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INTELLIGENT SINGLE AXIS SOLAR TRACKING USING AI-BASED CONTROL ALGORITHMS

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Abstract

This paper presents the design and analysis of an intelligent single-axis solar tracking system using Artificial Intelligence (AI) techniques to improve the efficiency of photovoltaic (PV) power generation. The proposed model employs an Artificial Neural Network (ANN) trained using temporal and geographical parameters including day, temperature, latitude and longitude to predict the optimal tilt and azimuth angles for maximum solar irradiance capture. A fuzzy logic controller is incorporated to enhance actuator precision and stability. Both simulation and experimental results validate the system's performance, demonstrate a significant performance improvement, achieving a prediction accuracy of 97% ($R^2 = 0.97$) and a Mean Square Error (MSE) of 0.0017 (in normalized angle units). The proposed hybrid AI tracking system demonstrates improved energy yield and operational reliability compared to traditional static and sensor-based trackers, making it suitable for cost-effective and sustainable solar energy systems.

Key words: ANN, high efficiency, radiation, single-axis tracking systems, zero emissions solar tracking systems

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