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Control and Optimization Strategies for DC Microgrid-Based EV Charging Infrastructure

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Abstract: *The widespread adoption of electric vehicles (EVs) introduces new challenges for conventional power distribution systems, particularly during periods of high demand. In response, this study proposes an intelligent control strategy for EV charging infrastructure based on a DC microgrid. The system integrates photovoltaic (PV) generation, battery storage, and grid support to ensure reliable, efficient energy delivery while minimizing grid dependency. A rule-based decision mechanism is developed to manage charging modes—fast, average, and slow—based on real-time power availability and user preferences.*

The proposed model simulates power flow across multiple sources, dynamically adjusting charging priorities to maintain voltage stability and optimize energy use. A microcontroller-based platform is used to validate the control logic through hardware and simulation, demonstrating improved energy autonomy and system responsiveness. Results confirm that the approach enhances power quality, supports flexible charging behaviour, and contributes to the development of sustainable EV infrastructure supported by renewable energy sources..

Keywords: Electric Vehicle, DC Microgrid, Power Management Strategy, Energy Storage System

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