ABSTRAK

PREDIKSI KETINGGIAN AIR DAN BANJIR BERBASIS GATED RECURRENT UNITS DENGAN INTEGRASI DASHBOARD NODE-RED UNTUK MONITORING REAL-TIME

(2025:xvi + 89 halaman + 49 gambar + 7 tabel + 2 Lampiran)

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Penelitian ini mengembangkan model *Gated Recurrent Unit (GRU)* untuk memprediksi ketinggian air sungai 48 jam ke depan menggunakan data tingkat menit dari Sungai Sahang yang dikumpulkan selama April–Mei 2025. Model dilatih dengan memanfaatkan campuran data intensitas curah hujan dan ketinggian air, menggunakan *optimizer Adam* dan fungsi kehilangan *mean squared error (MSE)* selama 50 *epoch*, dengan penerapan *early stopping* untuk mencegah *overfitting*. Tiga skenario pembagian data (80:20, 70:30, dan 60:40) digunakan untuk mengevaluasi kinerja model dengan metrik *MSE, RMSE, R^2*, dan *Nash-Sutcliffe Efficiency (*NSE*)*. Hasilnya menunjukkan bahwa model *GRU* secara konsisten memberikan kinerja yang sangat baik (NSE > 0,99) pada semua skenario validasi. Pembagian data 60:40 mencapai akurasi tertinggi (R^2 = 1,00, NSE = 0,9963), sementara konfigurasi 80:20 menawarkan keseimbangan terbaik dalam hal efisiensi pelatihan dan stabilitas model. Analisis korelasi lag menunjukkan korelasi tertinggi (R^2 = 0,8397) pada lag 0 menit, yang mengindikasikan bahwa lonjakan curah hujan secara langsung memicu peningkatan ketinggian air tanpa penundaan waktu. Selain itu, output model diintegrasikan dengan *Node-red Dashboard* untuk menyediakan prediksi ketinggian air secara real-time dan interaktif. Dengan menggunakan *Node-red* sebagai platform pemrograman visual, hasil prediksi model ditampilkan melalui *widget gauge* dan *chart*, memungkinkan visualisasi langsung terhadap peningkatan ketinggian air dan intensitas curah hujan yang terkait.

Kata kunci : Banjir, *Gated Recurrent Units,* Prediksi, Tinggi air.

ABSTRACT

PREDICTION OF WATER LEVEL AND FLOODING BASED ON GATED RECURRENT UNITS WITH NODE-RED DASHBOARD INTEGRATION FOR REAL-TIME MONITORING

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*This study develops a Gated Recurrent Unit (GRU) model to predict river water levels 48 hours ahead using minute-level data from the Sahang River collected during April–May 2025. The model was trained using a combination of rainfall intensity and water level data, employing the Adam optimizer and mean squared error (MSE) loss function over 50 epochs, with early stopping applied to prevent overfitting. Three data split scenarios (80:20, 70:30, and 60:40) were used to evaluate model performance using MSE, RMSE, R^2, and Nash-Sutcliffe Efficiency (*NSE*) metrics. The results show that the GRU model consistently delivers excellent performance (*NSE *> 0.99) across all validation scenarios. The 60:40 split achieved the highest accuracy (R^2 = 1.00,* NSE *= 0.9963), while the 80:20 configuration offered the best balance in terms of training efficiency and model stability. Lag correlation analysis showed the highest correlation (r = 0.8397) at lag 0 minutes, indicating that rainfall surges directly trigger an increase in water level without time delay. Furthermore, the model output was integrated with the Node-RED Dashboard to provide real-time and interactive water level predictions. By using Node-RED as a visual programming platform, the model's prediction results were displayed through gauge and chart widgets, allowing for direct visualization of rising water levels and associated rainfall intensity.*

Keywords: : *Flood, Gated Recurrent Units, Prediction, Water Level.*