Leveraging Artificial Intelligence (AI) in Managing Climate Change

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ABSTRACT

Pressing environmental challenges such as climate change, biodiversity loss, global warming, environmental degradation, etc. are among the core issues discussion globally. On the other hand, the progress and advancement of artificial intelligence (AI) has been very rapid where many are using AI in their work, recognising the role and precision AI can provide in many fields. This article discusses how the advancements in AI could be utilised in reducing environmental impacts and foster a more sustainable future. AI provides innovative solutions across multiple sectors from optimising energy consumption and resource management to enhancing conservation efforts and predicting environmental risks.

INTRODUCTION

Climate change is one of the most pressing challenges of our time, with far-reaching impacts on ecosystems, economies, and societies worldwide. As the global community strives to reduce greenhouse gas emissions (GHGs) and adapt to the changing climate, innovative solutions are urgently needed, a strategic integration of artificial intelligence (AI) technologies. Climate, the long-term pattern of temperature, precipitation, and other atmospheric conditions in a region, is not only a fundamental aspect of Earth's natural systems but also a crucial determinant of human well-being, ecological stability, and socioeconomic development. The importance of climate transcends geographical boundaries and temporal scales, shaping ecosystems, economies, and societies in profound ways. In this introduction, we explore the multifaceted importance of climate and underscore the urgency of addressing climate change, one of the defining challenges of the 21st century.

Rapid development is a positive sign for most countries, showcasing wise and suitable economic policies to bring a country forward. Nevertheless, along the path to growth and development of a country, there has been a significant negligence on the environment, which led to global warming and now is moving towards global boiling. This indicated that there is a deterioration in the environment condition

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globally, where the weather has been unpredictable and extreme weather temperature on recently. The weather has been erratic, leading to condition named as El Nino and La Nina.

Urgent action is needed as the climate crisis worsens and the world is expected to exceed the 1.5°C warming limit by around 2029 (Lamboll RD et al., 2023). Science and technology play an important role in finding solutions and creating a more sustainable future. However, scientific research itself also affects the environment. Studies show that laboratories use three to ten times more energy than regular offices. For example, the University of Oxford (UK) found that 60% of its greenhouse gas emissions come from lab buildings (Royal Society of Chemistry, 2024). Laboratory work also produces a lot of waste, including water, chemicals, and plastic. According to Urbina MA et.al (2015), it was estimated that labs around the world create about 5.5 million tons of plastic waste each year with roughly 2% of the world's total plastic waste.

BACKGROUND OF AI ON CLIMATE CHANGE

The intersection of Artificial Intelligence (AI) and climate change management has evolved significantly over the past few decades. Understanding the historical context provides insight into how AI's role in addressing climate challenges has expanded, matured and continue growing exponentially in the future, highlighting key milestones and advancements.

Early Beginnings and Conceptual Foundations

The conceptual foundations of AI date back to the mid-20th century, with pioneers like Alan Turing and John McCarthy laying the groundwork. Turing's seminal 1950 paper "Computing Machinery and Intelligence" and McCarthy's coining of the term "Artificial Intelligence" in 1955 marked the formal beginnings of AI research. However, it wasn't until the 1980s and 1990s that AI began to show potential for environmental applications, including early climate modeling efforts (A. M. Turing (1950); McCarthy.et.al (2006)).

Climate Modeling and Data Analysis

One of the earliest applications of AI in climate science was in improving climate models. Traditional climate models, based on physical and statistical methods, often struggled with the complexity and scale of the climate data. AI, a machine learning algorithm, offered new ways to handle large datasets and identify patterns that were not easily discernible through conventional methods. In the 1990s, AI techniques such as neural networks and fuzzy logic began to be explored for climate-related applications. These methods provided more accurate predictions of weather patterns, improved climate simulations, and enhanced the understanding of climate dynamics. For instance, neural networks were used to analyse historical weather data to predict future climate trends, offering a glimpse into AI's potential for climate forecasting (Chen, L et.al, 2023).

Current AI technologies include tools for weather forecasting, iceberg monitoring, and pollution detection. According to the World Economic Forum, AI can also enhance agricultural practices while minimising their environmental footprint. By processing vast amounts of data and supporting human decision-making, AI is revolutionising various industries, including the environmental aspect. For exam-