PREDIKSI KONSENTRASI POLUTAN UDARA DI DKI JAKARTA BERDASARKAN FAKTOR METEOROLOGI MENGGUNAKAN METODE CNN-BILSTM

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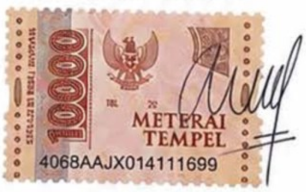

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ABSTRAK

PREDIKSI KONSENTRASI POLUTAN UDARA DI DKI JAKARTA BERDASARKAN FAKTOR METEOROLOGI MENGGUNAKAN METODE CNN-BiLSTM

Kualitas udara di DKI Jakarta terus mengalami penurunan akibat tingginya konsentrasi polutan yang berdampak terhadap kesehatan masyarakat dan lingkungan. Variasi konsentrasi polutan dipengaruhi oleh interaksi kompleks antara parameter polutan dan faktor meteorologi, sehingga diperlukan metode prediksi yang mampu memodelkan hubungan multivariat dan temporal secara efektif. Penelitian ini bertujuan untuk menganalisis hasil ekstraksi fitur Convolutional Neural Network (CNN), menentukan arsitektur CNN-Bidirectional Long Short-Term Memory (CNN-BiLSTM) terbaik, serta memprediksi konsentrasi polutan udara di DKI Jakarta. Data yang digunakan meliputi parameter PM2.5, PM10, SO2, CO, O3, NO2 serta variabel meteorologi dari enam stasiun pemantauan selama periode 2023–2024. Penelitian ini menggunakan kombinasi hyperparameter terbaik berupa lookback 14, CNN filters 64, kernel size 3, BiLSTM units 64, learning rate 0,0005, batch size 32, dan fungsi loss Mean Squared Error (MSE). Hasil ekstraksi fitur CNN menghasilkan feature map berukuran 14 × 64, yang menunjukkan 14 time-step dan 64 fitur hasil ekstraksi. Hasil evaluasi pada data pengujian menghasilkan nilai MAPE sebesar 26,70%. Dengan demikian, metode CNN-BiLSTM mampu menangkap pola lokal dan temporal pada data polutan serta meteorologi untuk memprediksi konsentrasi polutan udara di DKI Jakarta.

Kata kunci: Kualitas Udara, CNN, BiLSTM, CNN-BiLSTM

ABSTRACT

PREDICTION OF AIR POLLUTANT CONCENTRATION IN DKI JAKARTA BASED ON METEOROLOGICAL FACTORS USING THE CNN-BiLSTM METHOD

Air quality in Jakarta continues to decline due to high pollutant concentrations, which impact public health and the environment. Variations in pollutant concentrations are influenced by complex interactions between pollutant parameters and meteorological factors, requiring a prediction method capable of effectively modeling multivariate and temporal relationships. This study aims to analyze the results of Convolutional Neural Network (CNN) feature extraction, determine the best CNN-Bidirectional Long Short-Term Memory (CNN-BiLSTM) architecture, and predict air pollutant concentrations in Jakarta. The data used include PM2.5, PM10, SO2, CO, O3, NO2 parameters, and meteorological variables from six monitoring stations during the 2023–2024 period. This study uses the best hyperparameter combination of lookback 14, CNN filters 64, kernel size 3, BiLSTM units 64, learning rate 0,0005, batch size 32, and Mean Squared Error (MSE) loss function. The CNN feature extraction results produce a 14×64 feature map, which shows 14 time-steps and 64 extracted features. The evaluation results on the test data produce a MAPE value of 26.70%. Thus, the CNN-BiLSTM method is able to capture local and temporal patterns in pollutant and meteorological data to predict air pollutant concentrations in DKI Jakarta.
Keywords: Air Quality, CNN, BiLSTM, CNN-BiLSTM

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