TABLE III. EIGENVALUES

PC	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Eigenvalues	9.09	3.13	2.16	1.72	1.53	1.36	1.15	1.08	0.99	0.89	0.81	0.6	0.55	0.52
Percentage (%)	32.45	11.18	7.73	6.15	5.47	4.84	4.12	3.85	3.51	3.17	2.88	2.14	1.97	1.85
Cumulative (%)	0.32	0.44	0.51	0.58	0.63	0.68	0.72	0.76	0.79	0.83	0.85	0.88	0.9	0.91
PC	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Eigenvalues	0.47	0.38	0.36	0.31	0.21	0.2	0.13	0.11	0.09	0.06	0.05	0.03	0.02	0
Percentage (%)	1.68	1.34	1.28	1.12	0.74	0.72	0.45	0.38	0.32	0.22	0.18	0.12	0.06	2.43

TABLE IV. EIGENVECTORS

Features	PC 1	PC1	Feature	PC 1	PC 2
djia	0.010	**-0.472**	RSI	**0.322**	0.013
gold	0.002	0.021	ADX	0.016	-0.022
hangseng	0.020	**-0.287**	APO	**0.209**	0.086
jse	0.051	**-0.264**	AronOsc	**0.262**	0.084
nasdaq	0.004	**-0.469**	BOP	0.132	-0.163
Nikkei	0.012	**-0.218**	CCI	**0.295**	-0.020
sp500	0.008	**-0.491**	Chande	**0.322**	0.013
usdidr	-0.038	**0.168**	MACD	**0.258**	0.086
Body	0.125	-0.172	MFI	**0.275**	0.044
head	0.009	-0.029	Momentum	**0.291**	0.000
Tail	0.044	0.050	DMI	0.000	-0.025
NormalizedATR	-0.085	-0.012	ROC	**0.292**	-0.003
ChaikinOsc	**0.271**	0.037	Stochastic	**0.242**	-0.011
OBV	0.113	0.033	WillR	**0.298**	-0.028

TABLE V. PERFORMANCE COMPARISON

Method	Number of Features	Accuracy (%)
Lasso + LSTM	16	**60**
Elastic Net +LSTM	18	**56**
PCA + LSTM	1	**71**
Unreductioned +LSTM	28	**60**

As benchmark, we try to compare the accuracies of the three methods with model with original dataset. Using 28 of original features, LSTM network gives 60% accuracy, as shown in Table V. Using the whole features gives better result compared to the ones with dimensional selection methods.

VI. CONCLUSION

In this study the three feature reduction methods are implemented. Overall result shows that the combination of PCA-LSTM gives highest accuracy compare to Lasso-LSTM or Elastic Net-LSTM. The low accuracy of feature selection based model might happen because both of the models group same features together and select only one representative feature, so during the implemntation of grouping mechanism those methods might throw some important information during the process. PCA gives highest accuracy because PCA takes into account the whole information give by all features.

REFERENCES

[1] E. F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," *The Journal of Finance*, vol. 25, no. 2, pp. 383–417, 1970.

[2] A. W. Lo, "The Adaptive Markets Hypothesis: Market Efficiency from an Evolutionary Perspective," Social Science Research Network, Rochester, NY, SSRN Scholarly Paper ID 602222, Oct. 2004.

[3] M. D. McKenzie, "Technical Trading Rules in Emerging Markets and the 1997 Asian Currency Crises," *Emerging Markets Finance & Trade*, vol. 43, no. 4, pp. 46–73, 2007.

[4] B. R. Marshall, R. H. Cahan, and J. Cahan, "Technical Analysis Around the World," Social Science Research Network, Rochester, NY, SSRN Scholarly Paper ID 1181367, Aug. 2010.

[5] H. Yu, G. V. Nartea, C. Gan, and L. J. Yao, "Predictive ability and profitability of simple technical trading rules: Recent evidence from Southeast Asian stock markets," *International Review of Economics & Finance*, vol. 25, pp. 356–371, Jan. 2013.

[6] P.-H. Hsu, M. P. Taylor, and Z. Wang, "Technical trading: Is it still beating the foreign exchange market?," *Journal of International Economics*, vol. 102, pp. 188–208, Sep. 2016.

[7] V. K. Bogullu, D. Enke, and C. H. Dagli, "Using neural networks and technical indicators for generating stock trading signals," *Intelligent Engineering Systems Through Artificial Neural Networks*, vol. 12, pp. 721–726, Jan. 2002.

[8] R. T. Farias Nazário, J. L. e Silva, V. A. Sobreiro, and H. Kimura, "A literature review of technical analysis on stock markets," *The Quarterly Review of Economics and Finance*, vol. 66, pp. 115–126, Nov. 2017.

[9] E. Chong, C. Han, and F. C. Park, "Deep learning networks for stock market analysis and prediction: Methodology, data representations, and case studies," *Expert Systems with Applications*, vol. 83, pp. 187–205, Oct. 2017.

[10] A. M. Rather, A. Agarwal, and V. N. Sastry, "Recurrent neural network and a hybrid model for prediction of stock returns," *Expert Systems with Applications*, vol. 42, no. 6, pp. 3234–3241, Apr. 2015.

[11] R. Tibshirani, "Regression Shrinkage and Selection via the Lasso," *Journal of the Royal Statistical Society. Series B (Methodological)*, vol. 58, no. 1, pp. 267–288, 1996.

[12] S. Hochreiter and J. Schmidhuber, "Long Short-Term Memory," *Neural Comput.*, vol. 9, no. 8, pp. 1735–1780, Nov. 1997.

[13] W. Li and J. Liao, "A comparative study on trend forecasting approach for stock price time series," in *2017 11th IEEE International Conference on Anti-counterfeiting, Security, and Identification (ASID)*, 2017, pp. 74–78.

[14] T. Gao, Y. Chai, and Y. Liu, "Applying long short term momory neural networks for predicting stock closing price," in *2017 8th IEEE International Conference on Software Engineering and Service Science (ICSESS)*, 2017, pp. 575–578.

[15] A. J. P. Samarawickrama and T. G. I. Fernando, "A recurrent neural network approach in predicting daily stock prices an application to the Sri Lankan stock market," in *2017 IEEE International Conference on Industrial and Information Systems (ICIIS)*, 2017, pp. 1–6.

[16] Z. Li and V. Tam, "Combining the real-time wavelet denoising and long-short-term-memory neural network for predicting stock indexes," in *2017 IEEE Symposium Series on Computational Intelligence (SSCI)*, 2017, pp. 1–8.

[17] K. A. Althelaya, E. S. M. El-Alfy, and S. Mohammed, "Evaluation of bidirectional LSTM for short-and long-term stock market prediction," in *2018 9th International Conference on Information and Communication Systems (ICICS)*, 2018, pp. 151–156.

[18] Z. Li and V. Tam, "A comparative study of a recurrent neural network and support vector machine for predicting price movements of stocks of different volatilites," in *2017 IEEE Symposium Series on Computational Intelligence (SSCI)*, 2017, pp. 1–8.

[19] D. A. Jackson, "Stopping Rules in Principal Components Analysis: A Comparison of Heuristical and Statistical Approaches," *Ecology*, vol. 74, no. 8, pp. 2204–2214, 1993.

[20] H. Zou and T. Hastie, "Regularization and Variable Selection via the Elastic Net," *Journal of the Royal Statistical Society. Series B (Statistical Methodology)*, vol. 67, no. 2, pp. 301–320, 2005.