ABSTRACT

Energy consumption in buildings represents a significant portion of global energy usage, reaching approximately 30% of the world's total final energy consumption. This research aims to develop an electricity load prediction model using the XGBoost algorithm, targeting a MAPE value below 48% based on power consumption and ambient temperature data. Furthermore, this study also aims to implement the optimized machine learning model into a functional building energy system (application).

The research method begins with the design of a data acquisition system using a PZEM-004T sensor and an ESP32 microcontroller, combined with temperature data from OpenMeteo. The collected data is then used to train the XGBoost model, where hyperparameter optimization is performed by comparing the GridSearchCV method and manual tuning to obtain the best performance. The optimized model is then implemented in a Flask-based web application that serves as a means of presenting the prediction results.

The research results show that the XGBoost model successfully achieved a prediction accuracy with a MAPE value of 20.88%. Sensor accuracy validation proved the high accuracy of the PZEM-004T sensor (99.63% for voltage and 96.26% for current). The best XGBoost model test results obtained a MAPE value of 20.88%, while feature analysis indicated that local ambient temperature made a positive contribution, although historical data remained the primary factor. This prediction system was successfully implemented in a functional web application for energy monitoring and forecasting.

Keywords: Machine Learning, XGBoost, Electricity Usage Prediction