ABSTRACT

The power supply switching system in charging stations is crucial in optimizing energy use, especially in reducing peak load costs. This research develops a fuzzy algorithm based on ESP32 device and PZEM-004T power measurement module to regulate power supply distribution by considering various factors, such as voltage condition (undervoltage, normal voltage, overvoltage), time of energy use (WBP, LWBP), and energy cost. This approach aims to ensure energy efficiency, system stability, and minimize operational costs.

In this system, the ESP32 serves as the main controller to process fuzzy algorithms and communicate with the PZEM-004T module to obtain technical parameters, such as voltage, current, power, and energy. The data processed by the ESP32 is used to generate appropriate switching decisions against changing system conditions. Through simulation and real-life testing, the system is able to efficiently switch the power supply to avoid high costs during peak loads, while ensuring uninterrupted vehicle charging.

Test results show that the application of ESP32-based fuzzy algorithms and PZEM-004T in switching power supplies can reduce peak load costs by up to 20% compared to conventional systems.

Keywords: Switching Power Supply, Charging Station, Fuzzy Algorithm, ESP32, PZEM-004T, Peak Load Charge, Energy Efficiency.