Optimization-Based Intelligent Energy Management Strategy for Photovoltaic System Integrated Electric Vehicle Wireless Charging System

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Abstract

The increasing number of electric vehicles poses significant challenges in determining the source and methods of energy transfer for charging. Grid to vehicle (G2V) and wireless power transfer technologies represent crucial milestones in this field. During the charging of electric vehicles from the grid, issues stemming from overloading can emerge, especially during peak demand periods. Introducing renewable energy sources into charging stations offers a sustainable and eco-friendly charging infrastructure as a solution to this problem. Effective energy management algorithms are necessary for the efficient operation of these systems. These algorithms play a critical role in optimizing the energy flow between electric vehicles, renewable energy sources, and the grid. This study proposes a system where the energy required for charging electric vehicles is provided both from the grid and photovoltaic panels and transferred wirelessly. The wireless power transfer system [1] is recommended for its convenience to users and for enhancing the safety of the charging process. The energy flow in the system is controlled by an optimization-based energy management algorithm. This algorithm maximizes system performance by optimizing energy flow both to electric vehicles (G2V) and the grid (V2G) [2]. The primary objective of the algorithm is to charge the electric vehicle. Energy for charging will primarily come from the photovoltaic system, with support from the grid when necessary. Additionally, surplus energy generated from the photovoltaic system can be transferred to the grid when the electric vehicle is not charging. Similarly, excess energy in the electric vehicle can also be transferred back to the grid. Furthermore, it has been observed that power converter circuits within the system operate with over 90% efficiency thanks to this energy management algorithm. This study presents an important solution to enhance the effectiveness of wireless charging stations integrated with renewable energy sources and to ensure energy efficiency.

Keywords: Energy management, Electric vehicle charge, Bidirectional flow, Photovoltaic sytem

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