International Journal of Engineering & Extended Technologies Research (IJEETR)

|ISSN: 2322-0163| www.ijeetr.com | A Bimonthly, Peer Reviewed, Scholarly Indexed Journal |

| Volume 8, Issue 2, March - April 2026 |

DOI:10.15662/IJEETR.2026.0802215

Advanced AI Based Water Quality and Vending Machine

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Publication History: Received: 25.02.2026; Revised: 20.03.2026; Accepted: 25.03. 2026; Published: 28.03.2026.

ABSTRACT: Ensuring access to safe drinking water remains a significant issue in many areas due to rising pollution levels and the absence of continuous monitoring systems. Traditional water supply methods depend on periodic manual testing, which increases the risk of distributing contaminated water before detection. To overcome this limitation, an intelligent and automated solution is necessary for real-time water quality assessment and controlled distribution.

This project presents an advanced AI-based water quality monitoring and smart vending machine system aimed at delivering safe drinking water. It utilizes multiple sensors, including pH, turbidity, total dissolved solids (TDS), and water level sensors, to continuously evaluate essential water quality parameters. The sensor data is gathered and processed by a microcontroller, where an AI-based decision mechanism is applied to analyze the results.

Based on the analysis, the system determines whether the water is suitable for consumption. If all parameters fall within safe limits, the vending system is activated to dispense water. Otherwise, the system restricts access and displays a warning message. Additional components such as an LCD display, keypad, and relay module enhance user interaction and automation.

The proposed system offers real-time monitoring, improved efficiency, and higher reliability compared to conventional methods. It is well-suited for deployment in public locations like schools, hospitals, railway stations, and rural areas to ensure safe and accessible drinking water.

KEYWORDS: Artificial Intelligence (AI), Water Quality Monitoring, Smart Vending Machine, Internet of Things (IoT), Total Dissolved Solids (TDS), Real-Time Monitoring.

I. INTRODUCTION

Clean and safe drinking water is very important for human health and overall development. However, due to rapid growth in population, industries, and urban areas, water pollution has increased significantly. This makes it necessary to monitor water quality regularly.

Traditional methods usually depend on manual collection and laboratory testing, which take more time, cost more, and do not provide instant results. Because of this delay, there is a chance that contaminated water may be supplied to people, leading to serious health problems.

To solve this issue, this project introduces an advanced system that uses Artificial Intelligence to monitor water quality and control water distribution automatically. The system uses sensors like pH, turbidity, TDS, and water level sensors to continuously check water quality. A microcontroller processes this data and makes decisions based on safety levels.

If the water is safe, the system allows it to be dispensed through a vending machine. If not, it stops the supply. This system provides real-time monitoring, reduces human effort, and ensures safe water, especially in public places like schools and hospitals.

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II. LITERATURE REVIEW

Water quality monitoring has become an important research area due to the increasing need for safe drinking water. Earlier systems mainly depended on laboratory testing, where water samples were collected and analyzed manually. This process was time-consuming and did not provide instant results, making it difficult to take quick action when contamination occurred.

With the advancement of technology, researchers have started using sensor-based systems and Internet of Things (IoT) devices to monitor water quality continuously. Parameters like pH, turbidity, temperature, and TDS are measured in real time, which helps in detecting pollution at an early stage. In addition, machine learning techniques such as decision trees and neural networks are used to analyze the collected data and improve accuracy.

However, most existing systems focus only on monitoring and do not control water distribution. This project improves upon previous work by combining real-time monitoring with an automatic vending system, ensuring that only safe water is supplied to users.

III. RESEARCH METHODOLOGY

The proposed system follows a systematic methodology for real-time water quality monitoring and automated control. Initially, various sensors such as pH, turbidity, TDS, and water level sensors are deployed to collect continuous data from the water source. These sensors provide real-time measurements of key parameters that determine water safety. The collected data is then preprocessed to remove noise, handle missing values, and normalize the data for consistent analysis.

A microcontroller, such as Arduino, is used to process the sensor data and implement the decision-making logic. An AI-based model is integrated into the system to analyze patterns and classify water quality as safe or unsafe. The model is trained using historical or predefined threshold data to improve accuracy and reliability. Feature selection techniques are applied to focus on the most relevant parameters.

Based on the analysis, the system automatically controls the vending mechanism using a relay module. If the water meets safety standards, the system allows dispensing; otherwise, it blocks the process and displays a warning message on an LCD interface. This methodology ensures efficient, accurate, and real-time water quality management with minimal human intervention.

IV. RESULTS AND DISCUSSION

The developed AI-based water quality monitoring and smart vending machine system was tested under different water conditions to evaluate its performance and reliability. The sensors successfully measured key parameters such as pH, turbidity, and total dissolved solids (TDS) in real time.

The collected data was processed by the microcontroller, and the AI-based decision model accurately classified water quality as safe or unsafe based on predefined thresholds and learned patterns.

During testing, the system allowed water dispensing only when all parameters were within acceptable limits. In cases where any parameter exceeded the safe range, the vending mechanism was automatically disabled, and a warning message was displayed on the LCD. This ensured that contaminated water was not distributed.

The response time of the system was quick, enabling immediate decision-making without delay.The results demonstrate that the integration of sensors, microcontroller, and AI improves the accuracy and efficiency of water quality monitoring.

Compared to traditional methods, the proposed system provides continuous monitoring and automatic control, reducing human effort and error. Overall, the system proved to be reliable, cost-effective, and suitable for real-time applications in public water distribution environments.

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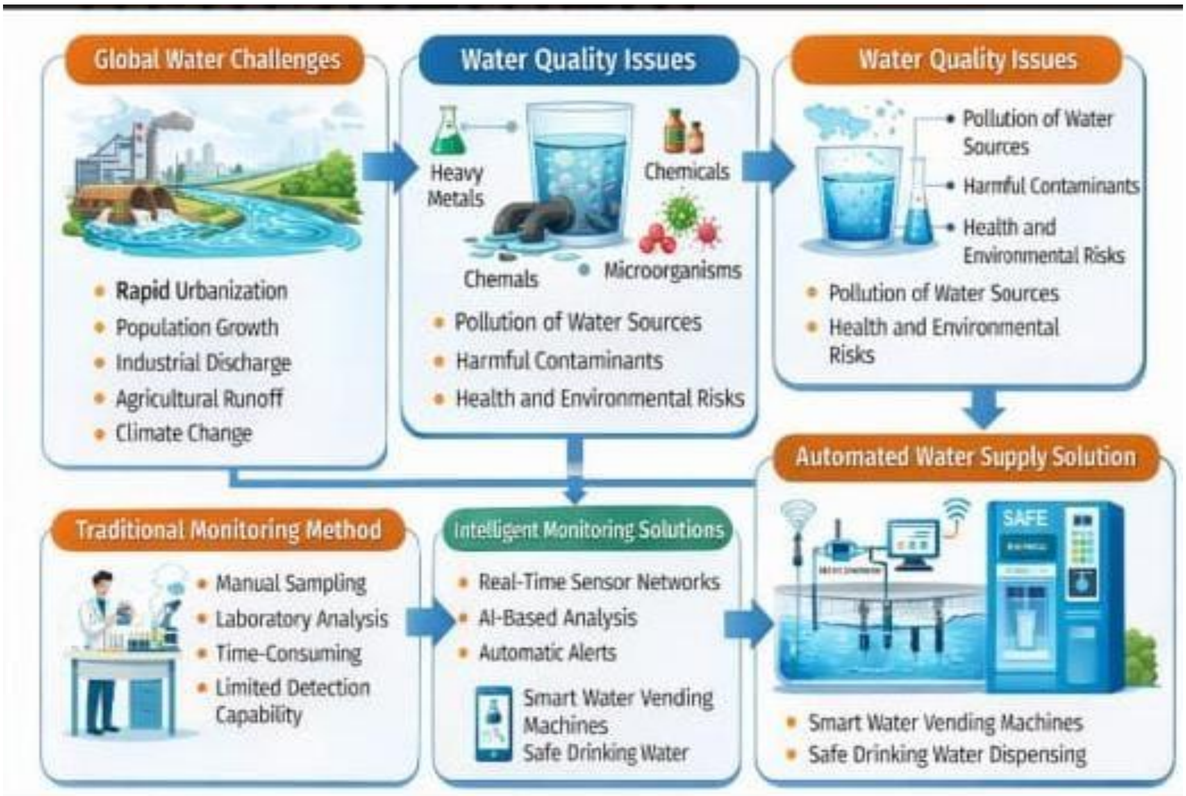

FIG: 1 Concept of AI-based smart water quality monitoring system that detects pollution in real time and ensures safe, automated water supply.

V. CONCLUSION

This project focuses on providing safe drinking water using an intelligent and automated system. In many areas, water quality is checked manually, which may lead to delays in identifying contamination. To solve this issue, the proposed system uses sensors and Artificial Intelligence to monitor water quality continuously.

Sensors such as pH, turbidity, and total dissolved solids measure important parameters in real time. The collected data is processed by a microcontroller, which analyzes the values using a smart decision method

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Based on the results, the system decides whether the water is safe for drinking. If the parameters are within acceptable limits, the vending mechanism allows water to be dispensed. Otherwise, the system stops the supply and displays a warning message.

This reduces human effort and improves accuracy. Overall, the project ensures reliable, real-time monitoring and helps provide clean and safe water in public places.

VI. FUTURE WORK

1. **Advanced Sensor Integration**: Future improvements can include additional sensors such as dissolved oxygen (DO) and temperature sensors to provide more detailed water quality analysis and improve system accuracy.
2. **Cloud Data Storage:** Integrating cloud technology will allow real-time data storage and remote monitoring using mobile or web applications.
3. **AI Model Enhancement:** More advanced machine learning algorithms can be used to improve prediction accuracy and detect complex contamination patterns in water.
4. **Mobile Application Development**: A dedicated mobile app can be developed to notify users about water quality status and system alerts in real time.

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5**. Solar Power Integration:** The system can be made energy-efficient by using solar panels, making it suitable for rural and remote areas.
6. **Multi-Source Water Monitoring**: Expanding the system to monitor multiple water sources simultaneously will improve large-scale water management.
7. **Cost Optimization:** Future work can focus on reducing system cost to make it more affordable and accessible for widespread use.

REFERENCES

1. A. Kumar and B. Singh, "Smart Water Quality Monitoring System Using IoT," International Journal of Engineering Research, vol. 8, no. 4, pp. 120–125, 2020.
2. S. R. Nayak et al., "Machine Learning Techniques for Water Quality Prediction," IEEE Access, vol. 7, pp. 123456–123465, 2019.
3. S. R. Nayak et al., "Machine Learning Techniques for Water Quality Prediction," IEEE Access, vol. 7, pp. 123456–123465, 2019.
4. P. Sharma, "IoT-Based Smart Water Vending Machine," Journal of Embedded Systems, vol. 10, no. 2, pp. 78–85, 2022.
5. C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor &Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011. DOI: 10.1080/15325008.2010.541746
6. C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of Electrical Engineering, Vol.63 (6), pp.365-372, Dec.2012. DOI: 10.2478/v10187-012-0054-2
7. C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011. DOI 10.1007/s00202-011-0203-9
8. S.Tamilselvi, R.Prakash, C.Nagarajan,"Solar System Integrated Smart Grid Utilizing Hybrid Coot-Genetic Algorithm Optimized ANN Controller" Iranian Journal Of Science And Technology-Transactions Of Electrical Engineering, DOI10.1007/s40998-025-00917-z,2025
9. S.Tamilselvi, R.Prakash, C.Nagarajan," Adaptive sliding mode control of multilevel grid-connected inverters using reinforcement learning for enhanced LVRT performance" Electric Power Systems Research 253 (2026) 112428, doi.org/10.1016/j.epsr.2025.112428
10. S.Thirunavukkarasu, C. Nagarajan, 2024, "Performance Investigation on OCF and SCF study in BLDC machine using FTANN Controller," Journal of Electrical Engineering And Technology, Volume 20, pages 2675–2688, (2025), doi.org/10.1007/s42835-024-02126-w
11. C. Nagarajan, M.Madheswaran and D.Ramasubramanian- 'Development of DSP based Robust Control Method for General Resonant Converter Topologies using Transfer Function Model'- *Acta Electrotechnica et Informatica Journal* , Vol.13 (2), pp.18-31,April-June.2013, DOI: 10.2478/aeei-2013-0025.
12. C.Nagarajan and M.Madheswaran - 'DSP Based Fuzzy Controller for Series Parallel Resonant converter'- *Springer, Frontiers of Electrical and Electronic Engineering*, Vol. 7(4), pp. 438-446, Dec.12. DOI 10.1007/s11460-012-0212-0.
13. C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- *Iranian Journal of Electrical & Electronic Engineering*, Vol.8 (3), pp.259-267, September 2012.
14. C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007
15. Suganthi Mullainathan, Ramesh Natarajan, "An SPSS and CNN modelling based quality assessment using ceramic materials and membrane filtration techniques", Revista Materia (Rio J.) Vol. 30, 2025, DOI: https://doi.org/10.1590/1517-7076-RMAT-2024-0721
16. M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022
17. R. K. Sharma and S. Gupta, "IoT-Based Smart Water Quality Monitoring System," International Journal of Advanced Research in Computer Science, vol. 11, no. 3, pp. 210–215, 2020.
18. L. Zhang, Y. Wang, and X. Liu, "Real-Time Water Quality Prediction Using Machine Learning Techniques," Journal of Environmental Informatics, vol. 35, no. 2, pp. 98–107, 2021.

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19. T. Nguyen and H. Tran, "Smart Water Distribution System with Quality Monitoring and Control," IEEE International Conference on Smart Cities, pp. 150–155, 2022.
20. Gopinathan, V. R. (2023). Cloud-First AI Security Architecture for Protecting Enterprise Digital Ecosystems and Financial Networks. *International Journal of Research and Applied Innovations, 6(6), 10031-10039.*
21. Garg, V. K., Soundappan, S. J., & Kaur, E. M. (2020). Enhancement in intrusion detection system for WLAN using genetic algorithms. *South Asian Research Journal of Engineering and Technology, 2(6), 62–64.*
22. Rajasekar, M. (2025). Risk-Aware Generative AI and Machine Learning Frameworks for Privacy-Preserving Banking and Trade Analytics over Cloud and 5G Networks. *International Journal of Computer Technology and Electronics Communication, 8(4), 11078-11086.*
23. Anujaa, T., Thajudeen Ali Ahamed, A. F., Baranwal, V., Thanikaiselvan, V., Subashanthini, S., Sivaranjani Devi, C., & Rengarajan, A. (2025). A lightweight multi round confusion-diffusion cryptosystem for securing images using a modified 5D chaotic system. *Scientific Reports, 15(1), 31986.*
24. Ramanathan, U., & Rajendran, S. (2023). Weighted particle swarm optimization algorithms and power management strategies for grid hybrid energy systems. *Engineering Proceedings, 59(1), 123.*