

Chapter 20

Role of IoT, AI, and ML in Carbon Management: A Convergence of Technologies for Efficient Monitoring and Analysis

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ABSTRACT

The integration of Internet of Things (IoT), Artificial Intelligence (AI), and Machine Learning (ML) is revolutionizing carbon management by enabling precise monitoring, predictive analysis, and automated decision-making. IoT plays a pivotal

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role in carbon management by deploying smart sensor networks that continuously monitor carbon flux in terrestrial and marine ecosystems. These sensors collect real-time data on greenhouse gas (GHG) concentrations, soil organic carbon, oceanic carbon absorption, and industrial emissions. ML techniques allowing for the early detection of carbon cycle anomalies and enhancing strategies such as reforestation, soil carbon enrichment, and ocean-based carbon capture. Additionally, edge computing in IoT devices ensures decentralized data processing, reducing latency and enhancing real-time decision-making. This chapter explores the convergence of IoT, AI, and ML in carbon management systems, discussing their applications, challenges, and future potential. Chapter shows the machine learning algorithms for detecting carbon emission in air.

1. INTRODUCTION

With rising global concerns about climate change and greenhouse gas (GHG) emissions, efficient carbon management has become a necessity. Traditional methods rely on manual data collection and analysis, which are often inefficient and error-prone. The integration of IoT, AI, and ML offers a promising solution by automating monitoring systems, optimizing carbon sequestration efforts, and enhancing carbon footprint analysis, Hossain et al. (2024).

As the global community intensifies efforts to combat climate change, managing carbon emissions has emerged as a critical priority. The rise of greenhouse gases, particularly carbon dioxide (CO₂), has driven the need for innovative solutions to monitor, analyze, and reduce emissions effectively. Traditional methods of carbon management—manual data collection, periodic reporting, and siloed analysis—are increasingly inadequate in the face of complex, real-time environmental challenges. Enter the convergence of the Internet of Things (IoT), Artificial Intelligence (AI), and Machine Learning (ML)—a technological triad that promises to revolutionize carbon management by enabling precise monitoring, predictive insights, and actionable strategies, Mcmillan et al (2022).

Air Pollution refers to the contamination of atmosphere by the harmful substances like CO₂, SO₂, NO₂, particulate matter etc. The main cause of Air Pollution is due to the smoke emission from automobiles, industrial emissions, and burning of fossil fuels. It has hazardous effects on health of humans and other living beings, leading to cardiovascular diseases, respiratory issues, and other serious health problems. To address these, certain technologies such as Machine Learning (ML) models, and Internet of Things (IoT) are being used.

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