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Design and Implementation of MPPT Techniques on PV Systems using Fuzzy Logic controller, ANN, and Genetic Algorithm

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Abstract: *This paper presents the design and implementation of Maximum Power Point Tracking (MPPT) techniques for Solar Photovoltaic (PV) systems using Fuzzy Logic, Neural Networks, and Genetic Algorithm (GA). Efficient energy harvesting from solar PV systems is essential to optimize performance under varying environmental conditions, such as changes in solar irradiance and temperature. The proposed approach combines intelligent control methods—Fuzzy Logic and Neural Networks to adaptively adjust the operating points of the PV system to track the maximum power point (MPP). Moreover, a Genetic Algorithm enhances the optimization process by adjusting the duty cycle of the DC-DC converter for efficient energy extraction. The Fuzzy Logic controller fine-tunes the duty cycle based on predefined membership functions and rules, while the Neural Networks approach uses training data for real-time adaptation. The Genetic Algorithm optimizes the duty cycle to maximize power output. Simulation results demonstrate the hybrid system's superior performance, especially in handling rapid environmental changes, compared to conventional MPPT methods.*

Keywords: Solar PV, Boost converter, fuzzy logic controller, ANN controller, Genetic algorithm