# CHAPTER V
## CONCLUSION AND RECOMMENDATION

### 5.1 Conclusion

Based on the results of testing, evaluation, and analysis conducted on the BiLSTM model to predict Bitcoin price movements using on-chain data, the following conclusions can be drawn to answer the problem formulations of this research:

1. Development of the Optimal BiLSTM Architecture: The BiLSTM architecture was successfully constructed and calibrated to process time-series data bidirectionally. Based on a comprehensive hyperparameter tuning process, the most optimal model configuration was achieved using a 90:10 data-splitting ratio, a learning rate value of 0.0001, and 2 hidden layers with a capacity of 16 and 32 neuron units, respectively. This architecture is further supported by a sequence length parameter of 60, the ReLU activation function, the Adam optimizer, and the Mean Squared Error (MSE) loss function, which proved successful in maintaining a balance between convergence speed and overfitting avoidance.
2. Model Performance Evaluation: The performance of the BiLSTM model under this final architecture demonstrates a high and precise degree of predictive accuracy. Measurement of the computational error rates proves that the model successfully minimizes prediction evaluation metrics against the actual ground-truth prices, yielding an MAE of 932.61, an RMSE of 1,257.07, and a MAPE of 0.97%. Achieving a MAPE value well below the 10% threshold confirms that the BiLSTM method is highly adaptive and capable of capturing extreme volatility patterns from Bitcoin on-chain data.
3. Model Results Implementation: The trained deep learning architecture was successfully deployed into a web-based application system utilizing the Flask framework as the backend. The system is designed as an interactive Single-Page Dashboard interface. This website is

functionally proven to accommodate users in uploading CSV-formatted datasets, executing price forecasting computations based on user uploads, visualizing Market Analysis charts, and displaying model performance evaluation metrics instantaneously within a single unified view.

## 5.2 Recommendations

Although the model proposed in this study has demonstrated excellent performance, there remain areas for improvement and further development. The recommendations that can be provided for future research are as follows:

1. Integration of Off-Chain Data (Sentiment Analysis): This research focuses entirely on utilizing variables from the Blockchain network (on-chain data). For future studies, it is highly recommended to integrate fundamental off-chain data, such as sentiment indices from social media (X/Twitter), Google Trends search indices, or macroeconomic news. Merging these analytical approaches is believed to enhance the model's responsiveness to market panic triggered by public figure sentiments or global regulations.
2. Utilization of Real-Time APIs: In the current web system developed, users are still required to manually upload datasets in CSV format. Future developments are expected to integrate the website directly with public Application Programming Interfaces (APIs), such as those from Binance, Glassnode, or CoinMarketCap. Automating live data fetching directly from the source will transform the dashboard system into a fully autonomous, real-time prediction tool.