Iot-Based Smart Water Quality & Safety Monitoring System with Alert Features

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***Abstract*—As urban water demand keeps increasing, it is essential to continuously and automatically monitor municipal storage infrastructures in order to maintain water safety and comply with regulatory requirements.**
In this paper, a sensor-integrated IoT framework has been introduced for the real-time monitoring of water tanks located overhead using embedded microcontroller architecture and threshold-based evaluation logic. For ensuring the quality of water stored in overhead tanks, the proposed system integrates sensors such as pH, turbidity, and Total Dissolved Solids (TDS) which would carry out the monitoring continuously. An Arduino-based controller gathers real-time data from the sensors and compares them with preset safety thresholds. Furthermore, the system facilitates auto-complaint generation in the event of water quality parameters exceeding permissible limits, thus allowing immediate actions to be taken without the need for manual intervention. Such a remedy enhances transparency, reduces human effort, and increases water quality surveillance that in turn leads to safe and efficient drinking water supply to the citizens. In terms of cost, the proposed system is cheap, scalable, and perfectly fit-for-purpose for smart city and e-governance scenarios.

Index Terms*—Overhead Water Tank Automation, Water Quality Monitoring, IoT, Arduino, pH Sensor, Turbidity Sensor, TDS Sensor, Municipal Water Supply, Smart Water Management, Automated Complaint Generation

I. INTRODUCTION

Water is very essential to human life, and municipal authorities have the main responsibility of ensuring safe and effective access to drinkable water. In most cities and towns, water is delivered to the homes through overhead water tanks. Unfortunately, these conventional water management models are mostly dependent on manual monitoring which is a big challenge. Its drawbacks include late detection of water contamination, irregular water distribution, overflow, and a lack of transparency in water quality management.

The demand for an uninterrupted and high-quality water supply has increased tremendously due to the rising population and urbanization. Exposure to human health risks from water contamination is very high when water is incorrectly stored, old pipelines with possible leaks are used, or pollutants come from the outside. pH level, turbidity, and total dissolved solids (TDS) are some of the major parameters that determine water quality and hence need to be closely monitored to ensure drinking water is safe. Manual testing methods that are time-consuming and labor-intensive also make it impossible to conduct continuous monitoring at multiple locations.

As a solution, the proposed system will function as an automated overhead water tank monitoring system with an alarm feature that uses sensor technology and microcontrollers. The system will always check the water quality parameters with the help of a pH, turbidity, and TDS sensor that is connected to an Arduino controller.

II. LITERATURE REVIEW

Paper Name	Author Name	Year	Algorithm / Logic Used	Database	Observation	Drawbacks
Advances in machine learning and IoT for water quality	Ismail Essamlali, Hasna Nhaila, Mohamed El Khaili	2024	common ML models (LSTM, Random Forest, SVM), and evaluation metrics.	Google Scholar, IEEE Xplore, SpringerLink, and ScienceDirect.	This detailed study examines the use of IoT-based communication systems and machine learning methods in water quality assessment.	Survey-style; limited empirical benchmarks on real-world deployments.
Smart Water Quality Monitoring with IoT Wireless Sensor Networks	Y. Singh and Tom Walingo	2024	use of AI to predict E. coil. Innovative use of surrogate models	Cloud-database platforms, MongoDB M ySQL	Innovative use of surrogate models to predict biological contamination; strong experimental results.	Focuses on specific contaminant (E. coli); generalization to other parameters requires more work.
An IoT Real- Time Potable Water Quality Monitoring and Prediction	R. Wiryasaputra, R. Yuwono, and H. Nugroho	2024	cloud services for visualization and alerts. It also applies simple ML models like ARIMA, linear Regression	Mongo DB, MySQL	End-to-end implementation with cloud dashboards and SMS/notification alerts.	Prediction models are lightweight (linear/ARIMA) and may not capture complex temporal patterns.
Development of an IoT-based multi-level system for real-time water quality	R.K. Nishan, M. Shukla, and P. Nair	2024	It uses deep learning models for classification of water suitability and emphasizes data validation routines	MySQL, SQLite,	Proposes a multi-level architecture that combines local edge nodes for preprocessing with cloud analytics	Relies on deeper models that increase compute requirements at the edge.
An IoT-enabled intelligent water quality monitoring system	M.A. Islam, A. Rahman, and K. Hasan	2025	ML prediction Models like Regression models, Forest models	MongoDB, MySQL,	Combines real-time sensors (pH, turbidity, TDS, temperature) with an ESP32-based network and ML prediction to monitor water in tourist areas.	Local conditions and sensor calibration remain practical hurdles.

1. Advances in machine learning and IoT for water quality (2024):
Ismail Essamlali, Hasna Nhaila, Mohamed El Khaili. This detailed study examines the use of IoT-based communication systems and machine learning methods in water quality assessment. It surveys sensor technologies, data ingestion pipelines, common ML models (LSTM, Random Forest, SVM), and evaluation metrics. The review also discusses edge/cloud splits and challenges such as data sparsity and sensor drift.

2. Smart Water Quality Monitoring with IoT Wireless Sensor Networks (2024):
Y. Singh and Tom Walingo. Proposes a system architecture that employs IoT- integrated wireless sensor network (WSN) nodes to track various water quality parameters. The research applies artificial intelligence models to estimate E. coli levels using indirect measurement signals and emphasizes the role of sensor fusion in enhancing prediction accuracy.

3. An IoT Real-Time Potable Water Quality Monitoring and Prediction (2024):
R. Wiryasaputra, R. Yuwono, and H. Nugroho. Develops an IoT system for potable water monitoring, using sensors for pH, turbidity, TDS and temperature, feeding to cloud services for visualization and alerts. It also applies simple ML models to forecast short-term parameter trends.

4. Development of an IoT-based multi-level system for real-time water quality (2024):
R.K. Nishan, M. Shukla, and P. Nair. Proposes a multi-level architecture that combines local edge nodes for preprocessing with cloud analytics. It uses deep learning models for classification of water suitability and emphasizes data validation routines to reduce false alarms.

5. An IoT-enabled intelligent water quality monitoring system (2025):
M.A. Islam, A. Rahman, and K. Hasan. Combines real-time sensors like pH, turbidity, TDS, temperature with an ESP32-based network and ML prediction to monitor water in tourist areas. The work provides a complete pipeline from sensing to cloud analytics.

III. EXISTING SYSTEM

Currently, municipal overhead water tanks are managed mostly through traditional and manual methods. Checking the water for its quality consists of the occasional sampling of the water and testing it in the labs. This process takes up a lot of time, demands skilled manpower, and the lack of real-time information about the water stored in the tanks is a major drawback. Thus, contamination can remain without detection for a significant period, which poses a great risk to the supply of safe water to the public.
Also, water level monitoring and inflow control are mostly manual or partially automatic. The valves are used depending on a fixed timetable or the operator's decision, which is the main cause of such issues as the overflow, water wastage, and irregular water supply. The continuous monitoring of parameters like pH, turbidity, or total dissolved solids is not done, and hence, it becomes difficult to maintain the water quality always at a high standard. Limitations

- Manual method
- Requires skilled manpower
- Does not provide real-time information
- No continuous tracking of parameters like pH, turbidity, or total dissolved solids
- Difficult to access historical data
- No automatic alert or notification mechanism

IV. PROPOSED METHODOLOGY

This project proposes an innovative, automated and smart method of monitoring and managing water tanks that are located overhead and used by municipal corporations. With sensor-based technology, it is able to detect the quality of water indoors such as pH, turbidity, and total dissolved solids on a real-time basis. The sensors are connected to a microcontroller that not only processes the data gathered but also checks the data against the predetermined safe limits. The system follows a step-by-step methodology to ensure accurate sensors values.

1. Sensor Data Collection: Sensors continuously collect pH, TDS and turbidity data from water tank.
2. Data Transmission: Arduino processes the sensor values and sends them to the Java backend through serial or wireless communication to give real time water quality.
3. Data Processing: The backend analyzes the sensor data and gives real-time quality of water from values came from water tank sensors.
4. Alert Generation: Generates alerts on the web dashboard when water quality exceeds or falls below predefined thresholds.
5. Notification System: Sends real-time notifications (SMS, email, or push notifications) to users when water quality crosses predefined thresholds.

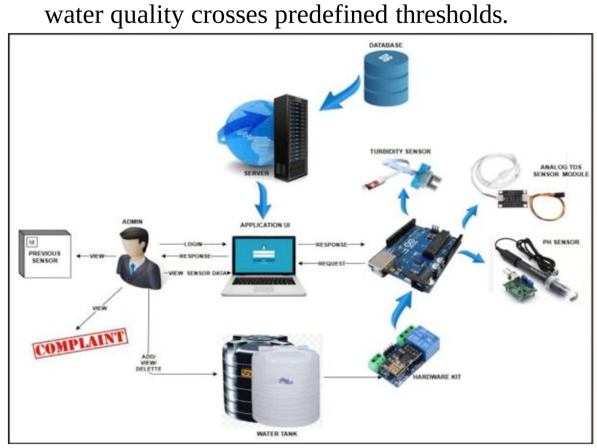

Fig. System Architecture

Advantages of Proposed System:

- Accurate Real-Time Water Quality Monitoring

- Reduced Human Intervention
- Early Detection of Contamination
- Centralized Monitoring System
- Cost-Effective and Scalable Solution
- Supports Smart City Initiatives

V. CONCLUSION

The overhead water tank automation and water quality monitoring system provides an effective and reliable solution to the challenges faced in traditional municipal water management. By integrating sensors for continuous monitoring of key water quality parameters and automating water inflow control, the system ensures that only safe and clean water is supplied to consumers. Real-time data collection and automatic alert generation enable quick identification and resolution of water quality issues, reducing health risks and operational delays.

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