AI/ML-Driven Climate Resilience: Mitigating Climate Change Challenges Through Data Science and Machine Learning

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Abstract

Climate Change poses serious threats to the environment making it vital to obtain effective mitigation strategies. This research paper explores the potential of AI and ML techniques by optimizing energy systems, reducing greenhouse gas emissions, and promoting sustainable practices. The intention of this paper is to explain how AI and ML techniques can enhance the effectiveness of current mitigation procedures. Additionally, it identifies AI driven solutions based on gaps in current approaches. The research involves a detailed literature review which is used to understand and analyze current mitigation strategies. Finally, it involves prior research to AI and ML applications and relevant evidence that is analyzed to emphasize the impact of AI driven solutions.

Keywords: Climate change, Data science, Machine learning, AI

1. Introduction

Climate change refers to long-term alterations in Earth's climate patterns. These are usually caused by human activities such as deforestation and the burning of fossil fuels that release a harmful level of greenhouse gasses into the atmosphere. These gasses (Carbon Dioxide, Methane, Water Vapour, Nitrous Oxide) trap heat from the sun and are the leading cause of global warming. Global warming can cause adverse effects such as rising sea levels, disruptions in ecosystems, and extreme weather conditions. The problem poses significant challenges to the planet's sustainability and requires urgent and effective mitigation strategies to limit its impact. AI and ML strategies offer an interdisciplinary approach by combining machine learning, data science, and climate science. These strategies can be used to derive real time climate analysis, predict extreme weather events, and create accurate forecasting models in limited time frames. Another exciting aspect of our research is scalability. If we are able to develop and implement a successful ML model which can predict climate challenges and provide AI driven solutions based on our research paper, in one region, we can then export the model to other regions facing worse climate conditions and broaden the impact making it extremely scalable.

Our driving research question for this paper is: How can AI and ML techniques be utilized to optimize energy systems, reduce greenhouse gas emissions, and promote sustainable practices in the climate change realm? What are key challenges that we can face with AI/ML integration and how can we overcome them? How can we use AI/ML effectively to create accurate predictions regarding climate events? How can we combine the most effective traditional models and AI/ML models to improve accuracy and reliability?

2. Potential Benefits

Academic Community: The Academic community can benefit from AI/ML integration as they can further expand their knowledge on Climate Change solutions.

Industries: A potential benefit includes innovation. They can adopt AI/ML techniques and apply them to their own mitigation strategies. This not only contributes to climate change mitigation but also the development of new products and services.

Society: Safety can be guaranteed. AI/ML techniques allow faster disaster warnings and more accurate extreme weather predictions. Climate change affects public health, but with AI/ML models that can predict health risks associated with extreme weather conditions and natural disasters we can safeguard more communities.

3. Literature Review

Since anthropogenic climate change first emerged into the news in the mid 1980s, public communication has risen greatly. This ideology of climate change was confusing, maybe even daunting. That fact that humans were contributing to such a deadly "theory", startled the nation. In fact, it threatened them. However, this so-called "theory" had multiple proven causes that needed to be addressed.

Number one on that list being, none other than, greenhouse gasses. "If global climate change were in fact to unfold with the serious impacts expected by many scientists, there could soon be a strong need and legal requirement to curtail greenhouse gas emissions and limit carbon-emitting land uses. Many with a direct stake in maintaining the carbon-heavy status quo emerged as loud spokespersons against the reality of climate