ABSTRAK

Jaringan *Fiber to the Home* (FTTH) menjadi infrastruktur utama dalam penyediaan layanan internet berkecepatan tinggi. Namun, kualitas sinyal *optical power* yang diterima oleh *Optical Network Terminal* (ONT) dapat mengalami degradasi akibat faktor seperti jarak kabel, jumlah splice dan konektor, usia perangkat, serta kondisi lingkungan. Penelitian ini bertujuan membandingkan algoritma Random Forest dan Long Short-Term Memory (LSTM) untuk memprediksi kondisi jaringan FTTH ke dalam tiga kategori, yaitu Normal, Waspada, dan Kritis, berdasarkan 63.145 data historis dari 58 ONT yang dikumpulkan selama periode Maret hingga Mei 2026. Untuk memastikan perbandingan yang adil, Random Forest dilatih menggunakan fitur tabular hasil rekayasa berupa *lag* dan statistik *rolling window*, sedangkan LSTM dilatih menggunakan data sekuensial mentah dengan enam langkah waktu historis. Kinerja kedua model dievaluasi menggunakan accuracy, precision, recall, F1-score, confusion matrix, Mean Absolute Error (MAE), dan Root Mean Square Error (RMSE). Hasil penelitian menunjukkan bahwa Random Forest secara signifikan mengungguli LSTM, dengan accuracy sebesar 98,41% dan rata-rata macro F1-score 95,49%, dibandingkan LSTM yang hanya mencapai accuracy 70,08%. Evaluasi tambahan menggunakan pembagian data berbasis urutan waktu (*time-based split*) menunjukkan hasil yang konsisten (98,59%), mengindikasikan performa Random Forest bukan disebabkan oleh kebocoran data. Analisis *feature importance* mengungkapkan bahwa riwayat *optical power* sebelumnya menjadi prediktor paling dominan. Model Random Forest dengan performa terbaik selanjutnya diimplementasikan ke dalam dashboard berbasis web yang dilengkapi fitur peringatan dini semi-otomatis melalui WhatsApp untuk mendukung pemeliharaan preventif jaringan FTTH.

Kata Kunci: FTTH, LSTM, *Optical Power*, Prediksi, Random Forest.

ABSTRACT

Fiber-to-the-Home (FTTH) networks serve as the primary infrastructure for high-speed internet services. However, the optical power signal received by the Optical Network Terminal (ONT) can degrade due to factors such as cable distance, the number of connections and connectors, device age, and environmental conditions. This study employs Random Forest and Long Short-Term Memory (LSTM) algorithms to classify FTTH network conditions into three categories Normal, Warning, and Critical based on 63,145 historical data points from 58 ONTs collected between March and May 2026. To ensure a fair comparison, the Random Forest model was trained using engineered tabular features (specifically lags and rolling window statistics), whereas the LSTM model was trained using raw sequential data with a six-step historical time window. Model performance was evaluated using accuracy, precision, recall, F1-score, confusion matrix, Mean Absolute Error (MAE), and Root Mean Square Error (RMSE). The results demonstrate that Random Forest significantly outperformed LSTM, achieving an accuracy of 98.41% and a macro-average F1-score of 95.49%, compared to LSTM's accuracy of 70.08%. Additional evaluation using a time-based data split yielded consistent results (98.59%), indicating that Random Forest's performance was not attributable to data leakage. Feature importance analysis revealed that historical optical power readings were the most dominant predictors. The best-performing Random Forest model was subsequently implemented in a web-based dashboard featuring a semi-automated early warning system via WhatsApp to support preventive maintenance of the FTTH network.

Keywords: *FTTH, Classification, LSTM, Optical Power, Random Forest.*