

BAB V

CONCLUSION

5.1 Conclusion

Based on all stages of the research, starting from data preparation, code implementation, to system testing, the following conclusions can be drawn:

1. The development of a sentiment analysis system using the **Bidirectional Long Short-Term Memory (Bi-LSTM)** method was successfully implemented. Through optimized preprocessing stages and the use of bidirectional context, the model demonstrated a superior ability to understand complex textual patterns in customer service conversations compared to standard architectures.
2. The implementation of a decoupled architecture between the backend (Python/Flask deployed on Hugging Face) and the frontend (Laravel) proved to be highly effective. This approach allows the web application to remain lightweight while seamlessly leveraging advanced artificial intelligence capabilities without burdening the main server.
3. System testing demonstrated **exceptional results**. Functionally, the application operates without critical bugs. In terms of performance, the model is able to classify positive, negative, and neutral sentiments with a **high accuracy of 96%**. Notably, the system achieved a **96% recall rate for negative sentiments**, ensuring that customer complaints are rarely missed. This significant improvement indicates that the system is highly reliable and fully ready to be used as a primary tool for automating customer service monitoring at Amikom WhatsApp Caller Center.

5.2 Recommendations

For future development of this system, several improvements are recommended:

- a) **Response Time Optimization**
Considering that the use of third-party cloud APIs introduces latency, future development should implement asynchronous mechanisms (such as AJAX) or queue-based job processing to prevent users from experiencing page loading delays when processing large volumes of data.
- b) **Handling Informal Language**
The integration of a more comprehensive slang normalization dictionary is recommended to improve the model's ability to accurately detect sentiment from users who frequently use informal abbreviations or non-standard language.
- c) **Advanced Visualization**
Future enhancements may include the development of an executive dashboard that presents monthly sentiment trend visualizations, which would assist management in making strategic, data-driven decisions.

