RINGKASAN

RANCANG BANGUN SISTEM MONITORING DAN MANAJEMEN PENGISIAN BATERAI MOBIL LISTRIK MENGGUNAKAN PHOTOVOLTAIC BERBASIS INTERNET OF THINGS DENGAN BLYNK

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Dengan meningkatnya penggunaan kendaraan listrik di Indonesia sebagai bagian dari upaya untuk mengurangi emisi karbon dan mencapai target *Net Zero Emission* pada tahun 2060, diperlukan teknologi yang dapat memastikan efisiensi dan keselamatan dalam proses pengisian daya. Kendaraan listrik menggunakan baterai sebagai sumber energi utama, yang dalam pengisiannya harus memerhatikan parameter seperti tegangan, arus, suhu, dan kapasitas baterai agar terhindar dari risiko *overcharge* dan *overheating*. Proses pengisian daya konvensional yang bersumber dari pembangkit listrik dengan bahan bakar fosil tidak ramah lingkungan, sehingga penggunaan energi terbarukan seperti *photovoltaic* menjadi solusi yang lebih berkelanjutan.

Penelitian ini dilakukan dengan merancang bangun dan eksperimen integrasi teknologi *photovoltaic* dengan *Internet of Things* (IoT) melalui platform Blynk sehingga dapat melakukan pemantauan proses pengisian daya secara *real-time* dan jarak jauh. Parameter yang dipantau yaitu tegangan *input* dan *output*, arus *input* dan *output*, *State of Charge* baterai, suhu baterai, *duty cycle* dan frekuensi dari *switching* MOSFET. Akurasi setiap parameter diuji dengan membandingkan hasil pembacaan sensor dan alat ukur yang menjadi referensi.

Pengujian dilakukan untuk mengevaluasi akurasi sensor tegangan, arus dan suhu. Sensor dengan RMSE (*Root Mean Squared Error*) dan MAPE (*Mean Absolute Percentage Error*) tinggi akan dikalibrasi untuk meningkatkan akurasi. Setelah kalibrasi, sensor tegangan *input* dan *output* memiliki RMSE 0,24 V dan 0,05 V serta MAPE 1,39% dan 0,43%. Sensor arus *input* dan *output* memiliki RMSE 0,012 A dan 0,011 A serta MAPE 1,52% dan 1,15%. Sensor suhu memiliki RMSE 0,15ºC dan MAPE 0,46%. Sistem proteksi *overheat* dan *overcharge* berfungsi dengan baik, dan sistem monitoring daya terhubung ke IoT untuk pemantauan *real-time* melalui aplikasi Blynk.

Kata kunci: monitoring, pengisian daya, photovoltaic, IoT, Blynk, *overcharge*, *overheat*

SUMMARY

DESIGN AND DEVELOPMENT OF AN IOT-BASED MONITORING AND MANAGEMENT SYSTEM FOR ELECTRIC VEHICLE BATTERY CHARGING USING PHOTOVOLTAICS WITH BLYNK

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The increasing adoption of electric vehicles in Indonesia, as part of the national effort to reduce carbon emissions and achieve the Net Zero Emission target by 2060, necessitates the development of technologies that ensure efficiency and safety during the charging process. Electric vehicles use batteries as their main energy source, which during charging must consider to parameters such as voltage, current, temperature, and battery capacity to avoid the risks of overcharge and overheating. The conventional charging process sourced from fossil fuel power plants is not environmentally friendly, so the use of renewable energy such as photovoltaic becomes a more sustainable solution.

This research was conducted by designing and experimenting with the integration of photovoltaic technology with the Internet of Things (IoT) through the Blynk platform, allowing for real-time and remote monitoring of the charging process. The parameters being monitored are voltage and current on the input and output side, State of Charge of the battery, battery temperature, duty cycle, and frequency of the MOSFET switching. The accuracy of each parameter was tested by comparing the sensor readings from the system with the reference measuring instrument.

Sensor testing is conducted to calculate the magnitude of the error by examining the RMSE (Root Mean Squared Error) and MAPE (Mean Absolute Percentage Error) parameters.Each sensor with a relatively high RMSE and MAPE value undergoes calibration or further data processing to improve measurement accuracy.After calibration, the voltage sensors on the input and output sides have an RMSE of 0.24 V and 0.05 V, and a MAPE of 1.39% and 0.43%.The current sensors on the input and output sides have RMSE values of 0.012 A and 0.011, as well as MAPE values of 1.52% and 1.15%.The Temperature Sensor does not need calibration because it is already accurate with RMSE and MAPE values of 0.15ºC and 0.46%.The protection systems for both overheat and overcharge also work well according to the design.The charging monitoring system is well-connected to the IoT system and can be monitored in real-time on the Blynk application.

Keywords: monitoring, charging, photovoltaic, IoT, Blynk, overcharge, overheat