Chapter 7
Improving Renewable Energy Production Systems Using Artificial Intelligence

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ABSTRACT

This article examines the use of artificial intelligence (AI) into the optimization of renewable energy production systems, primarily focusing on solar energy. In light of the growing demand for renewable energy sources and the difficulties associated with their intermittent production, IA appears to be a promising approach to increase these systems' reliability and efficiency. A thorough analysis of the effect of the IA on the effectiveness of renewable energy generation systems is presented. It investigates the machine learning approaches used to forecast energy output based on historical and meteorological data and suggests intelligent storage and management strategies. In order to determine the most effective solutions, a comparison of the performance of several optimization algorithms is conducted. The anticipated studies show a significant increase in the efficiency of renewable energy production systems, a decrease in production costs, and an improvement in the accuracy of energy output forecasts.

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INTRODUCTION

Between 2000 and 2030, there will likely be an average annual rise in global energy consumption of 8%. Fossil fuel combustion provides a significant portion of the required energy, which has the strongest effects. Many developed and developing nations have implemented policies that support the use of renewable energy sources like solar and wind power to lessen their reliance on fossil fuels. One of the most popular alternatives to fossil fuels is the use of renewable energy sources. There are several reasons for this, including the decrease in the use of fossil fuels, price fluctuations, demographic growth, and environmental concerns like climate change (Shoaei et al., 2024).

Equally important, the world population is expanding at an accelerated rate, which puts a great strain on our ability to protect the environment and severely restricts our access to natural resources. Also, there has been increased scrutiny of the agriculture industry, particularly about feeding our people. Moreover, energy is a necessary component of daily life that has been crucial to the development of civilizations.

Degradation of the ecosystem and global warming have escalated due to greenhouse gas emissions and more frequent extreme weather occurrences. To lessen the environmental problem and the impending climate disaster, nations must move quickly to agree and implement workable remedies (Ren et al., 2024).

Researchers and industry have turned their attention to clean and renewable energy sources in recent years due to the acceleration of climate change and global warming. One way to reduce the emissions produced by fossil fuel-based energy systems is to implement a hybrid renewable energy system (Ghandehariun et al., 2023).

Following this, renewable energy can help the environment by providing more environmentally friendly alternatives to fossil fuels, which have negative effects. When taking into account the buildings' whole lifecycle, green energy plays a critical role in keeping these structures clean by generating significantly fewer greenhouse gases and little to no air pollutants (Perkel 2017). Compared to conventional energy sources, alternative energy sources have several benefits.

Development of renewable energy on a large scale can guarantee electricity supply. It helps to accomplish ecological preservation and lower carbon emissions by substituting high-carbon energy sources. The main benefit is that renewable energy is highly sustainable and can eventually meet the energy requirements for human progress (Rasool et al., 2022).

The growth of Internet of Things (IoT) technological solutions for energy management is unabated as the need for greener energy grows and environmental awareness becomes the norm. Modern technologies, including the Internet of Things (IoT), have a plethora of possible uses in the energy sector, including energy demand as well as the supply, transmission, and distribution of energy. It is feasible to determine securely and accurately whether the information can be used or disregarded thanks to the resilience of the Internet of Things structure. For academics to use these new technology and information for analysis (Said et al., 2020; Wang et al. 2022).

Future power systems may be developed sustainably with the help of renewable energy. Numerous prediction studies have been carried out by academics using pertinent data and knowledge on the production of renewable energy. Within the discipline of forecasting, researchers investigate unresolved issues related to application scenarios, energy transitions, and future development trajectories for renewable energy (Goncalves et al., 2021; Yang et al., 2022).

Relatively new ideas in the energy field, artificial intelligence and machine learning have the potential to be useful tools for operating systems by using past and anticipated futures to improve system efficacy (Entezari et al., 2023). The term “artificial intelligence” describes a spectrum of data-driven techniques