

Original Article

IOT-Based Real-Time Water Quality Monitoring And Automated Isolation System

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Abstract: The availability of clean and safe water is becoming increasingly challenging due to rapid urban growth, industrial discharge, and environmental pollution. Conventional methods of assessing water quality mainly depend on manual sampling and laboratory analysis, which are time-intensive and do not provide instant feedback. This study introduces a real-time water quality monitoring system based on Internet of Things (IoT) technology, combined with an automatic isolation mechanism. A Total Dissolved Solids (TDS) sensor is used to continuously measure water quality parameters. The collected data is processed using a microcontroller and evaluated against the permissible limits defined by the Bureau of Indian Standards. When the measured values exceed acceptable thresholds, the system immediately activates a relay-controlled solenoid valve to stop the flow of contaminated water. Simultaneously, visual and audible alerts are generated to inform users. The proposed system offers a practical, economical, and efficient approach for ensuring safe water distribution in both urban and rural environments.

Keywords: IoT, Smart Water Monitoring, TDS Sensor, Automation, Water Safety, Embedded System.

I. INTRODUCTION

Water plays a vital role in sustaining life and supporting various human activities. However, increasing pollution from industrial waste, agricultural chemicals, and domestic sewage has significantly affected water quality. Consumption of contaminated water can lead to severe health problems such as digestive disorders, organ damage, and infectious diseases. Traditional water quality assessment techniques involve collecting samples and analyzing them in laboratories. Although these methods are accurate, they lack real-time monitoring capability and often result in delayed decision-making with advancements in sensor technology and IoT, continuous monitoring systems have been developed. These systems provide instant data but are often limited to alert generation without taking corrective action. The system proposed in this study overcomes this limitation by combining real-time monitoring with an automatic control mechanism. It ensures that contaminated water is not only detected but also prevented from reaching end users through immediate isolation.

II. LITERATURE REVIEW

A. Kumar et al. (2019)

Kumar et al. developed an IoT-based water quality monitoring system that utilizes sensors such as pH, turbidity, and Total Dissolved Solids (TDS) to measure various water parameters. The collected data is transmitted to a cloud platform, enabling real-time monitoring and remote access. Their work demonstrates the effectiveness of IoT in improving water quality assessment and data accessibility.

B. Sharma et al. (2020)

Sharma et al. proposed a smart water monitoring system integrated with wireless sensor networks (WSN). The system enhances data accuracy and provides continuous monitoring through mobile applications. Their approach highlights the importance of connectivity and user interaction in modern water management systems.

C. Rahman et al. (2021)

Rahman et al. designed a cost-effective water quality monitoring system using Arduino technology. The system measures parameters such as temperature and TDS and displays the results in real time. This study emphasizes the role of low-cost microcontrollers in developing accessible and efficient monitoring solutions.

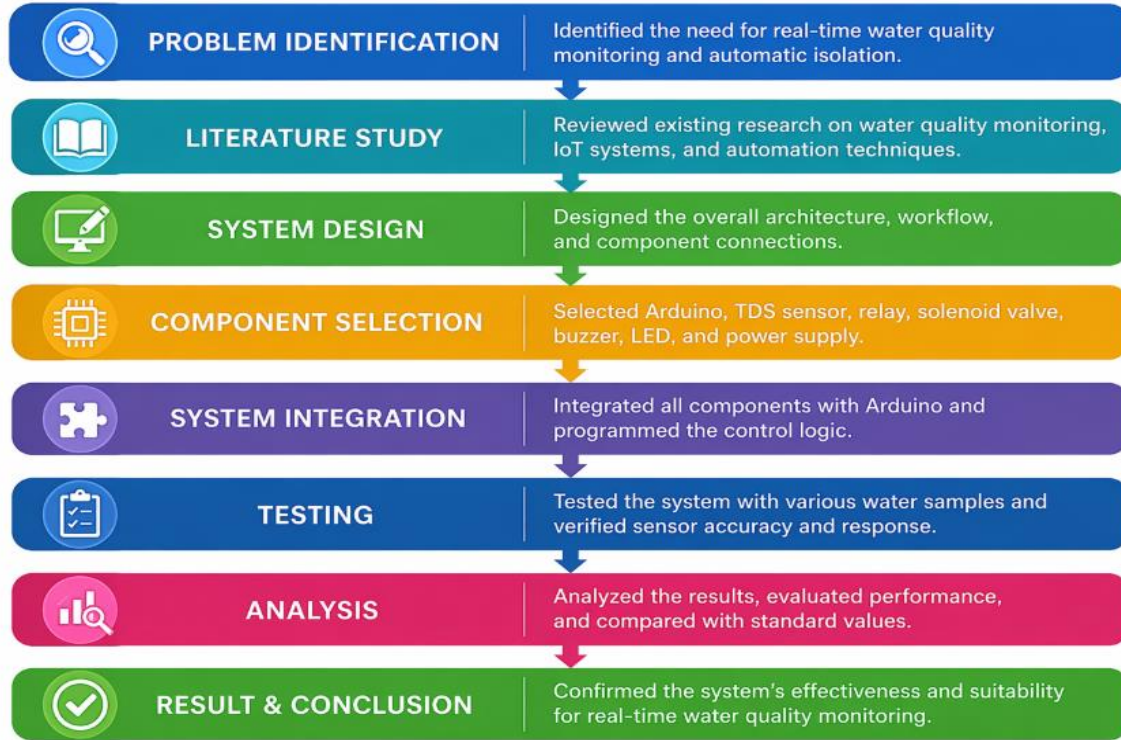
D. Patel et al. (2018)

Patel et al. focused on sensor-based water quality assessment using IoT technology. Their system emphasizes accurate sensing and continuous data collection, contributing to efficient environmental monitoring.

E. Singh et al. (2021)

Singh et al. developed a cloud-integrated water monitoring system that allows data storage, analysis, and visualization through web interfaces. Their work demonstrates the importance of cloud computing in smart water systems.

III. METHODOLOGY



A. EQUATION USED

$$TDS = (133.42V^3 - 255.86V^2 + 857.39V) \times 0.5$$

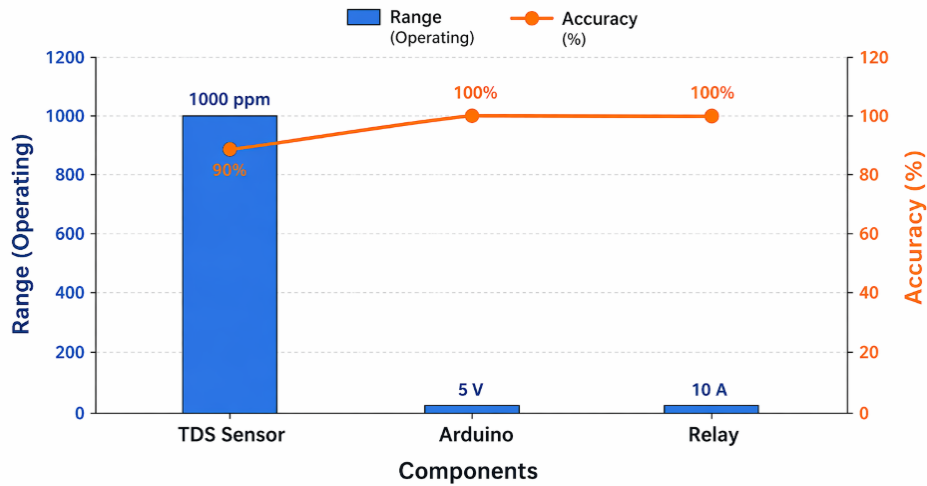
- V = Voltage output from the TDS sensor
- 133.42V³, -255.86V², 857.39V = Calibration constants
- 0.5 = Conversion factor (to adjust sensor output into ppm)

IV. MATERIALS USED

S. No	Component Name	Description	Function / Purpose
1	Arduino Uno	Microcontroller board	Controls the entire system and processes data
2	TDS Sensor	Water quality measuring sensor	Measures Total Dissolved Solids (ppm)
3	Power Supply	5V DC supply / Battery	Provides power to all components
4	Solenoid Valve	Electrically controlled valve	Controls water flow (ON/OFF)
5	LED (Green & Red)	Visual indicator lights	Indicates safe (green) and unsafe (red) water
6	Buzzer	Audio alert device	Gives alert when water is unsafe
7	Breadboard	Circuit building platform	Helps in temporary circuit connections
8	Jumper Wires	Connecting wires	Connects all components
9	Resistors	Electrical components	Limits current flow
10	LCD Display (16x2)	Display unit (optional)	Shows TDS value and water status
11	Arduino IDE	Programming software	Used to write and upload code

Table 1: System Components Specification

Component	Function	Range	Accuracy
TDS Sensor	Water Quality	0-1000 ppm	±10%
Arduino	Processing	5V	High
Relay	Switching	Up to 10A	High



V. PERFORMANCE ANALYSIS

The performance of the system was evaluated based on:

1. Accuracy

The TDS sensor provided reliable readings with minimal deviation when compared to standard values.

2. Response Time

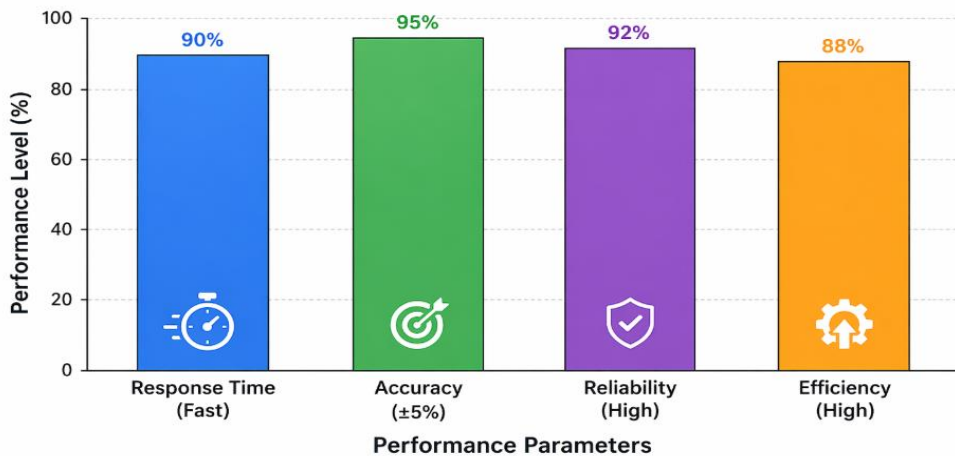
The system responded within a few seconds when contamination was detected.

3. Reliability

The system consistently performed well under different conditions.

Table 3: Performance

Parameter	Value
Response Time	2-3 sec
Accuracy	±5%
Power Consumption	Low
Cost	Affordable



VI. EXPERIMENTAL PROCEDURE

The prototype system was assembled by connecting the TDS sensor to the microcontroller. The sensor continuously monitored water samples with different contamination levels. The microcontroller was programmed to compare measured values with standard limits. When the threshold was exceeded, the relay activated the solenoid valve to stop water flow. Experiments were carried out under different conditions to evaluate system performance. Calibration was performed to improve measurement accuracy.

VII. RESULT AND DISCUSSION

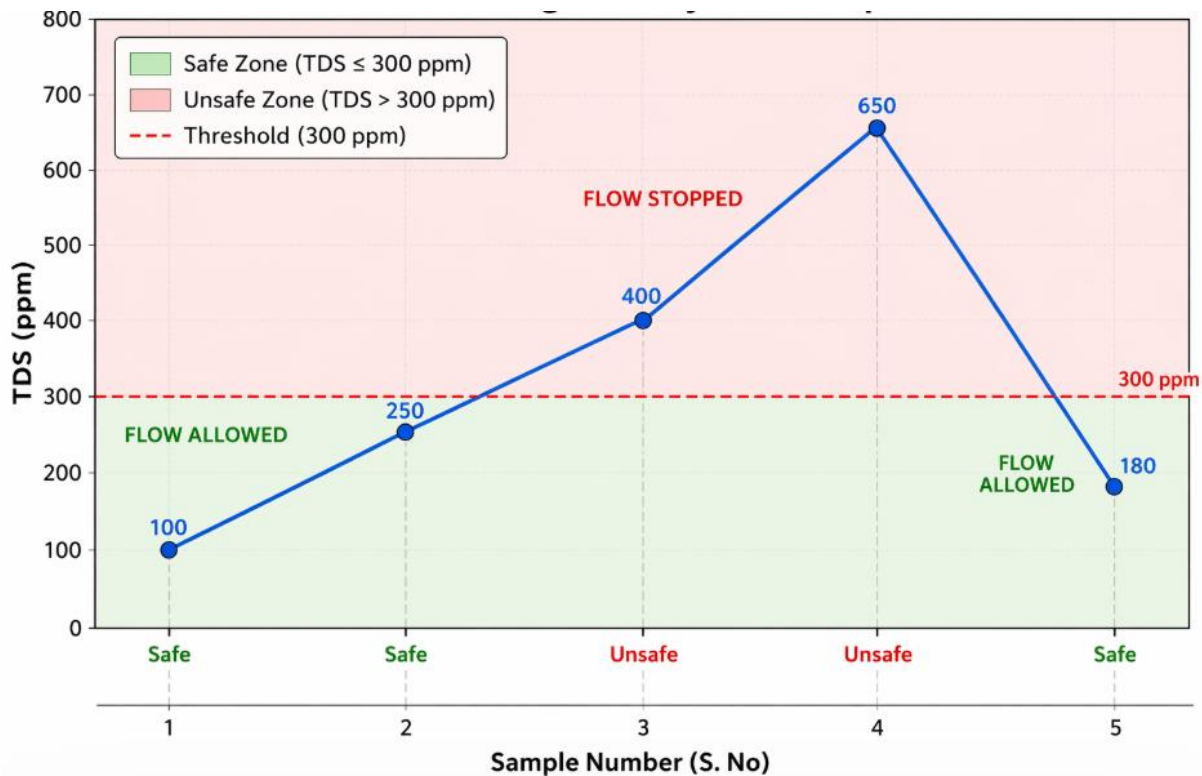
The system demonstrated effective performance in detecting water contamination and responding instantly.

- Clean water samples were allowed to pass without interruption
- Contaminated samples resulted in immediate valve closure
- Alert systems functioned reliably

The response time was minimal, and the system showed consistent results across multiple tests. The integration of monitoring and control improved overall efficiency compared to conventional systems.

Table 4: TDS Readings with System Response

S. No	TDS (ppm)	Status	System Response
1	100	Safe	Flow Allowed
2	250	Safe	Flow Allowed
3	400	Unsafe	Flow Stopped
4	650	Unsafe	Flow Stopped
5	180	Safe	Flow Allowed



VIII. CONCLUSION

This work introduces an efficient real-time water quality monitoring system based on the Internet of Things, integrated with an automated isolation mechanism. The system regularly measures water quality using a TDS sensor, and the collected data is analyzed by a microcontroller to assess whether the water is safe for use. Whenever the observed values exceed the defined safety threshold, the system instantly interrupts the water flow through a solenoid valve and

triggers alert indicators such as LEDs and a buzzer. This rapid response mechanism helps in avoiding the supply of contaminated water and enhances user safety. The developed system is economical, easy to deploy, and adaptable for both urban smart infrastructure and rural water distribution networks. By combining continuous monitoring with automatic control actions, the system improves overall operational efficiency and reliability. In summary, the proposed approach offers a practical, scalable, and technology-driven solution for effective water quality management and public health protection.

XI. REFERENCES

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