Chapter 13

AI Applications in Drinking-Water Management

P. Selvakumar
https://orcid.org/0000-0002-3650-4548
Nehru Institute of Technology, India

Abhijeet Das
https://orcid.org/0000-0003-4599-5462
C.V. Raman Global University, Bhubaneswar, India

Ratan Rajan Srivastava
https://orcid.org/0009-0000-4565-9667
Shri Ramswaroop Memorial College of Engineering and Management, India

T. C. Manjunath
https://orcid.org/0000-0003-2545-9160
Rajarajeswari College of Engineering, India

Sumanta Bhattacharya
https://orcid.org/0000-0003-2563-2787
Maulana Abul Kalam Azad University of Technology, India

Sandeep Gupta
https://orcid.org/0000-0002-3734-3723
Graphic Era University, Dehradun, India

ABSTRACT

This introduction explores the transformative potential of AI technologies in addressing complex challenges facing drinking water systems, while also examining the ethical considerations and technical hurdles that must be navigated for responsible and effective deployment. Drinking water is a fundamental resource essential for human health, economic prosperity, and ecosystem integrity. However, managing water quality and distribution systems presents significant challenges, exacerbated by population growth, urbanization, climate change impacts, aging infrastructure, and emerging contaminants. Traditional methods of water quality monitoring and management rely on periodic sampling, laboratory analysis, and manual intervention, which are often time-consuming, resource-intensive, and may not provide real-time

DOI: 10.4018/979-8-3693-8074-1.ch013

insights needed to prevent waterborne diseases or respond swiftly to contamination events. Firstly, AI enables real-time detection of water quality deviations and potential contaminants through advanced sensor networks and predictive analytics.

INTRODUCTION TO AI IN DRINKING WATER MANAGEMENT

This introduction explores the transformative potential of AI technologies in addressing complex challenges facing drinking water systems, while also examining the ethical considerations and technical hurdles that must be navigated for responsible and effective deployment. Drinking water is a fundamental resource essential for human health, economic prosperity, and ecosystem integrity. However, managing water quality and distribution systems presents significant challenges, exacerbated by population growth, urbanization, climate change impacts, aging infrastructure, and emerging contaminants. Traditional methods of water quality monitoring and management rely on periodic sampling, laboratory analysis, and manual intervention, which are often time-consuming, resource-intensive, and may not provide real-time insights needed to prevent waterborne diseases or respond swiftly to contamination events. The key opportunities presented by AI in drinking water management are manifold. Firstly, AI enables real-time detection of water quality deviations and potential contaminants through advanced sensor networks and predictive analytics. By analyzing historical data and sensor readings, AI algorithms can forecast water quality trends, identify early warning signs of contamination, and trigger alerts or automated responses to mitigate risks before they escalate. This proactive approach not only enhances public health protection but also minimizes operational costs associated with reactive measures and infrastructure maintenance.

Secondly, AI facilitates predictive modeling and scenario analysis to optimize water treatment processes, resource allocation, and infrastructure planning. ML algorithms predict water demand patterns based on historical consumption data and environmental variables, enabling utilities to adjust pumping schedules, optimize chemical dosing, and manage reservoir levels efficiently. Deep learning models analyze complex datasets from satellite imagery and remote sensing technologies to monitor watershed dynamics, assess water availability, and inform drought management strategies in water-stressed regions (Antunes A, et al., 2018). Furthermore, AI-driven decision support systems enhance operational efficiencies and resilience in response to dynamic environmental conditions and regulatory requirements. Autonomous systems can autonomously adjust treatment parameters, optimize energy consumption, and prioritize maintenance activities based on real-time data and predictive insights. This adaptive approach reduces energy consumption, minimizes carbon footprints, and enhances the overall sustainability of drinking water

Related Content

Water and Wastewater Engineering
Avinash Kumar, Jaya Yadav, Rubeena Vohraand Anand Sebastian (2024). *Advanced Geospatial Practices in Natural Environment Resource Management (pp. 26-37).*
www.irma-international.org/chapter/water-and-wastewater-engineering/342209

Safety and Efficiency Enhancement in LNG Terminals
Ravinder Singhand Helen Huiru Lou (2017). *Natural Resources Management: Concepts, Methodologies, Tools, and Applications (pp. 1584-1596).*
www.irma-international.org/chapter/safety-and-efficiency-enhancement-in-lng-terminals/165362

Crisp and Fuzzy AHP in GIS-MCDA for Wildlife Habitat Suitability Analysis
Suman Sinha (2020). *Spatial Information Science for Natural Resource Management (pp. 1-23).*
www.irma-international.org/chapter/crisp-and-fuzzy-ahp-in-gis-mcda-for-wildlife-habitat-suitability-analysis/257694

Understanding Climate Smart Agriculture (CSA) Practices by Smallholder Farmers to Cope With Risks in Tanzania
Joel Johnson Mmasa (2024). *Advanced Geospatial Practices in Natural Environment Resource Management (pp. 189-213).*
www.irma-international.org/chapter/understanding-climate-smart-agriculture-csa-practices-by-smallholder-farmers-to-cope-with-risks-in-tanzania/342217

The Call for Global Responsible Inter-Generational Leadership: The Quest of an Integration of Inter-Generational Equity in Corporate Social Responsibility (CSR) Models
Julia Puaschunder (2017). *Natural Resources Management: Concepts, Methodologies, Tools, and Applications (pp. 265-278).*
www.irma-international.org/chapter/the-call-for-global-responsible-inter-generational-leadership/165296