

# SMART WATER WITH ARTIFICIAL INTELLIGENCE

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Digitalization is revolutionizing every facet of our society, reshaping industries ranging from finance, services and education to natural resource management. It's not just altering the way we conduct our daily activities, but also revolutionizing how we interact and communicate with one another. From streamlining processes to fostering global connections, its impact is profound and far-reaching. The adoption of digital technology in any industry is a dynamic process, necessitating shifts in organizational culture alongside the seamless incorporation of digital tools to propel the sector's advancement. Among modern technological interventions, Artificial Intelligence (AI) stands out as a pivotal technology in the digital transformation.

According to a United Nations' report on global clean water and sanitation, it is alarming that over 40% of the world's population lacks access to safely managed drinking water. The report also reveals that a staggering 4.5 billion people, representing more than half of the global population, lack access to safe sanitation facilities. It is disturbing that nearly 2 billion people are reliant on water sources contaminated with sewage. The urgent and noble objective of providing clean water and sanitation demands significant attention and innovation. It must be promptly addressed by amalgamating sustainable development practices with intelligent infrastructure management.

There has been considerable speculation regarding the potential of emerging technologies such as Artificial Intelligence to benefit various sectors, including water management. While it may appear as a distant concept to some utilities, the reality is that as we progress into 2024, water utilities worldwide are actively turning this vision into reality. Its applications extend to real-time monitoring, predictive maintenance, process control, and forecasting,

among other crucial functions, showcasing its transformative impact on the water sector.

Artificial intelligence (AI) is increasingly proposed to address deficiencies across water systems. It is poised to enhance supply insights, resource management and emergency response, improve treatment plant and distribution network design, operation and maintenance, and advance service availability, demand management and water regulations.

AI and its subdivision of machine learning (ML), is the latest technological intervention proposed to solve problems across water systems by building climate resilience, enhancing performance of infrastructure and assisting WASH efforts. AI holds promise in addressing challenges pertaining to clean water and sanitation. It aids utilities and municipalities in more effectively managing their water and wastewater systems, thereby ensuring a supply of clean and sanitized water. Several utilities and water-intensive industries have already begun leveraging AI to enhance services related to water delivery and sanitation. With AI, they now possess a more efficient means of monitoring water quality, managing usage, and predicting maintenance needs for aging infrastructure.

When utilized in addressing challenges within the water sector, artificial intelligence has the potential to create unparalleled opportunities for enhancing efficiency, sustainability, and resilience.



The added benefit AI provides to a water utility encompasses enhanced efficiency in operations, improved decision-making through data-driven insights, proactive maintenance to prevent system failures, optimized resource allocation, and ultimately, the ability to ensure a more reliable and sustainable water supply for domestic and industrial sectors. The significant benefits that it brings to the operation of a utility involve:

- Water utilities are increasingly managing vast and complex datasets; AI plays a crucial role in transforming this data into actionable insights for informed decision-making.
- By integrating AI into existing systems, utilities can enhance operational efficiency, improve planning processes, and track resource flows more effectively.
- AI enables the development of innovative concepts like Digital Twins, which are digital replicas of water utilities that simulate real-time operations. These digital twins serve as powerful tools for decision-making and future projections in the water sector.
- AI enhances the capabilities of other technologies such as Virtual Reality and Blockchain applications, further advancing the

efficiency and effectiveness of water utility operations.

- AI technology, integrated into existing IT infrastructure, enhances the efficiency of water treatment facilities by reducing operating expenses (OPEX).
- AI-powered software solutions learn from treatment plant's historical performance data and prescribe optimal control actions based on energy and chemical objectives, as well as real-time and forecasted conditions.
- Intelligent plant operations driven by AI facilitate predictive control at every stage of the wastewater treatment process. This includes optimization of aeration, anaerobic digestion, membrane bioreactors, membrane recovery, membrane cleaning schedules, and chemical dosing to ensure the effluent leaving the facility meets prescribed safety standards.
- AI-assisted solutions utilize machine learning to analyze data from wastewater treatment plants, offering predictive recommendations to meet clean water and sanitation goals at minimal operating cost.
- AI-based systems detect leaks, pipe bursts, and other failures in water supply networks. These detection systems automatically process pressure and flow sensor data in real-time, forecasting signal values to anticipate potential issues.
- AI-based solutions automate urban drainage systems, where the integrity of the pipe network is crucial to avoid pollution and flooding incidents caused by undetected structural faults such as displaced joints or cracks.
- During rainfall, AI detects flows and blockages in sewers, assessing whether they exceed critical levels or deviate from expected flow patterns, helping to prevent potential overflows or backups.
- Targeted AI applications could help reduce the unnecessary consumption of freshwater in agriculture sector.
- At the household level, AI-based smart water-saving devices may curtail household water



AI in water management revolves around utilizing data to enhance decision-making processes.

consumption, while smart meters coupled with predictive demand and pricing analytics could provide incentives to drive behavioral change towards water conservation.

### THE CHALLENGES

The global progress towards achieving Sustainable Development Goal 6 is faltering, with more than 1.6 million deaths yearly attributed to unsafe water and inadequate sanitation. Climate change is poised to worsen these issues. While AI is publicized as a solution, it's not a panacea.

There are issues related to data quality, availability, and compatibility across various systems and sources that hamper the AI ability to process it correctly to make informed decisions. The complexity

The primary role of AI in water management lies in its capacity to forecast future water demands.

of water systems and the need for domain-specific expertise make it challenging to develop effective AI solutions. Mismanaged AI adoption may create progress traps, worsening water security challenges. As AI adoption remains limited, especially within the water sector, there is a scarcity of empirical data on real-world applications. Overcoming these challenges requires collaborative efforts among stakeholders and careful planning to ensure successful AI implementation in the water sector.

### GOING FORWARD

Digital technologies have profoundly enhanced various aspects of our lives, and their impact on water management is equally significant. Intelligent technologies have the potential to revolutionize routine maintenance tasks and minimize downtime. In developing countries, water network leakage causes the loss of about 45 billion liters of potable water daily, enough to hydrate 180 million people. AI-enabled leak identification applications improving the accuracy of pipeline networks.

The effectiveness of AI relies heavily on the integration with existing systems and the expertise of those involved in its development. Many of the potential AI applications mentioned earlier necessitate well-established water infrastructure, robust information and communications technology (ICT) infrastructure, and domain expertise to be successfully implemented. It is imperative that we thoroughly comprehend these technologies and continue to foster their advancement to ensure ongoing improvements in our lives and the sustainability of water resources for future generations.

### About the Author



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As Chief Strategist of TS Advisory Services, he is responsible for planning, evaluating, defining, and developing measurable business and communication strategies for infrastructure development and water companies. With a Ph.D. in media and an MBA in marketing, he brings over 28 years of experience across various sectors, including water and wastewater management.