ABSTRACT

Accurate and continuous train location tracking is a crucial component of railway systems to ensure safety and operational schedule efficiency. However, train sensor data often suffer from irregular updates due to signal interference or transmission delays, leading to data gaps. This study aims to address these challenges by developing a near real-time train location prediction model based on deep learning.

The proposed approach involves three primary steps. The initial step includes data preprocessing, utilizing consistent and accurate rail track reference points as spatial references to ensure optimal positional accuracy of sensor data. Next, data interpolation is employed to produce a dataset with consistent temporal resolution at 60-second intervals. This interpolation method is also applied to cases with significant data gaps, such as months-long data unavailability caused by hardware sensor failures, by leveraging train movement patterns from preceding and subsequent periods. These methods yield a more continuous and representative dataset for prediction processes.

The prediction model is developed using a two-layer Long Short-Term Memory (LSTM) network with an attention mechanism. The LSTM layers enable the model to capture long-term dependencies in temporal data, while the attention mechanism prioritizes relevant information from historical data. The model was evaluated using the Commuter Line Wilayah II Bandung dataset. Evaluation results indicate that the LSTM-Attention model achieved an average Mean Absolute Error (MAE) of 0.0013 and Root Mean Squared Error (RMSE) of 0.0023 for latitude and longitude predictions. This performance significantly outperformed other neural network methods such as GRU, RNN, and regular LSTM.

*Keywords—**attention mechanism, data interpolation, location prediction, long short-term memory***