Malaysia stock market prediction using artificial intelligence

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Abstract - It is impossible for an ordinary investor to access and analyze a large amount of data to make decision in which stock to invest. It will consume time, knowledge and experience to analyze a stock value or trend by using traditional approach. Artificial Intelligence technology can process to analyze a huge amount of data for stock market prediction and able to generate much higher efficient and accurate prediction result by using historical and present data. There are many researches have been conducted on stock market prediction, this paper will review various artificial intelligence techniques for different stock markets around the world on the index, the sector, the stock, etc., whereby this paper is helping to identify artificial intelligence technique for future research to predict and support human in making decisions to invest in the Malaysia stock market. Keywords—Digital Transformation, IR4.0, Challenges, Benefits, Implementation, Strategy.

Keywords—stock market, prediction, artificial intelligence

I.   INTRODUCTION

An income generated from a working salary or business profit is mainly spent on a person or a family living expenses. After deducting from all living expenses, if any balance from the income, the money can be put into saving, insurance, or investment. The investment can be real estate, fixed deposit, mutual funds, stocks, etc. One of the best investment choices is the stock market. A good investment in the stock market is to be a shareholder in a good company and get a better return of money from the investment without physically contribute the energy and time to the company as a passive income to increase personal assets and building wealth. It can consider as a sleeping partner.

The world's stock markets are very volatile for the year 2020 due to the pandemic COVID-19. Malaysia is one of the key markets of South East Asia that has successfully attracted investors to participate during the pandemic and cause the transaction volume surged up and breaking the record high around 20 billion units per day in August compared to average around 3 to 5 billion units previously.

A lot of investors are taking part in this opportunity to participate and invest in the Malaysia stock market. However, to select a good stock is not an easy task as stock price prediction is very challenging and there is a risk in investing stock market. The stock price is determined by both the buyer and seller through the open market platform during market hours and affected by many factors such as financial performance of a company, company management, economic

and industry condition, political event, investors' emotion, etc. The stock price movement will affect the profit or the loss to the investor. Therefore, many researchers and investors are attracted to discover in the stock market prediction for the purpose to get a good return of investment value.

There are two traditional approaches where investors are commonly use to do prediction on the stock market which are fundamental analysis and technical analysis. Fundamental analysis can refer to analyze the historical company's financial performance data and evaluate the company value to predict the price in the future. Dividends, cash flow, net profit, etc. are common analysis items in fundamental analysis. Technical analysis is predicting stock price base on the historical price movements from the transaction regardless to consider the fundamental information and based on trend, momentum, volume, and volatility. The famous technical analysis indicators such as Bollinger Bands, Relative Strength Index, Stochastic Oscillator, Moving Average Convergence Divergence, etc. are commonly use to predict stock. There is a need to develop a model with a higher efficiency and accuracy in the prediction stock market besides these two traditional approaches.

It is complicated to develop a model and simulate non-linear relations between input and output parameters. With the Artificial Intelligence technology that will be more approaches can be applied and gets better efficient and accurate result by analyzing the huge amount of data. The Artificial intelligence approach such as Machine Learning, Deep Learning, Neural Network, Support Vector Machine, Decision Tree, Genetic Algorithm, etc. have been commonly applied for developing a model which is capable to manage the challenging problem.

This paper is structured with few sections. The section I introduction of the need for investment in the stock market and apply artificial intelligence in stock market prediction. Section II gives a review on various related works conducted which are between 2015 to 2020 with the artificial intelligence in stock market prediction. Section III is the summary of related works in the matrix table. Section IV gives conclusions and future work discussion.

II.   RELATED WORKS

Various related works were conducted by researchers for stock market prediction using Artificial Intelligence in

different specific areas. Here, I carry out a review of some noteworthy researchers from recent years.

Strader et al. [1] conducted a study for review and research directions to predict the stock market using machine learning techniques. This research has reviewed the journals for the past 20 years and categorized them under similar groups. 4 similar groups have identified and categorized them into Support Vector Machines, Artificial Neural Networks, Genetic Algorithms and hybrid artificial intelligence approaches. The matching of task and technology can determine the performance of the system.

Artificial Neural Networks are good for predicting numerical stock market index. Supper Vector Machines are fix to the classification problems to determine stock market index trend. Genetic algorithms can be used for an evolutionary problem solving. Hybrid machine learning techniques can use to solve the limitation of single method. They concluded that if there is any best stock prediction technique found and everyone using the same technique, there will be no winner in game as it is a zero-sum game.

Iyer and Mehra [2] conducted a survey with several models to predict the stock market. The dividend the model into a few parts which are trend prediction model, time series forecasting, and several other trendy methods. The models studied by them such as Support Vector Machine, Genetic Algorithms, Artificial Neural Networks, Hidden Markov Model, Fuzzy Times Series, different data mining techniques, Sentiment Analysis, Backpropagation Neural Network, etc. This research concluded found every technique has its limitations and advantages. Different factors may affect the efficiency of the prediction.

A. Studies Using Artificial Intelligence in Prediction on The Stock

The stock is referring to a public listed company such as Amazon.com, Incorporated., Apple Incorporated. and Google or Alphabet Incorporated, Facebook Incorporated, Alibaba Group Holding Limited, etc. Pathak and Shetty [3] conducted research using machine learning and sentiment analysis to predict the stock in the Indian market. They studied the limitation of the traditional approach for fundamental analysis and technical analysis, they proposed the modern approach to do analysis which is the qualitative analysis and quantitative analysis. Qualitative analysis able to analyze the stock base on the news feeds that affected the stock price such as news from the media, social media, company's announcement. This involves text mining and sentiment analysis. Besides this, quantitative analysis is analyzing historical data. This historical data can be the dataset to apply in machine learning models for prediction.

The model proposed by them is to build a system involved machine learning, sentiment analysis, and fuzzy logic. From Fig. 1, the machine learning module is playing a role to analyze the historical data and handle stock prediction value. Sentiment analysis is playing a role to analyze the financial news from the website and classify the data. After machine learning and sentiment analysis analyze and process the data, the fuzzy logic module will generate the stock recommendation. This model needs more training data to integrate with different market to improve the accuracy.
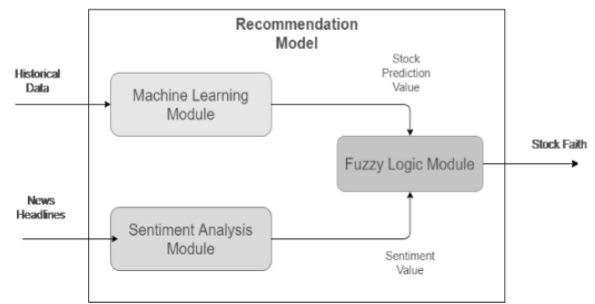

Fig. 1. The model proposed by Pathak and Shetty, 2017

Ghani, Awais and Muzammul [4] were used machine learning algorithms to predict the stock market on the three most popular stock in the US market which are Amazon.com, Incorporated., Apple Incorporated. and Google or Alphabet Incorporated. This research used machine learning algorithms which are Linear Regression, Times Series Forecasting, Exponential Smoothing, and Three- month Moving Average in predicting stock market monthly trend. They assumed that Exponential Smoothing will give less error and more accurate prediction and they found Exponential Smoothing produces the best prediction result compared to another 2 methods. Fazeli and Houghten [5] has conducted research using Long-short Term Memory networks to predict the stock trends. They used Apple, Microsoft, Google, and Intel are under the same sector for testing. The data is from 2014 to 2019 which consists of six items such as Open, High, Low, Close, Volume, Adjusted Close. They used the deep learning model by choosing correct technical indicators from the traditional approach which is technical analysis can generate a profitable result. The indicators such as Moving Average Convergence Divergence, Relative Strength Index, Williams %R, etc.

B. Studies Using Artificial Intelligence in Prediction on The Sector

The sector is referring to an industry such as financial, plantation, healthcare, telecommunication, education, manufacture, technology, entertainment, automobile, etc. Investors will refer to the sector when there is any news to affect the particular sector trend. Example, glove company benefit from the pandemic Covid-19 which surged huge demand of the products and cause the stock price broke new high. Nabipour et al. [6] used tree-based models such as Decision Trees, Random Forest, Boosting, Bagging, XG Boost, Gradient Boosting, and neural network-based models such Artificial Neural Networks, Long Short-term Memory and Recurrent Neural Network to conduct the study on Tehran's stock exchange market and predict stock groups values which are financials, petroleum, non-metallic minerals, and basic metals. This research used 10 years of historical data to predict a value for 1, 2, 5, 10, 15, 20 and 30 days in advance. The finding from this research both tree-based and neural network-based models have the remarkable potential to predict future value in regression problems. Comparison among all models, Long Short-term Memory models shows the highest fitting, lower error and more accurate results.

C. Studies Using Artificial Intelligence in Prediction on The Index

The index is referring to a benchmark an exchange which composed several companies from different sector that important to the particular stock exchange such as Dow Jones

Industrial Average, NASDAQ, Standard & Poor's 500 for the New York Stock Exchange, Hang Seng Index for Hong Kong Stock Exchange, Straits Times Index for Singapore Stock Exchange, FTSE Bursa Malaysia KLCI for Malaysia Stock Exchange, etc. Index is an important indicator to the investor as a benchmark and predict the trend for a stock.

Hu and Song [7] proposed multi-layer stochastic Artificial Neural Network bagging which is integrated Artificial Neural Network with bagging to do prediction on Standard and Poor's 500 index. Standard and Poor's 500 index is an index composed 500 stocks whereby the well-known company such as Microsoft Corporation, Apple Incorporated, Amazon.com Incorporated, Facebook Incorporated, Johnson & Johnson, Berkshire Hathaway Incorporated, etc. They compared the proposed model with Support Vector Machine, Artificial Neural Network, Random Forest and Artificial Neural Network model which optimized by genetic algorithms by using data which is randomly selected from 2006 to 2013 and distributed into a 90 percent training set and 10 percent test set. The result of the proposed model has achieved 3 percent to 15 percent better compared to other models. Yang, Gong and Yang [8] conducted research to predict China stock market index which are Shanghai Composite Index and Sheng Zhen Stock Exchange Component Index. They used Deep Neural Network Ensemble model to do prediction on the index and Backpropagation and Adam algorithm were used to train the data. The model proposed has accuracy to predict the trend for both indexes with around 70 percent. Moghaddam, Moghaddam and Esfandyari [9] used Artificial Neural Network on NASDAQ Index prediction. NASDAQ is composed of 100 stocks such as Cisco, Intel, Netflix, Adobe, Paypal, Nvidia, etc. They used NASDAQ as the index with around 5 months daily data from January 28, 2015, to 18 June 2015 categorized into 2 datasets which are 4 prior days and 9 prior days as input parameter to develop and validate the prediction. The final result between these 2 is not much different. Lachiheb and Gouider [10] conducted research on a Deep Neural Network to predict the TUNINDEX which is a Tunisian stock exchange index which is composed of 75 stocks. The dataset used 45 stocks every 5 minutes' price as data from 2013 to 2017. The proposed Deep Neural Network model has accuracy up to 73 percent.

D. Studies Using Artificial Intelligence in Prediction on Other Stock Market Products

Besides common stock, there are other products listed in the stock market as well such as Exchange Traded Fund, Structured Warrants, etc. The diversified products provide investors more options for selection to invest in the market. Zhong and Enke [11] conducted research on predicting the daily stock direction by using machine learning algorithms which is Deep Neural Networks.

The Deep Neural Networks model is combined with various algorithms of network structure, activation function, and model parameters. The research is focused on the prediction of the SPDR S&P 500 ETF with 60 economic and financial factors. They gradually increased the hidden layers from 12 to 1,000. The research found with the proper number of hidden layers and the result able to generate the highest accuracy among the hidden layers.

E. Studies Using Artificial Intelligence and Data Mining in Prediction on Stock Market

Navale et al. [12] conducted a review for using Artificial Intelligence and Data Mining in stock market prediction. The Artificial Intelligence techniques listed in the review included Genetic Algorithm, Support Vector Machines, Backpropagation Algorithm, Artificial Neural Networks, Linear Regression, etc. Putting Artificial Intelligence and Data Mining together able to get a nearly accurate result. Bouktif and Awad [13] has proposed a model based on the collective classification in social networks using a number of public mood states to predict stock movement. The approach is based on Ant Colony Optimization algorithm and Bayesian classifiers and compared with other alternative methods such as bagging, Adaboost, best expert, etc. They discovered mood states' attributes and scores are affected by the particular stock movement. The result showed the model proposed gets higher performance compared to other alternative methods. Jiang and Pan [14] has conducted research for stock prediction based on company announcements for China Markets. They proposed a model using natural language processing techniques for text classification based on the content of the announcement. They proposed to process the announcements and build a classifier model to predict in the stock market. They used naïve Bayes and successfully classified correctly 8 out of 10 samples.

F. Studies Using Artificial Intelligence in Prediction on Malaysia Stock Market

Sagir and Sathasivam [15] used Artificial Neural Network and Multiple Linear Regressions to predict the Malaysia Stock Exchange Index. The result showed Artificial Neural Network was much more accurate compare to Multiple Linear Regressions on Mean Squared Error and Coefficients of determination. A study conducted by Tan and Chan [16] on Bursa Malaysia Stock Index Prediction for the FTSE Bursa Malaysia KLCI using Artificial Neural Network and Autoregressive Integrated Moving Average. This research proposed a study to the ability of artificial intelligence and time series analysis on stock market prediction. They used data for daily closing prices from 3 January 2012 to 31 March 2015. Both approaches are capable of Malaysia stock market prediction.

G. Studies on others related Malaysia Stock Market Prediction

There are many other related techniques can use as a good reference to enhance the prediction technique besides Artificial Intelligence approach. Redzwan et al. [17] conducted an analysis of the stock market during a few Malaysia general elections for 2004, 2008 and 2013 on 10 sectors which are Financial, Trade and Services, Construction, Technology, Consumer, Plantation, Property, Industrial Product, Industrial, and Mining. The dividend the timeframe into 3 categories which are pre window, window (10 day during the event plus 5 days before the event), window and post window, and compared Markov Chain model with Moving Average method. However, Markov Chain model performance higher accuracy.

Yong and Hassan [18] has conducted a study on economic outlook impact the service sector stock in Malaysia. They proposed to find out the relationship between money supply, interest rate, and exchange rate by using correlation and multiple regressions analysis. They found all the factors have a relationship with the service sector stock in Malaysia.

TABLE I.   LITERATURE REVIEW MATRIX

Author/ Date	Theoretical / Conceptual Framework	Research Question(s)/ Hypotheses	Methodolog y	Analysis and Results	Conclusions	Implications for Future research	Implications For practice
Strader et al., 2020 [1]	Application machine learning in stock market prediction studies	Identify directions for future machine learning stock market prediction	Literature review for journal articles from past 20 years	4 groups using similar approach have identified. They are Artificial Neural Network, Support Vector Machine, Genetic Algorithms combined with other techniques and hybrid or other artificial intelligence approaches	Many studies use techniques without consider the financial theory	To have a system able to perform under different risk and volatility environment	Financial theory is important for the inputs, algorithms and performance measures
Iyer and Mehra, 2018 [2]	A survey on stock market prediction	Maximizing the profit from different approaches and techniques	Literature review for 12 journal articles	Every method has its own limitation and advantages	Stock prediction is an advanced work	Design a system with maximized exactness and less computation al complication	Should utilizing current and historical available data to predict the stock.
Pathak and Shetty, 2017 [3]	Application of machine learning and sentiment analysis in Indian stock market	Combining both machine learning and sentiment analysis can provide more accurate and flexible recommendations ons	Implementat-ion with machine learning, sentiment analysis and fuzzy logic	Stock prediction value is depending on news sentiment	This model can generate a good stock recommenda tion	Integrate the model with other markets and improve the training data	This combination models able to cover markets sentiment with stock historical price
Ghani, Awais and Muzammul, [4]	Application of machine learning algorithm in stock market prediction	Exponential Smoothing given less error and more accurate	Comparison of Linear Regression, Exponential Smoothing Three-month Moving Average and Time Series Forecasting	Exponential Smoothing produced best result compared to other models	Prediction helps to manage risk base on analyze historical data and previous business trend	Many other algorithms to be used for prediction stock market	Predicting a non-linear signal require machine learning progressive algorithms
Fazeli and Houghten, 2019 [5]	Application of deep learning in stock market prediction	Using historical stock prices and technical indicators to increase the accuracy	Used long-short term memory networks along with technical indicators	Deep learning can integrate with technical analysis	The deep learning model with correct technical indicators can generate a profitable result.	Integrate with sentiment analysis	Focus on trend prediction and optimize hyperparameters

Nabipour et al. [6]	Application of deep learning in stock market prediction	Prediction of stock market groups	Comparison of Decision Trees, Random Forest, Boosting, Bagging, XG Boost, Gradient Boosting, Artificial Neural Networks, Long Short-term Memory and Recurrent Neural Network	Long Short-term Memory was best model fitting with lowest error	Stock market prediction changes to detect accurate profit and minimize risk	Testing on other stock markets or examining hyperparameters effects	It is necessary in stock prediction for investment
Hu and Song [7]	Application of Multi-layer Stochastic Artificial Intelligence Networks Bagging in stock trend prediction	Alternative model for prediction	Comparison of proposed model- Multi-layer Stochastic Artificial Intelligence Networks Bagging with others	The model proposed perform well in stock prediction	The model proposed can be used for stock prediction	Use Convolutional Neural Networks or Recurrent Neural Networks to replace Artificial Intelligence Networks	To have an effective stock data
Yang, Gong and Yang, 2017 [8]	Application of Deep Neural Networks Ensemble in stock market index prediction	Use Deep Neural Networks Ensemble to predict Chinese stock market index	Backpropagation and Adam algorithm are used to train the networks. Bagging approach to generate ensemble	Prediction accuracy around 71 percent to 76 percent for Shanghai and Shen Zhen Index	Chinese stock is partially predictable	No	The relative errors of prediction are fluctuate fiercely.
Moghaddam, Moghaddam and Esfandyari, 2016 [9]	Application of Artificial Neural network in stock market index prediction	Ability of Artificial Neural Network in predicting NASDAQ	Artificial Neural Network with 4 and 9 prior working days data and measure with R squared	The proposed model worked quite well	There is no difference between two parameters inputs	No	Use artificial intelligent systems to solve the challenging problems
Lachiheb and Gouider [10]	Application of Deep Neural Network for prediction stock returns	Predict a stock return in the high frequency context	The model is improved by hierarchical design	The prediction up or down accuracy near 71 percent by mean squared error	Deep Neural Network performs well in most cases compared with artificial neural networks	To add financial news, reports and moods for prediction	Use high frequency context for short term trading
Xiao Zhong and David Enke [11]	Application of hybrid machine learning algorithm in daily stock return prediction	Prediction of daily return direction	Deep Neural Networks with gradually increases hidden layers from 12 to 1,000	Analyze on SPDR S&P 500 ETF	The proper number of hidden layers can generate better result	Continue on Deep Neural Networks research	Deep Neural Networks is a black block with less clear theoretical confirmations
Navale et al., 2016 [12]	Application data mining and artificial intelligence in stock market prediction	To get accurate prediction result using data mining and artificial	Literature review for 10 journal articles	Most researches used artificial intelligence method to achieve accuracy and performance	The help of data mining and artificial intelligence will generate accurate result	Put together data mining and artificial intelligence	Use data mining in analyze large amount of information

Bouktif and Awad, 2015 [13]	Application of data mining in stock market prediction	Use social networks in stock prediction	Ant Colony Optimizatio n algorithm, Bayesian classifier and Mood scores	The proposed model showed higher performance compared to 4 alternative approaches	The proposed model was performed	Other models for research	Data mining on mood scores
Zhihua Jiang and Xixi Pan, 2016 [14]	Application of Natural Language Processing in stock market prediction	Is stock price able to predict from company announcemen ts?	Text classificatio n based on the announcemen nts content	Accuracy up to 80 percent from 8 out of 10 samples	Natural Language Processing helps to use information data better	Explore in lexicon- based and machine learning approaches	Qualitative analysis using Natural Language Processing
Sagir and Sathasivam, 2017 [15]	Application of Artificial Neural Network and Multiple Linear Regression in stock market prediction	Can use Artificial Neural Networks to predict in Malaysia stock market?	Comparison of Artificial Neural Network and Multiple Linear Regressions by Mea n Squared Error and Coefficients of determinatio n.	Artificial Neural Networks was much more accurate compare to Multiple Linear Regressions	Artificial Neural Networks can be used by investor to maximize profit	Use R statistical software to develop a model	Applied Artificial Neural Networks in Malaysia stock market prediction
Tan and Chan, 2015 [16]	Application of Autoregres sive Integrated Moving Average and Artificial Neural Networks in stock market prediction	Able to predict FBM KLCI by Autoregressiv e Integrated Moving Average and Artificial Neural Networks?	Autoregressi ve Integrated Moving Average and Artificial Neural Networks	Both approaches are capable for Malaysia stock market prediction.	Using right technique will give added advantage on more accurate prediction	Further improve on accuracy by a hybrid model	Implementation of Autoregressive Integrated Moving Average and Artificial Neural Networks in Malaysia stock market
Redzwan et al., 2019 [17]	Application of artificial intelligence and traditional approach in stock market prediction	Relationship of Malaysia stock market with general elections	Comparison of Mar kov Model and Moving Average	Markov Chain model performance higher accuracy.	This can help investors in making investment decision during general elections	Further explore in different sector	Comparison modern approach with traditional approach
Yong and Hassan, 2019 [18]	Economic outlook on stock market	Relationship of stock market with other variables like money supply, interest rate and exchange rate	Correlation analysis and multiple regressions analysis	All listed factors have the relationship with the service sector stock in Malaysia	Government should improve to educate the investors.	Can consider to input more variables	Data analysis techniques

III.   CONCLUSIONS AND FUTURE WORK

The related works have been categorized in a few studies as they are specifying the research in particular areas such as stock, index, sector, other products, or Malaysia stock market. Most of the study is applying the artificial intelligence techniques in a particular area without considering the system can be applied effectively in certain markets, products, and situations. First, the model has tested in specific markets like US stock markets, it could apply and test for other stock markets such as Malaysia, Hong Kong, London, etc. Second, the model has tested in a specific period during the market up or down. It should be able to analyze and predict for whatever situations such, up trend, downtrend, sideways, very volatile, volume slow down, volume surge, etc. Third, the researches have been conducted the research specify on stock, sector, or index. However, they should find out the relationship between these three as they interact with one another. During pandemic Covid-19, all rubber gloves related stock price surged as the demand for gloves shooting up and it may go down if any vaccine has discovered. Lastly, the financial knowledge is very important when conducting the research to predict the stock market. As many studies during the process to conduct the research and develop a model without considering significant financial theory.

Although there are many related works but could not find many recent researchers who have conducted prediction using Artificial Intelligence techniques in the Malaysia stock market. Hence, this paper is the purpose to conduct a future work to focus on Malaysia stock market prediction with considering the analysis, discussion and evaluation above.

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