Chapter 17
Wireless Sensor Networks (WSNs)–Integrated Machine Learning Algorithms for Water Resource Management

Ashay Devidas Shende
https://orcid.org/0000-0002-2082-1311
Department of Civil Engineering, K.D.K. College of Engineering, Nagpur, India

J. Bibiana Jenifer
https://orcid.org/0009-0005-9396-0450
Department of Information Science and Engineering, New Horizon College of Engineering, Bengaluru, India

Gururaj L. Kulkarni
Department of Computer Science and Engineering, Vardhaman College of Engineering, Hyderabad, India

Amar Choudhary
https://orcid.org/0000-0003-3865-2680
Department of Electronics and Communication Engineering, Alliance College of Engineering and Design, Bengaluru, India

Aparajita Mukherjee
https://orcid.org/0009-0009-1259-7864
Department of Computer Science and Engineering, IEM Newtown Campus, Kolkata, India

Sampath Boopathi
https://orcid.org/0000-0002-2065-6539
Department of Mechanical Engineering, Muthayammal Engineering College, Namakkal, India

ABSTRACT

The integration of Wireless Sensor Networks (WSNs) with advanced machine learning algorithms is revolutionizing water resource management. This chapter delves into

DOI: 10.4018/979-8-3693-5448-3.ch017

the synergistic application of these technologies to address critical challenges in monitoring and managing water resources. It begins with an introduction to WSN technology, emphasizing its role in real-time data collection for water quality monitoring, irrigation systems, and flood detection. The chapter then explores various machine learning algorithms, such as Support Vector Machines (SVM), Convolutional Neural Networks (CNN), and Recurrent Neural Networks (RNN), highlighting their applications in predictive analytics and anomaly detection. The chapter discusses successful implementations of WSNs and machine learning in water distribution and proactive infrastructure maintenance, emphasizing the importance of accurate data interpretation for informed decision-making in real-time data analysis techniques.

INTRODUCTION

Water resources management is an important aspect of sustainable development. It would involve a plan, development, and management of water resources that cater to present and future human needs while protecting the natural environment. This discipline encompasses a very wide area; therefore, it addresses activities that include water supply and quality control to flood protection and ecosystem conservation. Proper management in water resources has become critical due to the continuous increase of the world population and alteration of hydrological regimes as a consequence of climate variability and change (Rosero-Montalvo et al., 2020a) .

Management of water resources deals with providing clean water in a reliable manner for uses such as domestic, agriculture, industry, and recreation. This involves planning and building infrastructures like dams, reservoirs, pipelines, and treatment plants. Management of these resources takes into consideration the equilibrium among the competing uses and also protection of water quality. Industrial waste, agricultural runoff, and urbanization all contribute various contaminants to water supplies. Advanced treatment processes and strict regulations have been implemented to offset these impacts in an effort to have safe water (Padmanaban & others, 2021).

The second critical aspect in which water resources are managed involves the management of water quantity to avoid shortage and excess. Water scarcity results from over-extraction of groundwater, inequitable use of water, and long droughts. To address these issues, different measures are implemented with respect to the conservation of water, utilization of other water supplies including desalination and recycled water, and the use of efficient irrigation methods. On the other hand, excess water is regulated, particularly for areas that are experiencing flood, through proper method of flood control. This will involve constructing levees, floodways, and detention basins in addition to early warning systems that will reduce the