SISTEM MONITORING TEGANGAN *CHARGING* PADA BATERAI *WAYSTATION TIPE VRLA* SL12-12 DENGAN ANALISIS TEGANGAN OPTIMAL

Nadya Rohmah

Program Studi Teknik Elektro, Fakultas Teknik, Universitas Muhammadiyah Jember

ABSTRAK

Tugas akhir ini bertujuan untuk merancang sistem monitoring tegangan pengisian pada baterai VRLA tipe SL12-12 pada sistem *waystation* berbasis IoT. Sistem ini memanfaatkan ESP32 sebagai pengendali utama, dilengkapi sensor INA219 untuk mengukur tegangan dan arus, serta sensor DHT22 untuk memantau suhu. Data dikirim secara real-time ke aplikasi Telegram yang memungkinkan pemantauan jarak jauh. Pengujian dilakukan dengan variasi tegangan pengisian 12V hingga 16V untuk menentukan tegangan optimal berdasarkan durasi pengisian dan kenaikan suhu. Hasil pengujian menunjukkan bahwa tegangan 16V mampu mengisi baterai hingga penuh dalam waktu tercepat (70 menit), tetapi menyebabkan suhu meningkat hingga 31,3°C yang melebihi batas aman. Sementara itu, tegangan 12V memerlukan waktu lebih lama (154 mrnit) dengan kenaikan suhu minimal (0,7°C). Tegangan 14V menjadi pilihan optimal dengan durasi pengisian 112 menit dan kenaikan suhu hanya 0,8°C, menyeimbangkan kecepatan dan keamanan. Sistem monitoring juga terbukti akurat dengan error pengukuran tegangan 1,06% dan suhu 0,48%, serta delay notifikasi rata-rata 4,6 detik. Kesimpulannya, sistem ini efektif untuk memantau kondisi baterai secara real-time dan menentukan tegangan pengisian optimal. Tegangan 14V direkomendasikan karena efisiensi waktu dan stabilitas suhu. Penelitian ini memberikan kontribusi praktis dalam meningkatkan keandalan sistem *waystation* dan dapat dikembangkan dengan integrasi algoritma Coulomb Counting untuk akurasi lebih tinggi.

Keywords: monitoring baterai, baterai VRLA, sensor INA219, ESP32, SoC

CHARGING VOLTAGE MONITORING SYSTEM FOR VRLA SL12-12 TYPE WAYSTATION BATTERIES WITH OPTIMAL VOLTAGE ANALYSIS

Nadya Rohmah

Program Studi Teknik Elektro, Fakultas Teknik, Universitas Muhammadiyah Jember

ABSTRACT

This final project aims to develop a charging voltage monitoring system for VRLA (Valve Regulated Lead Acid) batteries type SL12-12 in *waystation* applications using IoT technology. The system employs an ESP32 microcontroller as the main controller, integrated with an INA219 sensor for voltage and current measurement and a DHT22 sensor for temperature monitoring. Real-time data transmission to a Telegram application enables remote monitoring capability. Experimental tests were conducted with charging voltage variations ranging from 12V to 16V to determine the optimal charging parameters based on charging duration and temperature rise. Test results indicate that while 16V charging achieves the fastest full charge time (70 minutes), it causes excessive temperature increase up to 31.3°C, exceeding safe operational limits. Conversely, 12V charging maintains minimal temperature rise (0.7°C) but requires significantly longer charging time (154 minutes). The 14V configuration emerges as the optimal solution, providing balanced performance with 112 minutes charging duration and only 0.8°C temperature increase. The monitoring system demonstrates high measurement accuracy, with voltage measurement error of 1.06%, temperature measurement error of 0.48%, and average notification delay of 4.6 seconds. These results confirm the system's effectiveness for real-time battery condition monitoring and optimal charging voltage determination. The 14V setting is recommended for its optimal balance between charging efficiency and thermal stability. This research contributes to improving *waystation* system reliability and suggests future development through Coulomb Counting algorithm integration for enhanced measurement accuracy. The implemented IoT-based monitoring solution provides a practical approach for battery management in critical infrastructure applications.

Keywords: battery monitoring, VRLA battery, INA219 sensor, ESP32, SoC