IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 2, March 2025

ANFIS-Driven Optimization for Off-Board EV Battery Charging Integrated with Solar Photovoltaic Arrays

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Abstract: *This paper presents an intelligent off board electric vehicle (EV) battery charging system enhanced by ANFIS optimization and powered by a solar photovoltaic (PV) array. The proposed system addresses challenges arising from the intermittent nature of solar energy by incorporating a backup battery and advanced control mechanisms. A SEPIC converter and a bidirectional dc-dc converter (BIDC) are employed to ensure continuous charging under varying solar irradiation. The Adaptive Neuro-Fuzzy Inference System (ANFIS) controller enhances system adaptability and optimizes charging performance by precisely managing power flow. Simulations conducted in MATLAB Simulink confirm the system's ability to maintain stable voltage and efficient energy transfer across diverse operating conditions. Comparative analysis demonstrates significant improvements in charging efficiency and reduced dependency on grid power. The simulation results validate the findings, establishing the effectiveness of this solution for sustainable EV charging infrastructure. This approach supports eco-friendly transportation by integrating renewable energy with advanced control strategies.*

Keywords: Solar PV, SEPIC converter, EV Battery, Bidirectional DC-DC converter, ANFIS controller