ABSTRAK

Banjir merupakan salah satu bencana alam yang sering terjadi di Indonesia dan dapat menimbulkan kerugian bagi masyarakat. Salah satu kendala dalam penanganan banjir adalah belum tersedianya sistem yang mampu memberikan informasi kondisi banjir secara cepat dan akurat. Oleh karena itu, penelitian ini bertujuan untuk mengembangkan Sistem Informasi Pendeteksi Banjir (SIABAN) berbasis website yang mampu mengklasifikasikan kondisi banjir ke dalam kategori Aman, Siaga, dan Bahaya menggunakan metode *Long Short-Term Memory* (LSTM) dengan arsitektur *Bidirectional Long Short-Term Memory* (BiLSTM) serta pendekatan *Ordinal Classification*. Pengembangan sistem dilakukan menggunakan metode *Extreme Programming* (XP). Aplikasi dibangun menggunakan *framework* Laravel, sedangkan model prediksi dikembangkan menggunakan *Python* dan diintegrasikan melalui FastAPI. Sebelum proses pelatihan model, data historis sensor IoT melalui tahapan *preprocessing* yang meliputi data cleaning, normalisasi menggunakan *Min-Max Scaling, feature engineering*, pembentukan data sekuens menggunakan sliding window, serta pembagian data menggunakan Strict Temporal Split untuk mencegah data leakage. Evaluasi model dilakukan menggunakan *Classification Report, Confusion Matrix, Safety Audit*, dan *Robustness Test.*

Hasil penelitian menunjukkan bahwa model memperoleh *accuracy* sebesar 61% dengan kemampuan yang cukup baik dalam mengenali kelas Aman dan Bahaya, meskipun masih mengalami kesulitan dalam mengklasifikasikan kelas Siaga akibat ketidakseimbangan distribusi data *(class imbalance)*. Hasil *Safety Audit* dan *Robustness Test* menunjukkan bahwa model masih mampu mendeteksi sebagian besar kondisi Bahaya meskipun data diberikan gangguan *(noise)*. Penerapan *Threshold Engineering* dengan mekanisme *hysteresis threshold* juga menghasilkan perubahan status banjir yang lebih stabil sehingga mampu mengurangi perubahan status akibat fluktuasi data sensor. Berdasarkan hasil penelitian, SIABAN berhasil diimplementasikan sebagai sistem pendeteksi banjir berbasis *website* yang mampu menyajikan informasi kondisi banjir secara lebih cepat dan mendukung upaya mitigasi bencana di Desa Sukarami.

Kata Kunci: *Long Short-Term Memory* (LSTM), *Bidirectional Long Short-Term Memory* (BiLSTM), *Ordinal Classification, Internet of Things* (IoT), Sistem Pendeteksi Banjir. *Website.*

ABSTRACT

Floods are one of the most frequent natural disasters in Indonesia and often cause significant losses to communities. One of the main challenges in flood management is the absence of a system capable of providing timely and accurate information regarding flood conditions. Therefore, this study aims to develop a web-based Flood Detection Information System (SIABAN) capable of classifying flood conditions into Safe, Alert, and Danger categories using the Long Short-Term Memory (LSTM) method with a Bidirectional Long Short-Term Memory (BiLSTM) architecture and an Ordinal Classification approach. The system was developed using the Extreme Programming (XP) software development methodology. The web application was built using the Laravel framework, while the prediction model was developed in Python and integrated through FastAPI. Before the model training process, historical IoT sensor data underwent several preprocessing stages, including data cleaning, Min-Max Scaling normalization, feature engineering, sequence generation using the sliding window technique, and dataset splitting using Strict Temporal Split to prevent data leakage. The model performance was evaluated using a Classification Report, Confusion Matrix, Safety Audit, and Robustness Test.

The experimental results showed that the proposed model achieved an accuracy of 61%, demonstrating satisfactory performance in identifying the Safe and Danger classes. However, the model showed relatively lower performance in recognizing the Alert class due to class imbalance in the dataset. Furthermore, the Safety Audit and Robustness Test indicated that the model was still able to detect most Danger conditions even when noise was added to the test data. In addition, the implementation of Threshold Engineering with a hysteresis threshold mechanism produced more stable flood status predictions by reducing unnecessary status fluctuations caused by sensor data variations. In conclusion, the proposed SIABAN system was successfully implemented as a web-based flood detection system capable of providing timely flood condition information and supporting flood disaster mitigation efforts in Sukarami Village.

Keywords: Long Short-Term Memory (LSTM), Bidirectional Long Short-Term Memory (BiLSTM), Ordinal Classification, Internet of Things), Flood Detection System.