

ABSTRAK

Panel surya memiliki kendala ketidakstabilan tegangan dan arus akibat perubahan intensitas cahaya, yang dapat menurunkan efisiensi pengisian dan mempercepat kerusakan baterai sekunder. Penelitian ini mengusulkan sistem *smart charging* menggunakan *Boost converter* XL6009 dan *auto cut-off* berbasis relay 24 V untuk menjaga kestabilan tegangan dan mencegah *overcharging*. Sistem juga dilengkapi teknologi *IoT* berbasis ESP32 dan sensor INA226 untuk monitoring *real-time* melalui aplikasi *Blynk*. Hasil penelitian menunjukkan bahwa sistem bekerja dengan baik dengan tingkat akurasi sensor di bawah 2%. Efisiensi *Boost converter* berada pada kisaran 76%–79%, serta koefisien variansi sebesar 0,17% yang menandakan kestabilan sistem yang baik. Pengujian juga menunjukkan bahwa pengisian menggunakan panel surya cenderung berfluktuasi, sedangkan *power supply* lebih stabil dan cepat. Sistem yang dikembangkan mampu meningkatkan efisiensi pengisian, menjaga keamanan baterai, dan mempermudah pemantauan secara *real-time*.

Kata kunci: Panel Surya, Efisiensi Pengisian, *Boost converter* XL6009, *Smart Charging*, *Internet of Things (IoT)*

ABSTRACT

Solar panels face instability issues in voltage and current due to variations in light intensity, which can reduce charging efficiency and accelerate the degradation of secondary batteries. This study proposes a smart charging system using an XL6009 Boost converter and a 24 V relay-based auto cut-off to maintain voltage stability and prevent overcharging. The system is also equipped with Internet of Things (IoT) technology based on ESP32 and an INA226 sensor for real-time monitoring through the Blynk application. The results show that the system performs well, with sensor accuracy having an average error below 2%. The Boost converter efficiency ranges from 76% to 79%, while the coefficient of variance of 0.17% indicates good system stability and consistency. The testing also shows that charging using solar panels tends to fluctuate, whereas a power supply provides more stable and faster charging. The developed system is capable of improving charging efficiency, ensuring battery safety, and facilitating real-time monitoring.

Keywords: *Solar Panel, Charging Efficiency, XL6009 Boost converter, Smart Charging, Internet of Things (IoT)*