Digital Payment Supervisory Technology Based On Sentiment Analysis Using The IndoBERT-BiGRU
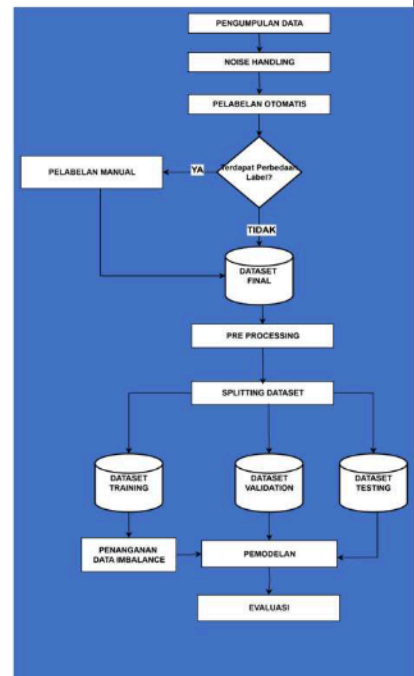
Background

As digital payment transactions in Indonesia continue to escalate, there is a corresponding rise in operational and cyber risks, necessitating the implementation of advanced Supervisory Technology (SupTech) for early problem detection. Sentiment analysis of public opinion on social media emerges as a potential SupTech solution, offering a way to monitor service stability in near real-time. However, the practical application of this approach faces several key challenges: a scarcity of public, domain-specific datasets for Indonesian digital payments; methodological limitations, as previous research is dominated by conventional machine learning models that struggle to capture complex semantic context; and the issue of naturally imbalanced data, where a higher volume of negative complaints can significantly bias the model.

Result & Discussion

F1 Score Comparison of IndoBERT BiGRU with other models

Confusion matrix of IndoBERT-BiGRU after back translation

Experimental results demonstrate the superiority of the proposed IndoBERT-BiGRU model, which achieved a final F1-Score of 88.46% after data augmentation. This performance significantly surpassed other deep learning and classical models, including IndoBERT-Finetuned (86.38%) and SVM (76.93%). The application of back translation was a key factor in this success; a detailed confusion matrix analysis revealed that the technique not only boosted the overall score but also significantly improved the model's ability to distinguish the ambiguous "Neutral" class from negative sentiments. Furthermore, a computational analysis confirmed a highly favorable trade-off, where the substantial accuracy gains of the IndoBERT-BiGRU model came at a marginal and practically negligible increase in inference time, solidifying its standing as the most robust and efficient solution

Selected References

1. Rana, M. R. R., et al. (2025). BERT-BiGRU-Senti-GCN: An Advanced NLP Framework for Analyzing Customer Sentiments in E-Commerce.
2. Koto, F., et al. (2020). IndoLEM and IndoBERT: A Benchmark Dataset and Pre-trained Language Model for Indonesian NLP

Previous Works

Prior local research on this topic by Maharani & Triayudi (2022) relied on classical models and private datasets, while international studies by Rana et al. (2025) validated the use of BERT-BiGRU architectures for English. This study addresses these gaps by implementing a language-specific IndoBERT-BiGRU model, developing the first public domain-specific dataset, and applying back-translation to resolve data imbalance.

Methodology

The methodology began with collecting tweets from social media, which were then filtered using keywords to produce a relevant, domain-specific dataset. A novel hybrid labeling method was employed, combining automated annotations from three tools—Brand24, ChatGPT, and Gemini—with manual validation To address class imbalance and enrich the training data, a back-translation technique was applied. The core of the study involved developing a hybrid IndoBERT-BiGRU model, which was then comprehensively evaluated using F1-Score, confusion matrices, and a computational time analysis.
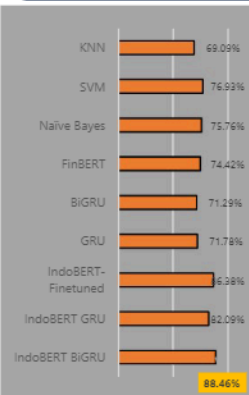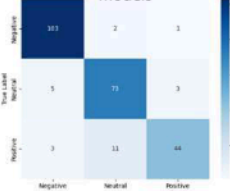

Methodology

Conclusions

This research concludes that the proposed hybrid IndoBERT-BiGRU architecture is a highly effective and practically efficient model for sentiment analysis in the Indonesian digital payment domain, achieving a final F1-Score of 88.46%. This success is supported by two key methodological contributions: the development of the first public, hybrid-labeled dataset for this specific domain , and the successful application of back-translation to augment data, which was proven to enhance model performance and balance. Ultimately, this study provides a robust framework that can be implemented for supervisory technology (SupTech) to enable more efficient, real-time monitoring of public opinion on digital payment services.

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