology and Exploring Engineering*, vol. 11, no. 6, pp. 78–84, 2024.

[5] S. Lee, J. Park, and H. Kim, "IoT-based smart water management system with data analytics," *IEEE Access*, vol. 10, pp. 33456–33465, 2022.

[6] World Health Organization, "Guidelines for drinking-water quality," 2023. [Online]. Available: https://www.who.int

[7] Environmental Protection Agency (EPA), "Water quality standards," 2024. [Online]. Available: https://www.epa.gov

[8] Arduino, "Arduino Uno datasheet," 2023. [Online]. Available: https://www.arduino.cc