

Water Resource Management Optimization Through Metaheuristics and Machine Learning in Smart Cities

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Abstract:

Effective water resource management is critical for ensuring sustainability and resilience in smart urban environments. This study proposes an intelligent optimization framework that integrates metaheuristic algorithms and machine learning techniques to enhance water distribution, usage forecasting, and leakage detection in smart cities. IoT-based sensor networks are deployed to collect real-time data on water flow, consumption, and environmental conditions. Machine learning models, such as Support Vector Machines (SVM) and Random Forests, are used for predictive analytics, while metaheuristic algorithms—including Genetic Algorithms (GA), Ant Colony Optimization (ACO), and Particle Swarm Optimization (PSO)—optimize resource allocation and system performance. The hybrid system allows for adaptive, data-driven decision-making, reducing waste and improving the overall efficiency of urban water infrastructure. Simulation results demonstrate improved accuracy, reduced response time, and enhanced sustainability outcomes compared to traditional methods.

Keywords:

Water management, smart cities, machine learning, metaheuristics, IoT, sustainability.

REQUEST FOR FULL TEXT

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