

RINGKASAN

ANALISIS KINERJA MODEL RANDOM FOREST, EXTRA TREES, DAN XGBOOST DALAM PREDIKSI NILAI DAYA LISTRIK

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Kemajuan teknologi 4.0 telah membawa perubahan signifikan di berbagai sektor, termasuk bidang industri, melalui penerapan *machine learning* (ML) yang mampu meningkatkan efisiensi serta mendukung pengambilan keputusan yang lebih tepat. Salah satu permasalahan penting dalam sektor energi adalah prediksi nilai daya listrik yang akurat untuk mendukung efisiensi operasional dan pemantauan energi. Penelitian ini bertujuan untuk membandingkan kinerja tiga algoritma ensemble learning, yaitu *Random Forest*, *Extra Trees*, dan *XGBoost*, dalam memprediksi nilai daya listrik berdasarkan data primer yang diperoleh dari powermeter. Dataset yang digunakan berjumlah 3100 data yang memuat parameter listrik berupa daya, tegangan, arus, frekuensi, dan faktor daya. Penggunaan metode *Split Data* serta *K-Fold Cross Validation* (5-Fold dan 10-Fold).

Evaluasi kinerja dilakukan menggunakan lima metrik regresi, yaitu MAPE, MAE, MSE, RMSE dan R^2 . Hasil penelitian menunjukkan bahwa ketiga model memiliki performa yang sangat baik dengan nilai $MAPE < 1\%$ dan $R^2 > 0,98$. Di antara ketiganya, *Random Forest Regression* menghasilkan kinerja terbaik dengan nilai error terendah dan R^2 tertinggi (0.9914) pada validasi 5-Fold, sehingga terbukti lebih unggul dibandingkan *Extra Trees* dan *XGBoost*. Saran penelitian selanjutnya adalah memperluas variasi dataset serta mengintegrasikan model terbaik ke dalam sistem monitoring energi *real-time* berbasis IoT guna mendukung implementasi industri cerdas.

Kata kunci: Daya Listrik, *Machine Learning*, Prediksi

SUMMARY

PERFORMANCE ANALYSIS OF RANDOM FOREST, EXTRA TREES, AND XGBOOST MODELS IN ELECTRICAL POWER PREDICTION

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The Advances 4.0 technology have brought significant changes to various sectors, including industry, through the application of machine learning (ML), which can improve efficiency and support more accurate decision-making. One important issue in the energy sector is the prediction of accurate electricity values to support operational efficiency and energy monitoring. This study aims to compare the performance of three ensemble learning algorithms, namely Random Forest, Extra Trees, and XGBoost, in predicting electrical power values based on primary data obtained from power meters. The dataset used consists of 3100 data points containing electrical parameters such as power, voltage, current, frequency, and power factor.

The Split Data method and K-Fold Cross Validation (5-Fold and 10-Fold) were used. Performance evaluation was carried out using five regression metrics, namely MAPE, MAE, MSE, RMSE, and R^2 . The results showed that all three models performed very well with MAPE values $< 1\%$ and $R^2 > 0.98$. Among the three, Random Forest Regression produced the best performance with the lowest error value and the highest R^2 (0.9914) in 5-Fold validation, proving to be superior to Extra Trees and XGBoost. Further research suggestions include expanding the dataset variation and integrating the best model into an IoT-based real-time energy monitoring system to support smart industry implementation.

Keywords: Electrical Power, Machine Learning, Prediction