ABSTRACT

Dense Wavelength Division Multiplexing (DWDM) networks serve as the backbone for high-speed data transmission in modern telecommunication infrastructure. However, DWDM reliability remains vulnerable to various disturbances, which are typically detected only through reactive and preventive maintenance approaches. Manual fault identification and handling often result in prolonged recovery times, economic losses, and decreased customer trust in network operators. The primary challenge addressed in this research is the limitation of existing monitoring systems, which are unable to proactively and automatically predict multiple concurrent failures.

This study proposes a solution by developing a machine learning-based multi-fault prediction system, integrated into a web-based platform. The system leverages historical alarm data from Optical Performance Monitoring (OPM) and utilizes Long Short-Term Memory (LSTM), Bidirectional LSTM (BiLSTM), and hybrid BiLSTM-XGBoost models for analysis. The developed platform not only identifies potential disturbances before they occur but also provides real-time visualization of prediction results, empowering technicians to make faster and more accurate decisions.

Experimental results using historical datasets from PT. Len Telekomunikasi Indonesia show that the proposed models achieve over 90% accuracy in multi-fault prediction, with average inference times below five seconds per prediction. Implementation of this system has demonstrated a reduction in troubleshooting time by up to 50% compared to conventional methods, while optimizing technical resource allocation and operational costs. These findings underscore the significant potential of machine learning in advancing digital transformation for optical network maintenance in Indonesia.

Keywords: Accuracy, DWDM, Inference, Machine Learning, Prediction