STOCK PRICE MANIPULATION DETECTION

CONTROL SYSTEMS AND INSTRUMENTATION ENGINEERING PROGRAM

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Introduction

The stock price manipulation causes damage to all groups of investors. It is necessary to use artificial intelligence to detect these strategies and continuously improve it, because the strategies of manipulators are always changing and being more sophisticated.

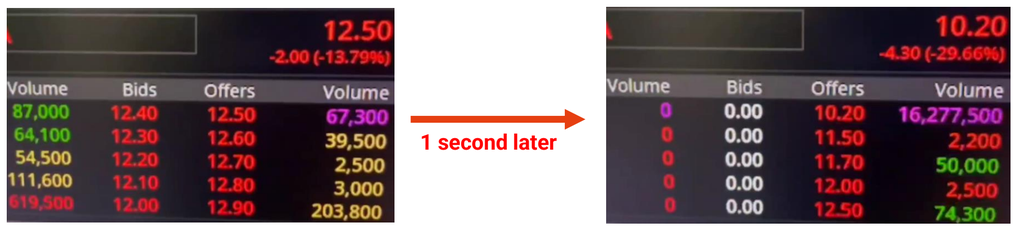

Fig.1 *Suspicious behaviors expressed on an order book (before-after)*

This research proposes a novel AI model using a **Transformer Autoencoder model**, It has better abnormalities detection performance than the LSTM Autoencoder in previous project

Method

In this project aims to develop the Transformer Autoencoder using **Unsupervised Learning** techniques. The strength is its ability to recognize the characteristics of abnormal trading patterns even without labeled manipulation examples.

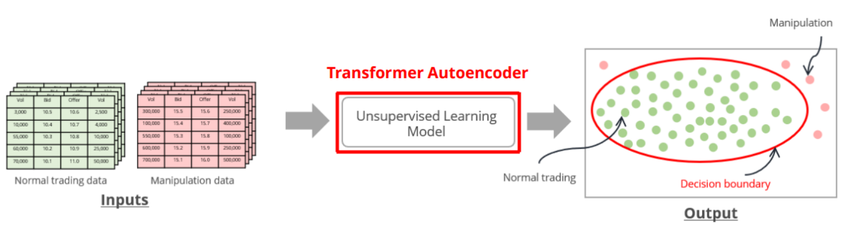

Fig.2 *Unsupervised Learning Model Framework for anomaly detection [1]*

This research builds upon the foundation transformer [2] originally introduced for natural language processing (NLP) tasks. Adaptation of the Transformer structure is presented, specifically designed for anomaly detection in time series data. Fig.3 shows the proposed model architecture.

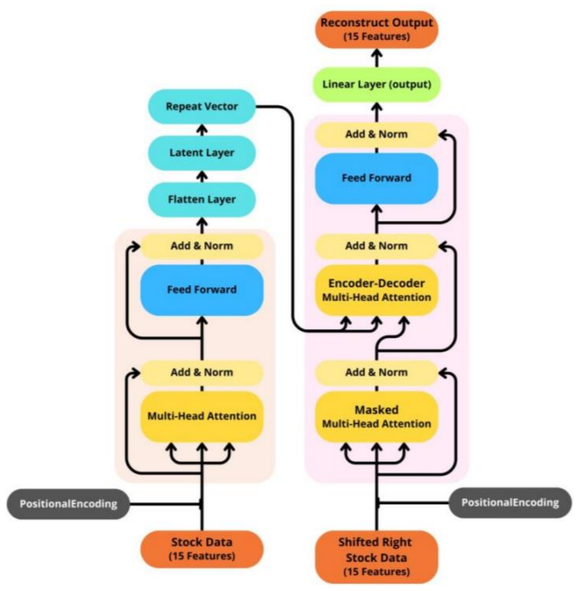

Fig.3 *Proposed Transformer-AE model for time-series anomaly detection*

The model was **trained using normal trading data** from the Stock Exchange of Thailand in the limit order book format. After that, the hyperparameters were optimized to achieve suitable performance, exceeding that of the project's previous LSTM Autoencoder model.

Results

The model performance in this project is evaluated and compared with the LSTM-Autoencoder from the previous project. The proposed model was **evaluated using normal data for 30 stocks and real manipulation data for 6 cases.**

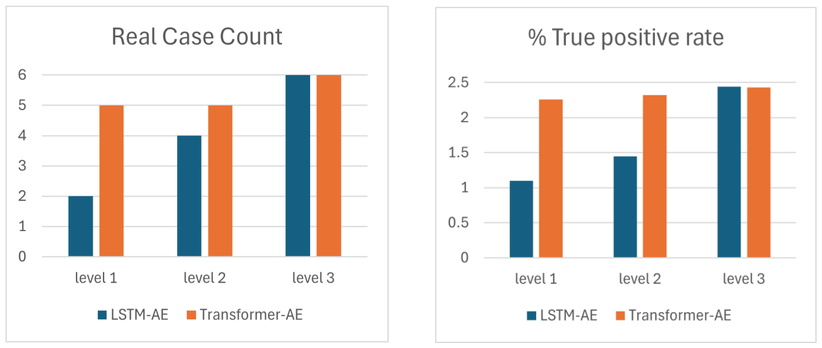

Fig.4 *Capability to detect abnormalities in both models.*

The results showed that **the performance of the proposed model has improved compared to the previous model**, such as the training time was reduced by a factor of five. Fig.4 shows that the transformer could detect abnormal cases or have a higher true-positive rate, and at a strict threshold of 0.00% false-positive rate, the transformer autoencoder was able to detect anomalies in five out of six cases, surpassing the LSTM-Autoencoder, which detects only two cases under the same condition. In addition, both models were able to detect real manipulation in all six cases at a false-positive rate of 0.10%, which is a level of precision that is still acceptable, as shown in Fig.5

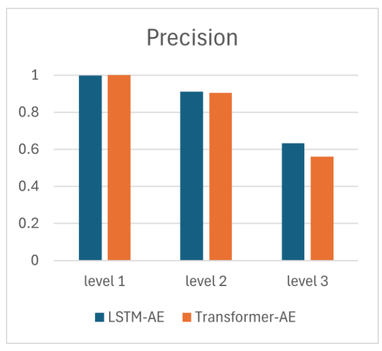

Fig.5 *The precision of models decreases with the detection intensity*

Conclusion

This project aims to create the Tranformer Autoencoder model for detecting manipulation. The model in this project outperforms the previous model “LSTM Autoencoder” in a variety of parts, especially with its significantly superior detection ability. Even though, training takes less time.

References

[1] Leangarun, T., Tangamchit, P. “Stock Price Manipulation Detection Using Deep Unsupervised Learning: The Case of Thailand”, IEEE Access, Vol.9.

[2] A. Vaswani, N. Shazeer, N. Parmar, J. Uszkoreit, L. Jones, A.N. Gomez, L. Kaiser, and I. Polosukhin. “Attention is all you need”. Advances in neural information processing systems, 30, 2017.