ABSTRAK

ANALISIS PARAMETER PENGISIAN CEPAT BATERAI KENDARAAN LISTRIK BERBASIS LSTM-RNN

Karya tulis ilmiah berupa Tugas Akhir Agustus 2025

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Analisis Parameter Pengisian Cepat Baterai Kendaraan Listrik Berbasis LSTM-RNN

(2025: 99 halaman+ 23 tabel + 26 Daftar Pustaka + 26 lampiran)

Pengisian cepat (fast charging) pada kendaraan listrik (Electric Vehicle/EV) menjadi solusi atas kendala lamanya waktu pengisian baterai, namun berisiko menyebabkan peningkatan suhu yang signifikan, degradasi baterai, dan overcharging. Oleh karena itu, dibutuhkan sistem monitoring dan prediksi cerdas yang mampu menganalisis parameter pengisian secara real-time. Penelitian ini merancang dan mengimplementasikan sistem monitoring dan prediksi pengisian cepat berbasis algoritma Long Short-Term Memory - Recurrent Neural Network (LSTM-RNN) untuk memprediksi State of Charge (SOC) baterai kendaraan listrik. Sistem menggunakan sensor PZEM-017 dan sensor suhu MLX90614 untuk membaca parameter tegangan, arus, daya, suhu, dan SOC, yang dikirimkan ke Raspberry Pi melalui Arduino. Model LSTM-RNN dikembangkan dengan dua lapisan LSTM (64 dan 32 unit), dropout 20%, dan dilatih menggunakan dataset pengisian pada tiga variasi arus: 5A, 10A, dan 15A. Hasil evaluasi menunjukkan bahwa model memiliki performa prediksi terbaik pada arus 15A dengan nilai R^2 sebesar 0.8558 dan MAPE < 1%. Visualisasi menunjukkan kesesuaian prediksi dengan data aktual, khususnya pada arus tinggi. Sistem ini juga menampilkan hasil prediksi dan monitoring secara real-time melalui Human-Machine Interface (HMI). Dengan demikian, penerapan model LSTM-RNN terbukti efektif dalam meningkatkan akurasi prediksi SOC serta mendukung pengisian cepat yang efisien dan aman.

Kata Kunci: Fast Charging, LSTM-RNN, State of Charge (SOC)

ABSTRACT

LSTM-RNN BASED ELECTRIC VEHICLE BATTERY FAST CHARGING PARAMETER ANALYSIS

Scientific paper in the form of Final Project August 2025

Advent Samuel Halomoan by Amperawan and Sabilal Rasyad

Parameter Analysis of Fast Charging of Electric Vehicle Batteries Based on LSTM-RNN

(2025: 10 Pages+ 23 table + 26 References + 26 Attachment)

Fast charging in electric vehicles (EVs) is a solution to the problem of long battery charging times, but it risks causing significant temperature increases, battery degradation, and overcharging. Therefore, an intelligent monitoring and prediction system capable of analyzing charging parameters in real-time is needed. This research designs and implements a fast charging monitoring and prediction system based on the Long Short-Term Memory - Recurrent Neural Network (LSTM-RNN) algorithm to predict the State of Charge (SOC) of electric vehicle batteries. The system uses PZEM-017 sensor and MLX90614 temperature sensor to read voltage, current, power, temperature, and SOC parameters, which are sent to Raspberry Pi via Arduino. The LSTM-RNN model was developed with two LSTM layers (64 and 32 units), 20% dropout, and trained using charging datasets at three current variations: 5A, 10A, and 15A. Evaluation results show that the model has the best prediction performance at 15A current with an R^2 value of 0.8558 and MAPE < 1%. The visualization shows the conformity of the prediction with the actual data, especially at high currents. The system also displays real-time prediction and monitoring results through the Human-Machine Interface (HMI). Thus, the application of the LSTM-RNN model is proven effective in improving the accuracy of SOC predictions as well as supporting efficient and safe fast charging.

Keywords: Fast Charging, LSTM-RNN, State of Charge (SOC)