

ANALISIS KOMPARATIF KINERJA LSTM DAN XGBOOST DALAM PREDIKSI KONSUMSI ENERGI *SMART HOME* DENGAN PENDEKATAN *EXPLAINABLE AI*

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ABSTRAK

Konsumsi energi pada *smart home* memiliki pola yang kompleks dan dinamis, sehingga prediksi yang akurat diperlukan untuk mendukung efisiensi penggunaan energi. Penelitian ini bertujuan membandingkan kinerja algoritma *Long Short-Term Memory* (LSTM) dan *Extreme Gradient Boosting* (XGBoost) dalam memprediksi konsumsi energi smart home, serta menerapkan pendekatan *Explainable Artificial Intelligence* (XAI) untuk menginterpretasikan kontribusi setiap fitur terhadap hasil prediksi. Penelitian mengikuti tahapan CRISP-DM menggunakan *Smart Home Energy Usage Dataset* dari Kaggle, dengan seleksi fitur *SelectKBest* pada tiga skenario (*Top 10*, *Top 15*, dan *All 19* fitur) serta optimasi *hyperparameter* menggunakan *Random Search* (LSTM) dan *RandomizedSearchCV* (XGBoost). Kinerja model dievaluasi menggunakan *Mean Absolute Error* (MAE), *Root Mean Square Error* (RMSE), *Mean Absolute Percentage Error* (MAPE), dan koefisien determinasi (R^2). Hasil terbaik LSTM diperoleh pada subset *Top 10* fitur dengan MAE 0,2253 kWh, RMSE 0,2942 kWh, MAPE 2,70%, dan R^2 99,30%, sedangkan hasil terbaik XGBoost diperoleh pada subset *Top 15* fitur dengan MAE 0,356 kWh, RMSE 0,4436 kWh, MAPE 4,23%, dan R^2 98,40%. Hasil tersebut menunjukkan bahwa LSTM memiliki tingkat kesalahan prediksi yang lebih rendah dan kemampuan mengikuti pola konsumsi energi yang lebih baik dibandingkan XGBoost. Analisis SHAP terhadap model LSTM terbaik menunjukkan bahwa fitur *HVAC_Usage_kWh* memberikan kontribusi terbesar terhadap hasil prediksi, diikuti oleh *Water_Heater_kWh* dan *Appliance_Usage_kWh*. Penelitian ini menegaskan bahwa LSTM lebih unggul dalam memprediksi konsumsi energi smart home, dan pendekatan XAI mampu memberikan interpretasi yang mendukung transparansi model.

Kata kunci: LSTM, XGBoost, Konsumsi Energi, *Smart Home*, *Explainable Artificial Intelligence*.

**COMPARATIVE ANALYSIS OF LSTM AND XGBOOST
PERFORMANCE FOR SMART HOME ENERGY CONSUMPTION
PREDICTION USING AN EXPLAINABLE AI APPROACH**

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ABSTRACT

Energy consumption in smart homes exhibits complex and dynamic patterns, requiring accurate prediction methods to support energy efficiency. This study aims to compare the performance of Long Short-Term Memory (LSTM) and Extreme Gradient Boosting (XGBoost) algorithms in predicting smart home energy consumption, and to apply an Explainable Artificial Intelligence (XAI) approach to interpret each feature's contribution to the prediction results. The research follows the CRISP-DM stages using the Smart Home Energy Usage Dataset from Kaggle, with SelectKBest feature selection across three scenarios (Top 10, Top 15, and All 19 features) and hyperparameter optimization using Random Search (LSTM) and RandomizedSearchCV (XGBoost). Model performance was evaluated using Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Mean Absolute Percentage Error (MAPE), and the coefficient of determination (R^2). The best LSTM result was achieved with the Top 10 feature subset, yielding an MAE of 0.2253 kWh, RMSE of 0.2942 kWh, MAPE of 2.70%, and R^2 of 99.30%, while the best XGBoost result was achieved with the Top 15 feature subset, yielding an MAE of 0.356 kWh, RMSE of 0.4436 kWh, MAPE of 4.23%, and R^2 of 98.40%. These results indicate that LSTM produces lower prediction errors and follows energy consumption patterns more closely than XGBoost. SHAP analysis on the best LSTM model showed that HVAC_Usage_kWh contributed the most to the prediction results, followed by Water_Heater_kWh and Appliance_Usage_kWh. This study confirms that LSTM outperforms XGBoost in predicting smart home energy consumption, and that the XAI approach provides interpretability that supports model transparency.

Keywords: LSTM, XGBoost, Energy consumption, Smart Home, Explainable Artificial Intelligence.