ABSTRAK

Perkembangan era digital menjadikan kolom komentar YouTube sebagai sumber data strategis untuk memahami opini publik, termasuk pada isu sensitif seperti intoleransi beragama di Indonesia. Namun, analisis sentimen pada teks media sosial menghadapi tantangan berupa penggunaan bahasa tidak baku, ambiguitas makna, kompleksitas konteks semantik, serta ketidakseimbangan distribusi kelas. Penelitian ini bertujuan untuk mengintegrasikan IndoBERTweet dan *Bidirectional Long Short-Term Memory* (Bi-LSTM) dalam arsitektur *Hybrid* serta membandingkan performanya dengan model tunggal dalam klasifikasi sentimen tiga kelas, yaitu *Negative*, *Neutral*, dan *Positive.* Integrasi direalisasikan dengan menjadikan IndoBERTweet sebagai *contextual feature extractor* yang menghasilkan embedding berbasis konteks, kemudian representasi tersebut diproses lebih lanjut oleh lapisan Bi-LSTM untuk memodelkan dependensi sekuensial dua arah. Dataset penelitian terdiri dari 6.467 komentar YouTube hasil *crawling* yang diproses menggunakan kerangka CRISP-DM. Penanganan ketidakseimbangan kelas dilakukan melalui penerapan *class weighting* pada proses pelatihan model. Hasil evaluasi menunjukkan bahwa model IndoBERTweet memberikan performa terbaik dengan *test accuracy* sebesar 90,63%, *macro F1-score* sebesar 0,8367, dan *weighted F1-score* sebesar 0,9051, serta menghasilkan jumlah kesalahan klasifikasi paling sedikit yaitu 91 kesalahan dari total 971 data uji. *Model Hybrid* IndoBERTweet dan Bi-LSTM berada pada posisi kedua dengan *accuracy* sebesar 90,32%, *macro F1-score* sebesar 0,8331, *weighted F1-score* sebesar 0,9003, dan total 94 kesalahan klasifikasi. Sementara itu, model Bi-LSTM menunjukkan performa paling rendah dengan *accuracy* sebesar 68,49%, *macro F1-score* sebesar 0,5401, *weighted F1-score* sebesar 0,7057, serta menghasilkan 306 kesalahan klasifikasi. Hasil penelitian menunjukkan bahwa pendekatan berbasis Transformer memiliki kemampuan yang lebih unggul dalam memahami konteks bahasa pada komentar media sosial dibandingkan model sekuensial murni. Di sisi lain, pendekatan *Hybrid* mampu memberikan keseimbangan antara performa klasifikasi yang tinggi dan stabilitas generalisasi model terhadap data baru.

Kata Kunci: Analisis Sentimen, Intoleransi Beragama, YouTube, Bi-LSTM, IndoBERTweet, Model *Hybrid*, *Deep Learning*, NLP.

ABSTRACT

The rapid growth of the digital era has made YouTube comment sections a strategic source of data for understanding public opinion, including sensitive issues such as religious intolerance in Indonesia. However, sentiment analysis on social media text faces several challenges, including the use of informal language, semantic ambiguity, contextual complexity, and class imbalance. This study aims to integrate IndoBERTweet and Bidirectional Long Short-Term Memory (Bi-LSTM) into a Hybrid architecture and compare its performance with standalone models in three-class sentiment classification, namely Negative, Neutral, and Positive. The integration was implemented by utilizing IndoBERTweet as a contextual feature extractor that generates context-based embeddings, which are then further processed by a Bi-LSTM layer to model bidirectional sequential dependencies. The dataset consisted of 6,467 YouTube comments obtained through a crawling process and processed using the CRISP-DM framework. Class imbalance was handled using a class weighting approach during model training. The evaluation results showed that the IndoBERTweet model achieved the best performance with a test accuracy of 90.63%, a macro F1-score of 0.8367, and a weighted F1-score of 0.9051, while also producing the fewest classification errors, with 91 misclassifications out of 971 test samples. The Hybrid IndoBERTweet and Bi-LSTM model ranked second with an accuracy of 90.32%, a macro F1-score of 0.8331, a weighted F1-score of 0.9003, and a total of 94 misclassifications. Meanwhile, the Bi-LSTM model demonstrated the lowest performance, achieving an accuracy of 68.49%, a macro F1-score of 0.5401, a weighted F1-score of 0.7057, and producing 306 misclassifications. The results indicate that Transformer-based approaches have superior capability in understanding contextual language in social media comments compared to purely sequential models. On the other hand, the Hybrid approach offers a balance between high classification performance and better model generalization stability on unseen data.

Keywords: Sentiment Analysis, Religious Intolerance, YouTube, Bi-LSTM, IndoBERTweet, Hybrid Model, Deep Learning, Natural Language Processing (NLP).