RINGKASAN

PERANCANGAN SISTEM *MONITORING* DAN PENGATURAN *MIKRO GRID* PLN-PLTS STASIUN PENGISIAN BATERAI MOBIL LISTRIK BERBASIS *IOT*

Akmal Badar Syah Doa

Perkembangan kendaraan listrik (*Electric Vehicle*/EV) mendorong kebutuhan akan infrastruktur pengisian daya yang andal dan efisien. Penelitian ini merancang sistem *monitoring* dan pengaturan *mikrogrid* PLN–PLTS berbasis *IoT* untuk menjaga kestabilan pasokan daya. PLTS digunakan sebagai sumber utama, sedangkan PLN sebagai cadangan yang diaktifkan otomatis melalui *relay* saat daya PLTS tidak mencukupi. Sistem dikendalikan oleh *ESP32* dan menggunakan aplikasi *IoT MQTT Panel* untuk memantau tegangan, arus, suhu, kapasitas baterai, waktu pengisian, serta *duty cycle* dari *buck-boost converter* (PLTS) dan *rectifier* (PLN). Data ditampilkan melalui *LCD 20x4* dan perangkat seluler. Pengujian dilakukan selama proses pengisian baterai dari 0% hingga 100%, diawali oleh PLTS dan secara otomatis beralih ke PLN ketika daya PLTS menurun. Sensor tegangan menggunakan *voltage divider* dengan resistor 30 kΩ dan 3,2 kΩ, menghasilkan *error* ±0,42%. Sensor arus *ACS712 (5A)* memiliki *error* ±2,27%. Suhu tertinggi selama pengisian tercatat 32,3°C, di bawah batas proteksi 45°C. *Duty cycle rectifier* PLN menurun dari 82,50% ke 66,45% saat beban aktif, menunjukkan respons otomatis sistem terhadap perubahan beban. Pengisian berhenti otomatis saat baterai penuh, ditandai arus turun dari 0,44 A ke 0 A. Sistem *monitoring IoT* memberikan data lebih detail dibanding *LCD* dan dapat saling melengkapi. Hasil pengujian menunjukkan sistem berjalan stabil dan efisien serta mendukung pemanfaatan energi terbarukan untuk pengisian baterai kendaraan listrik.

Kata kunci: kendaraan listrik, *mikrogrid*, PLN, PLTS, *IoT*, *ESP32*, *buck-boost converter*, pengisian baterai.

SUMMARY

DESIGN OF MONITORING AND CONTROL SYSTEM FOR PLN-PLTS MICRO GRID OF ELECTRIC VEHICLE BATTERY CHARGING STATION BASED ON IOT

Akmal Badar Syah Doa

The development of Electric Vehicles (EVs) demands reliable and efficient charging infrastructure. This study designs an IoT-based monitoring and control system for a PLN–PV microgrid to ensure power supply stability. The system prioritizes the photovoltaic (PV) source, with PLN as a backup that is automatically activated via a relay when PV power is insufficient. The system is controlled by an ESP32 microcontroller and uses the MQTT Panel IoT application to monitor voltage, current, temperature, battery capacity, charging time, and the duty cycle of the buck-boost converter (PV) and rectifier (PLN). Data are displayed on a 20x4 LCD and mobile devices. Testing was carried out during a full battery charging cycle from 0% to 100%, initially powered by PV and automatically switching to PLN when PV power declined. The voltage sensor uses a voltage divider with 30 kΩ and 3,2 kΩ resistors, resulting in an error of ±0,42%. The current sensor ACS712 (5A) showed an error of ±2,27%. The highest temperature during charging was 32,3°C, below the 45°C protection threshold. The PLN rectifier duty cycle decreased from 82,50% to 66,45% under load, indicating the system's automatic response to load changes. Charging stopped automatically when the battery was full, indicated by the current dropping from 0,44 A to 0 A. The IoT monitoring system provided more detailed data than the LCD, and both can complement each other. Test results show that the system operates stably and efficiently and supports the use of renewable energy in EV battery charging.

Keywords: *electric vehicle, microgrid, PLN, PV, IoT, ESP32, buck-boost converter, battery charging.*