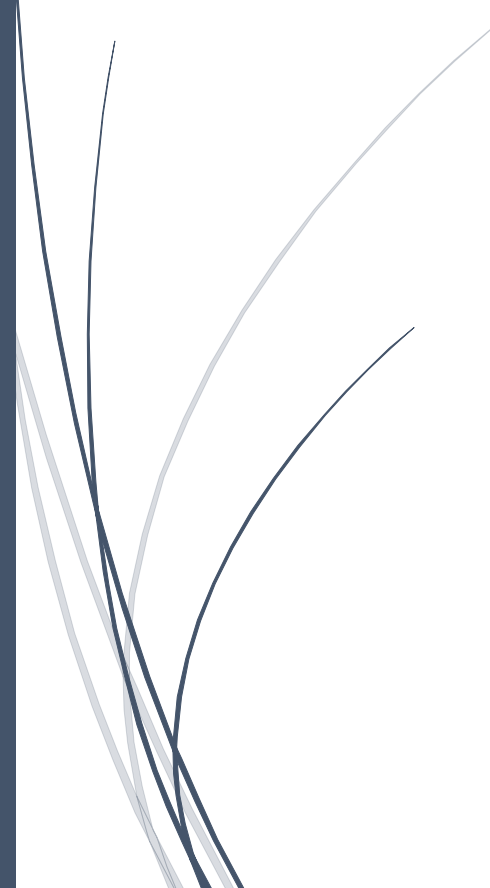


The logo for RADemics, featuring the text "RADemics" in white on a blue arrow-shaped background pointing to the right. The arrow is part of a larger blue graphic element on the left side of the page.

RADemics

Artificial Intelligence and IoT Frameworks for Climate Change Monitoring and Environmental Sustainability

A decorative graphic on the left side of the page consisting of several thin, curved lines in shades of blue and grey, resembling stylized grass or reeds, extending from the bottom left towards the center.

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Artificial Intelligence and IoT Frameworks for Climate Change Monitoring and Environmental Sustainability

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Abstract

The increasing impacts of climate change have necessitated the development of more accurate and dynamic systems for climate monitoring, prediction, and adaptation. This chapter explores the integration of Artificial Intelligence (AI) and the Internet of Things (IoT) to enhance climate change monitoring and sustainability efforts. The synergy between AI and IoT provides powerful capabilities for real-time data collection, analysis, and predictive forecasting. IoT-enabled sensors deployed across diverse environments generate vast amounts of real-time environmental data, while AI algorithms process and interpret this data to improve climate models and forecasting accuracy. By incorporating IoT-generated data into predictive climate models, cities, industries, and governments can make data-driven decisions to mitigate risks and adapt to environmental changes. The chapter examines key applications in urban and rural areas, focusing on how AI and IoT are reshaping climate change adaptation strategies, disaster preparedness, and resource management. Case studies highlight the transformative role of these technologies in achieving climate resilience and sustainability goals. This research underscores the need for an integrated, data-driven approach to addressing climate challenges, offering a comprehensive framework for leveraging AI and IoT to build climate-smart solutions.

Keywords: Artificial Intelligence, Internet of Things, Climate Change Monitoring, Sustainability, Predictive Analytics, Real-Time Data.

Introduction

The escalating impacts of climate change present unprecedented challenges to ecosystems, economies, and societies worldwide [1]. From rising sea levels to extreme weather events such as hurricanes, droughts, and floods, the effects of a changing climate are becoming more apparent [2]. As these impacts intensify, the need for advanced technologies to monitor, predict, and mitigate climate-related risks is more urgent than ever [3]. Traditional methods of climate observation, while valuable, often struggle to provide the resolution, real-time data, and comprehensive coverage needed to track climate shifts accurately [4]. In response to these challenges, the convergence of Artificial Intelligence (AI) and Internet of Things (IoT)

technologies offers a transformative approach to climate change monitoring and sustainability efforts [5].

The integration of IoT with AI allows for the development of smart systems capable of providing real-time environmental monitoring across a vast array of ecological landscapes [6]. IoT systems consist of interconnected sensors deployed in various environments to measure critical environmental parameters such as temperature, humidity, air quality, and soil moisture [7]. These sensors generate continuous streams of data that, when processed by AI algorithms, enable accurate assessments of climate conditions [8]. AI-driven models can process these data points to detect patterns, identify anomalies, and provide predictive insights into climate trends [9]. This combination of real-time data collection and advanced predictive analytics enhances the precision of climate models, improving the forecasting of extreme weather events and long-term climate changes [10].

In urban environments, IoT-based climate monitoring systems play a vital role in managing sustainability efforts and improving the quality of life for residents [11]. Cities, with their high concentrations of population, industry, and infrastructure, are both major contributors to and affected by climate change [12]. IoT sensors placed in key locations, such as along transportation routes, industrial zones, and residential areas, continuously measure factors like air pollution, energy consumption, and waste generation [13]. The data collected by these sensors, when analyzed with AI, helps urban planners and policymakers understand the dynamics of environmental degradation [14]. This information is crucial for implementing climate policies, such as regulating air quality, optimizing energy usage, and reducing greenhouse gas emissions [15].