STOCK MARKET EQUITY ADVISORY TOOL BY USING NEURAL NETWORK METHOD

BY

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Date : ___24 April 2024_____

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ABSTRACT

This field of study of this project is a stock market equity advisory tool that will analyze the stock market using machine learning which is Neural Network Method. Stock market prediction like traditional statistical as well as artificial intelligence techniques are used widely in the world. In this study, we proposed a stock market equity advisory tool to analyze Malaysia's stock market by using the Neural Network Method as the analyzing tool. Malayan Banking Berhad are chosen to be the stock that use to train the model. The historical data of the stock have been getting from yahoo finance and put into the model to do training and testing. After the training, the pre-trained model has been saved and merge to the webpage. A webpage will be deployed to let user to use the tool to do real-time prediction for any stocks in Malaysia. User can choose to predict and get investment recommendation for the next day closing prices or predict for the next five days prices.

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LIST OF ABBREVIATIONS

NN	Neural Network
ANN	Artificial Neural Network
API	Application Programming Interface
SVM	Support Vector Machine
LSTM	Long Short-Term Memory
KLSE	Kuala Lumpur Stock Exchange
HDF	Hierarchical Data Format
CSV	Comma-Separated Value
MSE	Mean Square Error
RMSE	Root Mean Square Error
MAE	Mean Absolute Error

CHAPTER 1 - Introduction

1.1 Project Inspiration

1.1.1 Project Background

Stock market is a public market for listing company to list their stock for purpose of gather financial resources through stock trading. A stockholder can earn profit from price difference through buy and sell activities. Stock market prediction is a large requirement for the world now. It gains significant importance among expert analysts and investors now. The reason for the stock market is hard for prediction because of the noisy environments and large volatility according to the market trends. Stock price will always be adapted by certain factor which involving the market open price, market close price, quarterly earning's reports, market news and varying changing behaviours. Making an accurate prediction of stock trends is an incredibly challenging and complex task in our world. Artificial Intelligence already has been used as the tool for the stock market analysis for some time. ANN is one of the most popular methods that are used as an analysis tool. There are various technical indicators that are based on the stocks, which are collected daily. Neural networks are inspired by biological nervous systems. The function of a neural network is to produce an output pattern when presented with an input pattern [1]. ANN is a three-layer architecture which including the Input Layer, Hidden Layer and Output Layer [2]. It can be used to solve a complex nonlinear problem like stock market volatility and public information flow. ANN are function with the data that train and improve the accuracy over time. The more the data trained, the more accurate for the output.

1.1.2 Project Overview and Motivation

The Stock Market Advisory Tool is to assist the investors and traders have more advice and decision when can make when dealing with Malaysia Stock Market. The tool will use the Artificial Neural Network (ANN) to analyse the historical data of stocks to identify the patterns and provide a prediction of the future trends.

1.2 Problem Statement

Inaccurate and Unreliable Stock Market Predictions. Current stock market predictions tool is often suffered with inaccurate and unreliable predictions. Some predictions are just done by investors or traders. The need for and AI analysis tool for the stock market trends arises due to the existing limitations of traditional stock predictions.

Lack of User-friendly Interface. Most current analysis tool that exits in the market are lack of intuitive and user-friendly interface. Most of the tool need users to pay or subscribe for monthly memberships to unlock all the features of the systems. Users always been limited to the predictions outcomes and insight that provided by the tool.

Lack of Model Optimization. The challenge in stock market prediction will back to model itself. The architecture applies and the choices of parameters that consider including in the ANN model is hard to determine. It is crucial to find the optimum combinations that deliver the higher predictive accuracy to Malaysia Stock Market.

1.3 Project Objectives

Enhancing Stock Market Predictions. To develop a Stock Market Equity Advisory Tool that using of NN method to analyse stock market trends to improve the accuracy of the stock market forecasting.

User-Friendly Interface for Actionable Recommendations. This application is to develop a user-friendly application that help the investor and traders to make decisions in the stock market. Some new investors and traders who not willing to analyse the data by their own can get a way to do the stock analysing. The tool will assist the users to reduce the risk of investment.

Model Optimization. To systematically explore and experiment with the NN model and parameter combinations. The aims to enhance the model optimization is to improve the stock market predictions accuracy through the fine tuning to the NN model.

1.4 Project Scope

The scope of the project is to develop a Stock Market Equity Advisory Tool by using Artificial Neural Network Method to analyse Malaysia Stock Market on web-based platform. The tool will help to predict the future trend of the stock market and

generate the investment recommendation to the user. The system allows the user to input the stock that wishes to do prediction and then Yahoo Finance API will be call and the ANN model will start to learn from the pre-trained weight of ANN model in real-time and make a prediction to the movement of the stock price for the next day. The system will show an output to the user which includes the current stock price, future stock price and the investment recommendation to the user.

The main target stocks in the system will be the stocks that have been listed in Kuala Lumpur Stock Exchange (KLSE). The system will only be focusing on short-term predictions. The whole system will be built by using Flask frameworks and Jupyter Notebook. After the most suitable model have been designed in Jupyter Notebook, the pre-trained weight will be saved and migrate the ANN model to run in real-time in Flask app platform.

Functionalities:

1.4.1 Artificial Neural Network Implementation:

Design and develop a better accuracy ANN model that use to analyse Malaysia Stock. Train the ANN model with historical data of the stock market to learn the pattern and trends.

1.4.2 Data collection:

The historical data and the real-time stock market data will be collected from Yahoo Finance platform.

1.4.3 Feature selection and insertion:

Identify the most suitable indicators, market variables and data points that influence stock prices of Malaysia Stock to insert the most suitable features for insert into the training of ANN model.

1.4.4 Prediction:

Utilized the trained ANN model to use to predict the Malaysia stock market future trends.

A. Generate the recommendation investment with strong sell, sell, neutral, buy or strong buy.
B. Generate the stock prices for the next five days.

1.5 Project Impact and Contribution

The project aims to develop an advisory tool for Malaysia Stock Market to do prediction for the future trend. It will use ANN to do the prediction. ANN enables the tool to analyse large amount of data, identify the patterns and make a more accurate predictions to the future trends compare to the traditional methods.

1.6 Chapter Summary

Chapter 1 of the project introduces the Stock Market Equity Advisory Tool by Using of Neural Network Method. The chapter highlight the project motivation, problem statement, project objectives and project scopes. The project is aimed to develop a stock market predictions tool with the NN model build.

CHAPTER 2 - Literature Reviews

2.1 Literature Review of Neural Network

2.1.1 Neural Network

Neural networks are also known as Artificial Neural Networks (ANN) or Simulated Neural Networks (SNN). They are the subset of machine learning algorithms. In this review, it explains the evolution of neural networks.

ANN are comprised of a node layer. An ANN model will contain a input layer, one or more hidden layer and one output layer. The node will connect with each other and has an associated weight and threshold. NN rely on training data to help it learn and improve their accuracy over time [3]. When the model has enough training and fine tune, it will be a powerful tool to use.

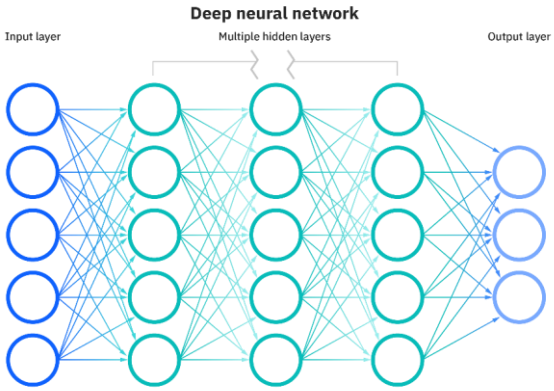

Figure 2.1 Deep Neural Network

2.1.2 Feedforward Neural Network

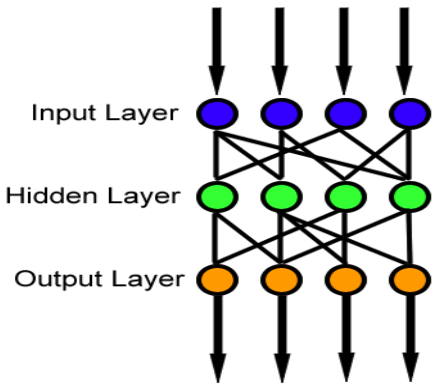

Figure 2.2 Feedforward Neural Network

FNN is the simplest NN that always applies in stock market prediction. FNN contains at least three layers which are input layer, hidden layer, and the output layer. The NN only moves to one direction which from the input layer(s) to the hidden layer(s) then the last move to the output layer(s).

Single-layer perceptron is the simplest NN that input is fed directly to output with the weights. Each node computes the sum of the products of the weights and the inputs, and if the value is greater than a threshold usually it will be 0, the active value typically it will be 1; if not, the deactivated value typically will be -1. A single-layer neural network can compute a continuous output. The common function of it is logistics function ($f(x) = 1/ 1+e$) which is one of family of sigmoid functions ($f^1(x) = f(x)(1-f(x))$.

Multi-layer perceptron has multiple layers of computational units which contains of few neurons in a layer. Neuron in one layer will directly connect with the subsequent layer. The layers usually apply with sigmoid function as the activation function. According to the universal approximation theorem for NN, a multi-layer perceptron with a single hidden layer can be approximate any continuous function that will convert input intervals of real values to and output interval of real number.

2.2 Literature Review of Neural Network on Stock Predictions.

2.2.1 Artificial Neural Network (ANN) and Support Vector Machines (SVM) on Stock Forecasting

Stock market always hard do prediction because of the uncertain nature. The machine learning algorithms such as SVM and ANN are always one of the best algorithms that use to predict the stock by analysing the financial data. The literature review aims to explore the existing research of ANN and SVM for the stock prediction and their relative performance. The application that applies with ANN and SVM for financial prediction has been widely explore in literature review. Both algorithms are popular choice due to their ability to capture non-linear relationships and patterns in financial time series data to let the model suitable for stock forecasting.

A detailed analysis comparing ANN and SVM in the context of stock forecasting was presented. [Kurani and colleagues]. The study involved an examination of historical stock data, aiming to assess and contrast the accuracy of the predictions that were generated by both. It emphasized the importance of considering multiple factors when selecting the most

suitable model for stock prediction. This was due to the findings which demonstrated that each strategy outperformed the other in some conditions. It also highlighted the need for a nuanced approach in choosing the optimal prediction method.

Some other studies also investigated the effectiveness of ANN and SVM for stock prediction. For example, [Smith et al.] the exploration of using ANN with different architectures to predict the stock and found the certain configurations provided more accurate predictions. Besides that, the recent advances in deep learning have led to a development called LSTM networks which are a type of ANN for time series forecasting.

2.2.2 Forecasting Stock Price by using Artificial Neural Networks (ANN)

In this paper (Al-Mashhadani et al) is focus on the stock forecasting in prediction to banking sector stock price in FTSE Bursa Saham Malaysia Kuala Lumpur Composite Index (FBM KLCI). The feedforward neural back-propagation network with Training Function Gradient Decent Training Algorithm used in this study. The study collects the stock market data in Yahoo Finance and the target stock that collect is Maybank Berhad which include the open prices, close prices lowest prices, highest prices and volumes from January 2016 to January 2017. After that, the data split into 4 input data set with different attributes and split into 612 input data for training and 100 data for testing.

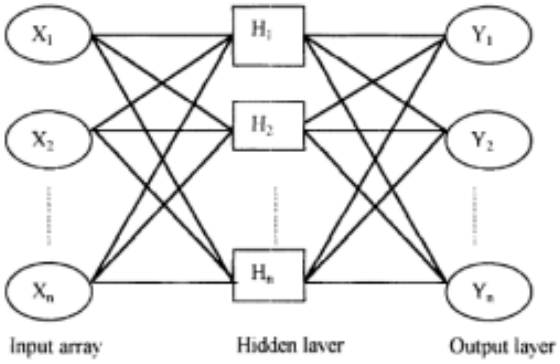

Figure 2.3 ANN Model Layer

The network structure for the price prediction for KLCI is as shown in figure 2.3.1 with applying the ANN backpropagation technique which is the feedforward network. The data will be input and process in the hidden layer and get the result in the output layer. Then the research use MATLAB's Neural Network package to conduct the experiment. The data have been trained with 1000 epoch, 3000 epoch and 5000 epoch and get a result of percentage of error as figure 2.3.2.

	1000 epoch	3000 epoch	5000 epoch
Data Set 1	2.001986%	1.332703%	1.625854%
Data Set 2	2.521365%	1.335073%	1.547953%
Data Set 3	1.523605%	1.518211%	1.571076%
Data Set 4	1.678359%	1.533301%	1.543805%

Figure 2.4 Accuracy of Each Epoch

The data set 4 that use to training has gained the best performance which include the 5 days of closing price, volume, and different of daily lowest price and highest price. This research show that artificial neural network is a good tool to predict the stock price. The highest percentage of error only archive 2.001986%. This mean that's the accuracy of the prediction is high. As a confluencesis suitable for stock market prediction because of its prediction accuracy is high.

2.3 Literature Review on Existing System

2.3.1 StockTwits

Figure 2.5 Stocktwits Logo

StockTwits is a platform that design for investor and traders to share ideas, insights, and other related information to stocks markets. It have provided space for trader to discuss stocks, follow the investment decisions of other traders and stay up to market trends. StockTwits mainly are by the user generated content and it does not contain any AI analysis that can help the traders to analyse the stock market.

The platform provide a wide range of features that build for stock market discussions. The platform provide a messaging system that allow users to send the message about stocks

and enable the user to do quick stock information exchange. The platform provide a ticker system that helps users to categorize and search for stocks. This increase the efficiency of conversations. The platform encourages users to have interaction with each other to engage each users in the stock market discussions.

The platform have a high impact on stock analysis because it hold the potential on affect to the stock market. Some sentimental tools applied on StockTwits data to analysis about the community's sentiments to some specific stocks. The platform have the ability to aggregate the real time information for the investor.

The platform have the limitations of noise and spam sometimes will infiltrate the discussion because the platform is based on user discussion to do stock analysis. It may affect the accuracy of stock prediction. The emotional biases also will affect the accuracy of sentiment analysis.

Numerous studies have done to analyse into the impact of StockTwits on stock market analysis. A study by M.Jaggie et al. [6] investigate the text mining in StockTwits that collect datas from different companies to help to enhance the analyse in stock predictions. Beside that, A study by A. Bozanta et al. [7] focus on the sentiment analysis of StockTwits using the transform models.

As a conclusion, StockTwits serves as a valuable platform for stock market traders and investors to engage in the discussions and information exchanges. Its features,usability and community engagement are offering the opportunities for knowledge sharing.

2.3.2 Kavout

Figure 2.6 Kavout Logo

Kavout is a platform that uses AI algorithms to predict the stock prices movements. This literature review for the system aims to provide an overview of the system related to the capabilities of Kavout to the stock prediction. AI is frequently now used in financial markets because of its ability to analyze complex data. Kavout leverage machine learning algorithms to process the big amounts of data of stock markets and produce an insight to investors and traders.

Kavout as an AI and ML techniques to analyze market data and do predictions, it has the core features that include of quantitative analysis, that help to analyze the different market indicators and factors that will affect the stock prices. The Machine Learning Algorithms in the platform are used to do regression and time series analysis that the purpose of modeling historical data and predicting the future prices. Kavout also uses the AI model to do predictions by historical data, patterns its identifies and offers some user insights into the potential stock market directions.

With the AI and ML techniques applying in the stock market analysis, Kavout will face some challenges which is model interpretability, the challenge arise about how the predictions are generated and impact the user trust and adoption. The second is the data quality. As an AI model, it relies on high quality and comprehensive data to ensure the accuracy of predictions. The last is the market dynamics that explain about the unpredictability of stock markets poses challenges for any prediction model.

As a conclusion, Kavout is an AI driven platform that use to do stock predictions. Through quantitative analysis, machine learning algorithms, and AI predictions, Kavout can provide the investors and traders with valuable information to help them in stock predictions.

2.4 Limitation of Previous Studies

Previous studies have made significant contributions to NN to predict the stock market, it is important to acknowledge that there are several limitations exiting studies.

2.4.1 Overfitting and Model Generalization

Overfitting and model generalization will occur when a NN model performs well in training data, but the data fail to generalize in the test data due to some unseen data. Previous studies may have faced the overfitting issues especially when dealing with limited datasets.

2.4.2 Real Time Prediction Challenges

Stock market always require of real time predictions to make time decisions. Existing studies often focus on historical data but not the real time data. The transitions to real time data predictions are a challenge that need to overcome.

2.4.3 Market Dynamics and Unpredictability

Stock market trends are always affected by a lot of factors which include the economic indicators, geopolitical event, investor sentiment and others. The unpredictable factors are a challenge on predicting market trends which include by using NN model.

CHAPTER 3 - Proposed Method/Approach

3.1 Project Development

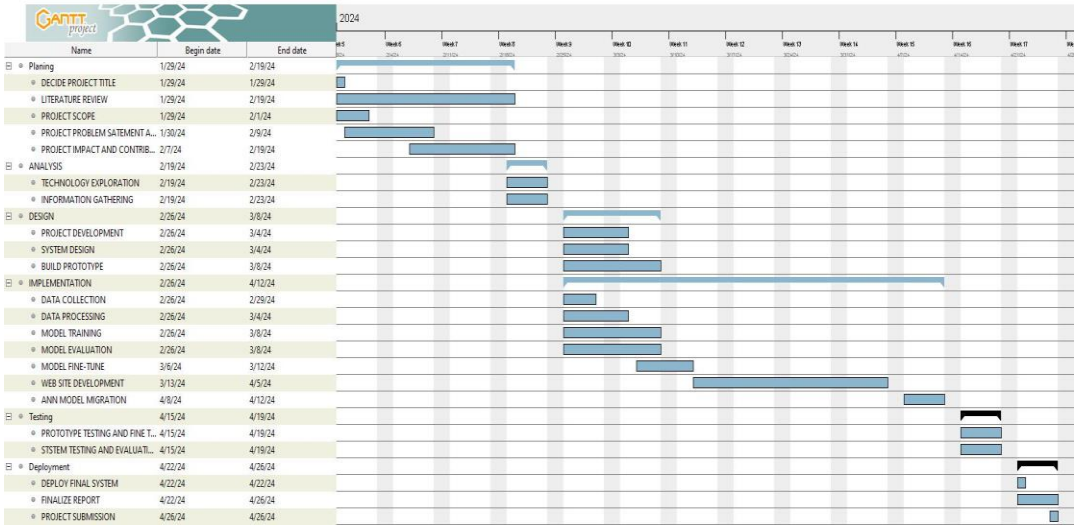

Figure 3.1 Gantt Chart

The Gantt chart above is a visual presentation of the project schedule. The methodology that chosen to develop this project is System Development Life Cycle (SDLC). It consists of the part of planning, analysis, design, implementation, testing and the last is deployment. At the planning phase, the first things that's have been done is decide for the project title. After that, a comprehensive literature reviews have been done. In the literatures review, some important things that related to the project can be answered such as the ANN model, the stock market of Malaysia, the market predictability, the existing system that provided the same services and the machine learning techniques. The project scope, objectives, problems statement and the project impact also have been carrying out from the planning phase.

At the analysis phase, the technology exploration has been done to find out the suitable technology to be used to develop for the project. Jupyter notebook have been found as the platform that allows programmers to build and test for the machine learning model. The programming language that has been selected is python. For the website and the back-end framework that let the user to use to do for real time prediction have been decided to use html and flask framework. Flask is a web framework that using python.

After that, the Implementation will split to two phases which are the development of ANN model and the web application. In the phases for ANN model development, the first step is the data collection. The historical data that need to use for the training of ANN model have been

get from Yahoo Finance. The historical data of Malaysia stock have been collected and used for the model building, training, evaluation and fine-tuning. After the completion for the first phases, the pretrained model have been migrate to the web application by using of Flask framework.

At the testing phase, some tests have been done to test for the accuracy of the prediction. This phase is ensuring the model is correct and there are no bugs, and the systems will achieve the project objectives. At the end of the project, the web application will be ready, and the report can be submitted for the project.

3.2 Information Gathering

The first thing that need to build the model is the stock market data of Malaysia. The historical data of stocks listed in Kuala Lumpur Stock Exchange (KLSE) will be collected through Yahoo Finance. The historical data are using for train and validate the ANN model. The comprehensive dataset is required which include the market prices, opening prices, close prices, high, low and volumes for companies listed on Bursa Malaysia.

When migrate the model into the web app, the lasted stock prices are needed to do the real-time prediction. With the services that provide by Yahoo Finance, the have a library call yfinance that allow to fetch the stock market data from there. Hence, the real time market data can get from the library and reduce the time for searching.

3.3 System Functionalities

Stock Market Equity Advisory Tool by Using Neural Network Method

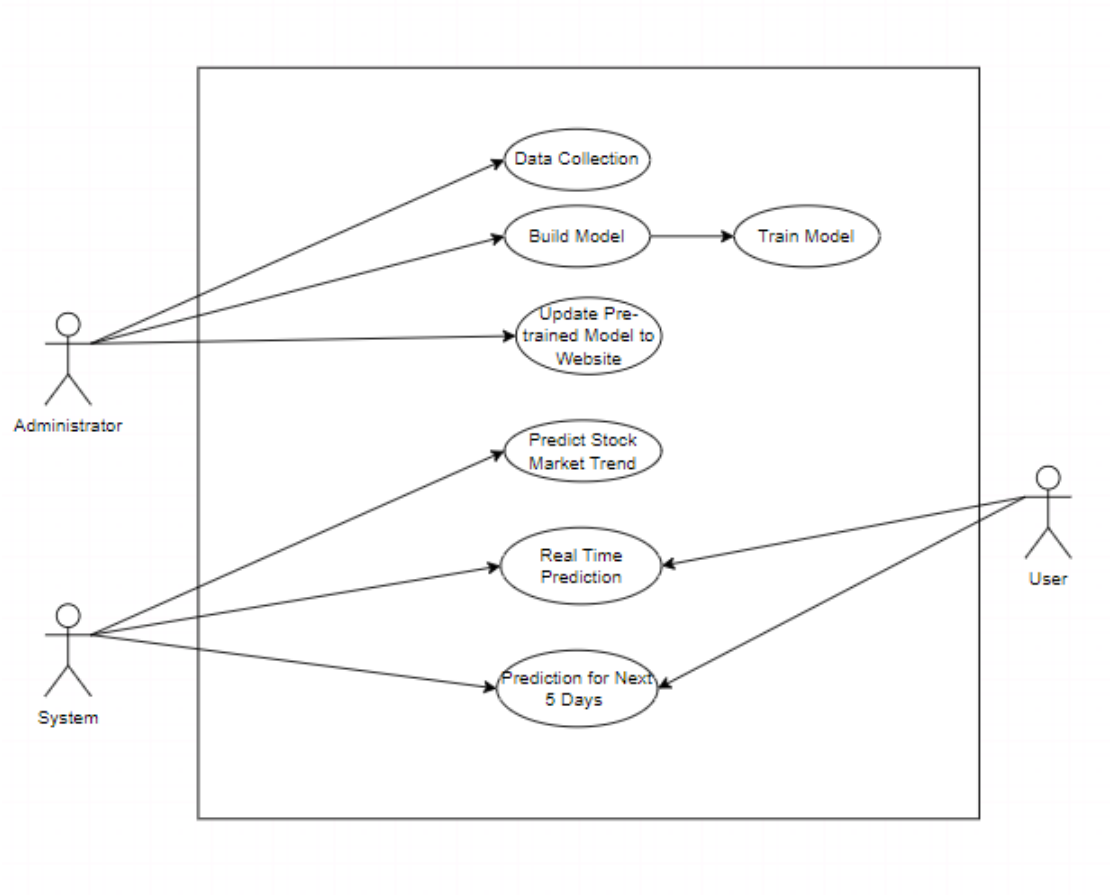

Figure 3.2 Use Case Diagram

An administrator will need to do data collection as the first step to build the model to predict for stock market trend. The historical data of stock market will be collected which include the date, open price, closing price, adjust close, high, low and volume. The data will be collected through yahoo finance. The data will save by using csv file format to do analysis. After that, administrator will need to build an ANN model to do prediction for the market trend. A few steps will be done to build the model which include the pre-processing part which will do data understanding, data preparation, data analysing and data cleaning to let the data more fit to the model that want to build. Then the data will be split to test and train set. The train set will be use for the training of the model. The model will use the train set to do learning and understanding. After the part of the training done, the test set will be use for the testing of the accuracy of the model. After the model have been build. The administrator needs to test for the accuracy of the model and then deploy the model to website to let user to use the real time prediction to the stock.

For system, it will detect user whether user want to do prediction to next day price and investment recommendation or prediction for next five days price. If the user chooses to predict for next day price and investment recommendation, the system will use the ANN model with the pre-trained weight to do real time prediction which will include the investment recommendation (strong sell, sell, neutral, buy and strong buy). If user choose to use the function of prediction for next five days, the system will start to analyse the stock that choose and generate the next five days prices of the selected stock to the user. If there are include Saturday and Sunday which are the market holidays of Malaysia, the system will automatically jump to next open market time which are Monday of the next week.

3.3.1 Diagram of Stock Market Analysis with ANN Model

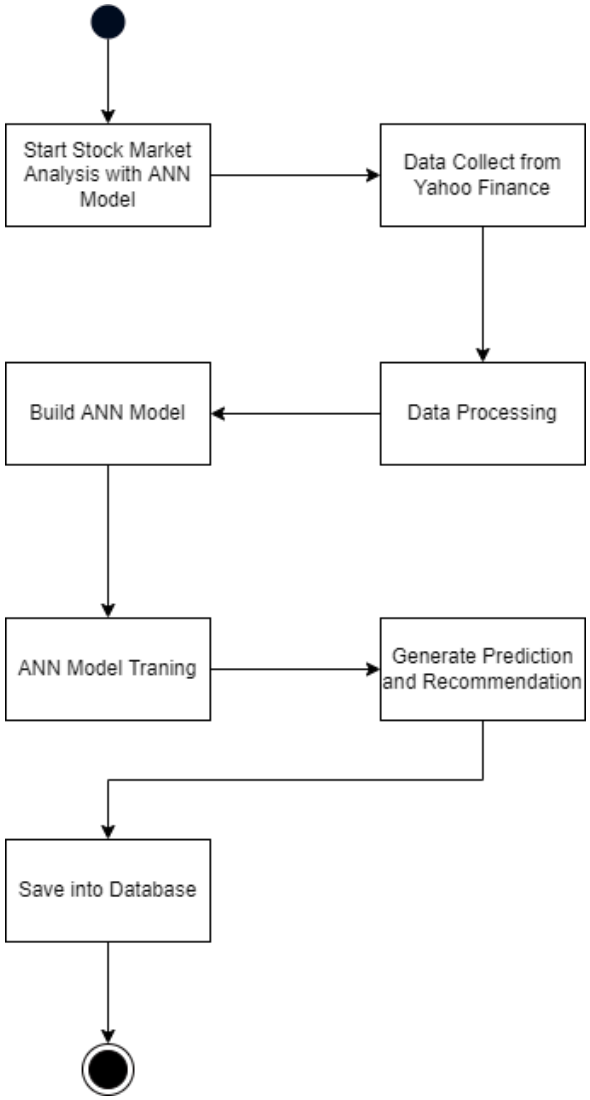

Figure 3.3 ANN model

Only the administrator can access to this page. The administrator will collect the stock market data that needed from Yahoo Finance which include the open prices, close prices,

highest prices, lower prices, and volume. Then the data processing will be done by the administrator by filling the missing value. Then the data will be split into train set and test set to use to train ANN model to predict the future trend and generate the investment recommendation. The administrator will keep repeating the process until get the most accuracy train model. Then the trained model will be saved into database and keep updating if there have more new data.

3.3.2 Design of Stock Prediction

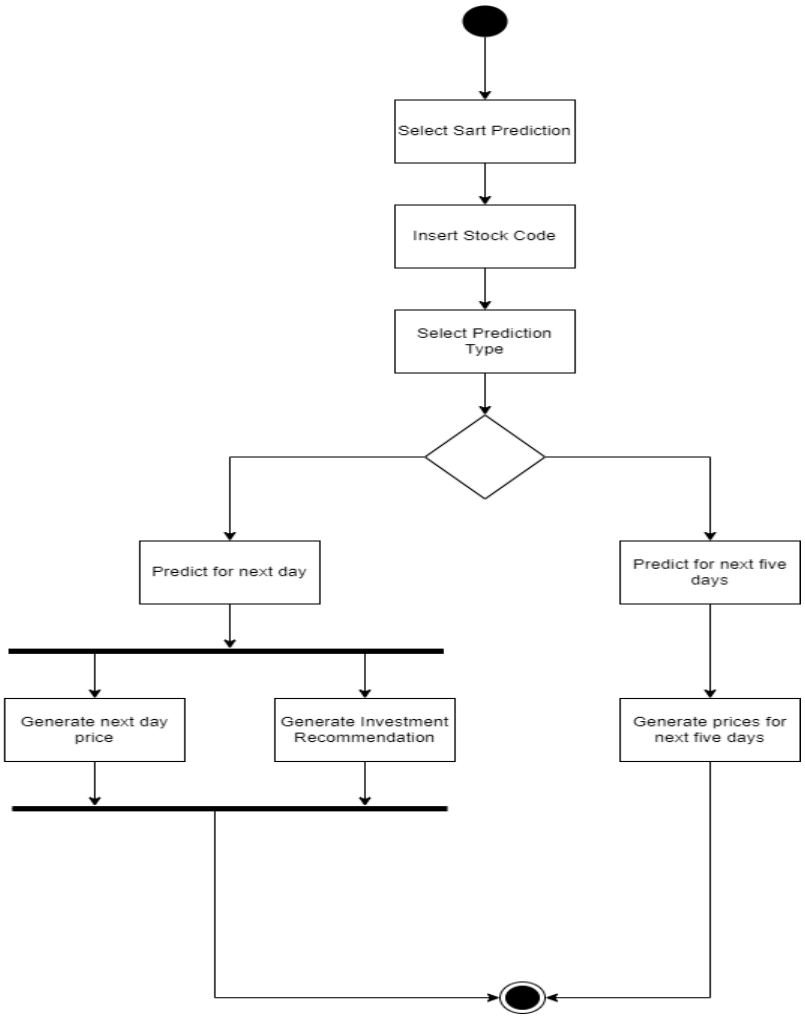

Figure 3.4 Stock Prediction

For the stock prediction, the user first need to click the start button that will bring the user to the page for prediction. Inside the page, there will provide a list of top 30 listed stock in KLSE, user can refer the list to get the code of the stock. Next user will require to insert the stock code of the stock that the user wish to do prediction. After the input, there will have two

buttons provide to user (predict for next day, predict for next five days). If user choose to predict for the next day, the system will start and do real time prediction. The system will generate the next day price follow by the investment recommendation (strong sell, sell, neutral, buy, strong buy). If the user chooses to predict for next five days prices, the system will list out the five days prices to the user. If there is Saturday and Sunday which are the market holiday for Malaysia, the system will skip the days and generate for the open market day.

Chapter 4 System Design

4.1 System Architecture Design

4.1.1 Web Application

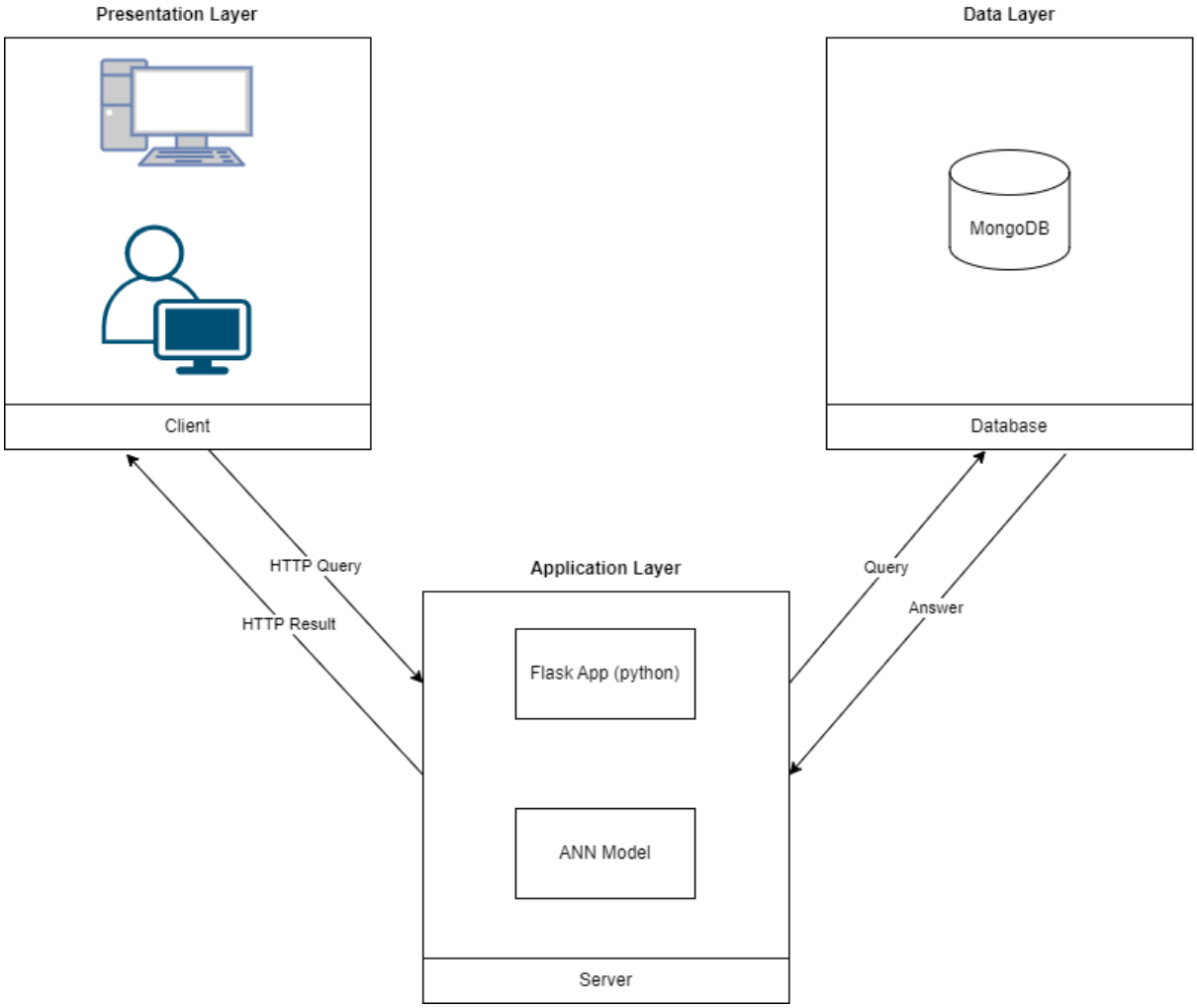

Figure 4.1.1 Web Application System Architecture Design Diagram

The system architecture design for this project will be the three-tier architecture. In this architecture, there will have three layers. Figure 4.1.1 shows the Three-tier Architecture design of the web application.

The first layer will be the presentation layer (client). The component of the layer will be the client-side interface which are the web browser that will let the user to interact with the application. The role of the layer is to display the user interface (UI) to allow user interaction. It will send http request to the server to receive responses from the server side.

The second layer will be the application layer (server). The layer will serve the server-side logic of the application. It receives request from the client then will process the data then interact with the database. After that, the server will perform stock market analysis by using the machine learning model. The application that includes in this layer will be the flask app which written with python and the ANN model which use for stock prediction.

The last layer is the data layer (Database). The layer is used to handle the data such as storing and managing the application data. The data layer comprises the MongoDB Atlas, which are the cloud-hosted MongoDB database.

4.1.2 ANN Model

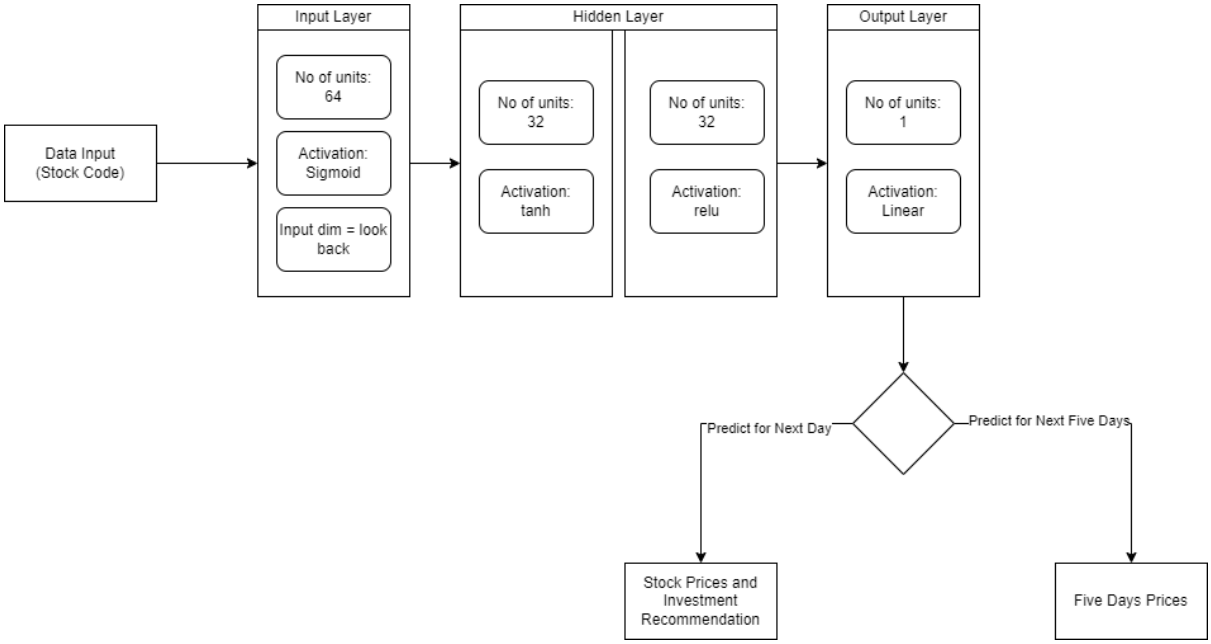

Figure 4.1.2 ANN Model System Architecture Design Diagram

The Figure 4.1.1 show the ANN model system architecture Design Diagram of the web app. The user allows to insert the stock code for the prediction. After that, the data of the related stock will process through the four layers. The first layer contains of 64 units with the sigmoid formula. The input dim =look back defines how many previous time steps of data of the model use for the predictions. In this project, the time steps have been set to 60, the model will use the closing prices from the previous 60days as the input to predict the closing price for the next day. After that, there will have two hidden layers with 32 units each. The first layer will be tanh. It will produce the output in the range of -1 to 1. After that will be relu which will return 0 when have negative input and will return value for positive value. The formula can be written as f(x)=max (0, x). In the last will be the output layer will only one unit and the activation will

be linear. After that, user can choose to show the result whether want to predict for next day or predict for the next five days prices.

4.2 Data Storage Design

For the data storage, the database that used by this project is MongoDB Atlas. It is a cloud storage platform that provided by MongoDB. For the database it uses for storing the weight of the pre-build model of the ANN model. The weight is saved into Hierarchical Data Format (HDF). The HDF format file can help to handle large amounts of data. The file will be uploaded to the cloud database that can let the user get the file there. With the file, the user no need to wait for a long time for the system to process the data. The system will only need to get the newest data and read the HDF file and start to do the real time analysis. It can help to reduce the waiting time for the process of analysing. The other data such as the stock market historical data that get from Yahoo Finance and the stock code data stored in Comma-Separated Value (CSV) file.

4.3 Hardware and Software Requirements

Table 4.2.1 Specifications of laptop

Description	**Specifications**
Model	Asus A456U series
Processor	Intel Core i5-7200U
Operating System	Windows 10
Graphic	NVIDIA GeForce GT 930MX 2GB DDR3
Memory	4GB DDR4 RAM
Storage	1TB SATA HDD

Anaconda Jupyter Lab will be use as the software to develop the ANN model for stock prediction. Jupyter Lab provide some useful libraries that can be used to doing data processing, data cleaning, model building, model training, model testing and fine tuning. The programming language for developing the ANN model will be python.

Visual Studio Code will be used to develop for the web application. HTML, CSS will be used to build the UI of the web app. For the back-end part, Flask will be use as the framework to build it. The flask also using python as the programming language, and it allow the migration of model easier from Jupyter lab into the web app.

There are not any specific hardware and software requirements in the client side. It is because the application is built with web where all the things will be hosted in a public server. Thus, the client can access with web browser anytime and anywhere with the internet connectivity.

4.3 User Interface Design

4.3.1 Main Page

Figure 4.3.1.1 Main Page

The web application is designed as user friendly interface which enables the user do all the things by using one click or some simple operation. For the main page of the web app, it has the logo with the explanation of the web app. When the user click “Get Started” button, it will lead the user to the stock prediction page as shown in Figure 4.3.1.2 and Figure 4.3.1.3

4.3.2 Prediction Page

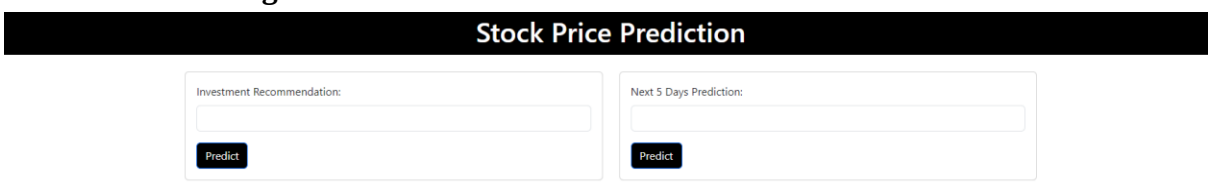

Figure 4.3.2.1 Prediction

Stock Codes

Stock Name	Stock Code
AMMB Holdings Berhad	5819.KL
AMMB Holdings Bhd	1015.KL
Aeon Credit Service(M) Bhd	5139.KL
Airasia Group Berhad	5099.KL
Alliance Bank Malaysia Berhad	2488.KL
Astro Malaysia Holdings Berhad	6399.KL
Ata IMS Berhad	8176.KL
Axiata Group Berhad	6888.KL
Axis REITS	5106.KL
Bank Islam Malaysia	5258.KL
Berjaya Sports Toto Bhd	1562.KL
Bermaz Auto Berhad	5248.KL
British American Tobacco(M)	4162.KL
Bumi Armada Berhad	5210.KL
Bursa Malaysia Bhd	1818.KL
CIMB Group Holdings Berhad	1023.KL
Cahya Mata Sarawak Bhd	2852.KL
Carlsberg Brewery Malaysia Bhd	2836.KL

Figure 4.3.2.2 Stock List

For the prediction page, it separates to two parts. The first part will have two button which separate the function of predict for next day and get investment recommendations. The second function will be predicting the prices for next five days. For the second part. It will show 100 stocks codes from KLSE as shown as in Figure 4.3.2.2. When the user clicked the stock code, it will automatically fill in the stock code and the user can do the prediction by only one click to the button. If the user wishes to predict other stocks that have in KLSE, they can insert manually by themselves.

4.3.3 Investment Recommendation Function

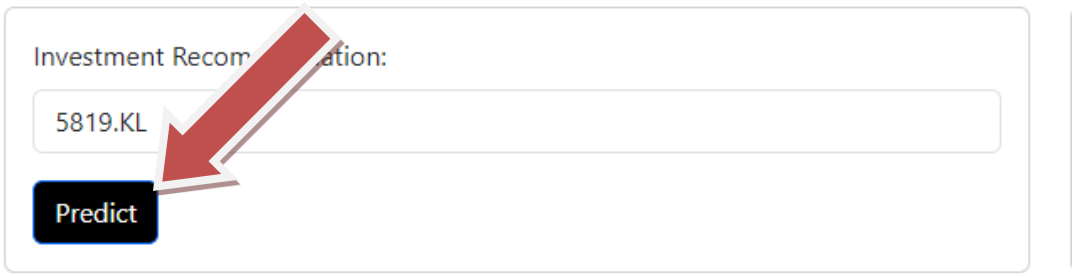

Figure 4.3.3.1 Investment Recommendation Button

If the user wants to do the investment recommendation, they can insert the stock code or click the stock code provided below. After that, they only need to click predict button as shown as Figure 4.3.3.1. After that, the system will start to analyse the stock that selected in real-time and the user will get the output that contains of Name of Bank, Last Known Price, Predicted Price for Tomorrow, Recommendation, MSE, RMSE of the stock predicted as shown as in Figure 4.3.3.2.

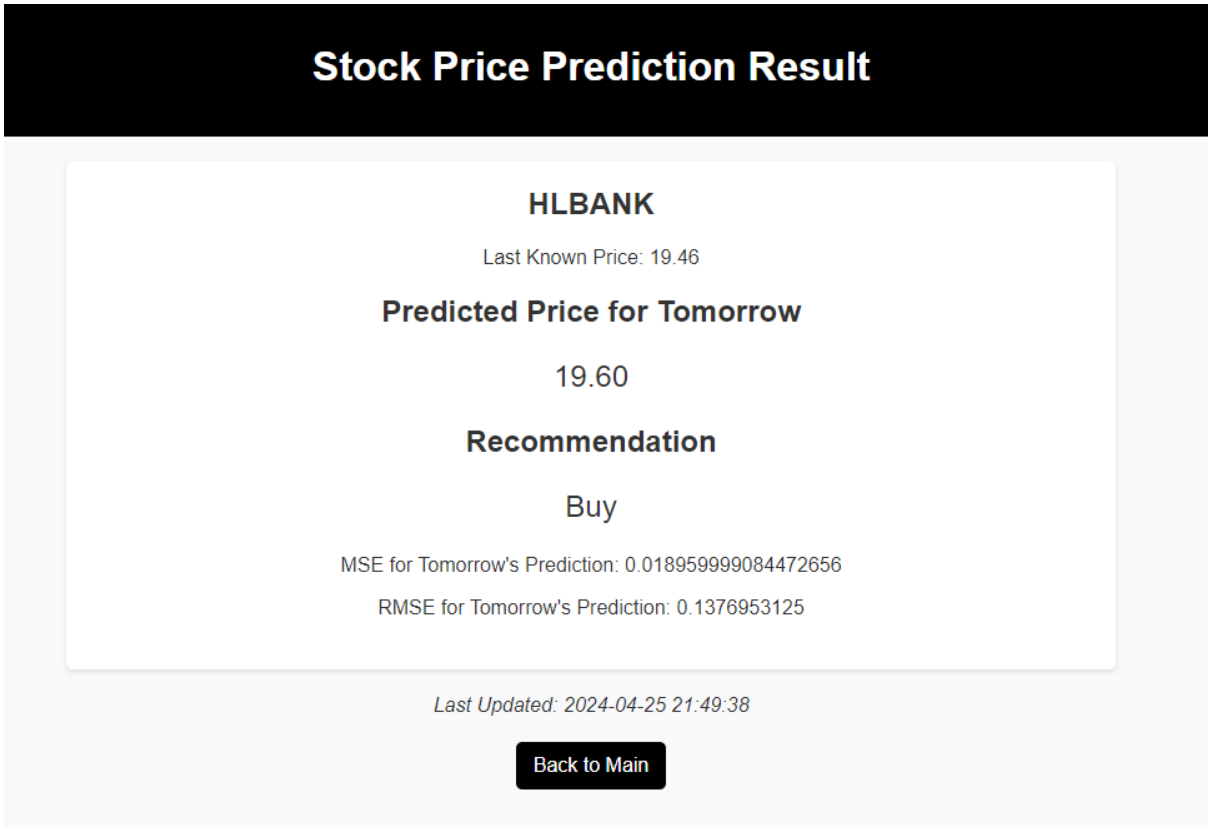

Figure 4.3.3.2 Output of Investment Recommendation

4.3.4 Prediction for next five days

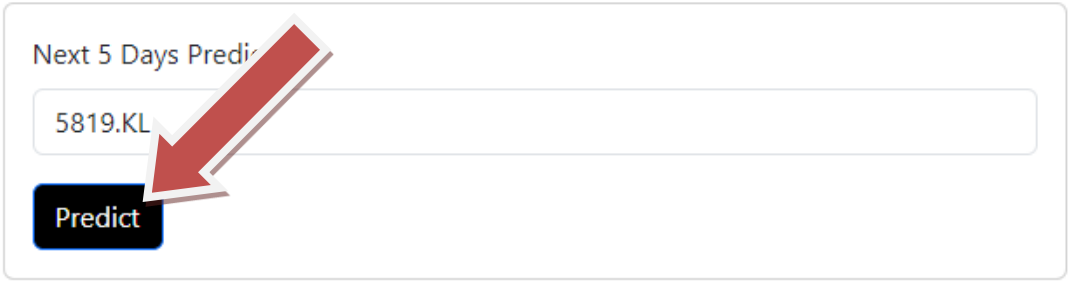

Figure 4.3.4.1 Prediction for Next Five Days Button

If the user wants to do the prediction for next five days, they can insert the stock code or click the stock code provided below same as investment recommendation. After that, they also only need to click for the predict button as shown as Figure 4.3.3.1. After that, the system will start to analyse the stock that selected in real-time, and the user will get the output that contains of Name of Stock, Date of Prediction and Predicted Prices that will be listed with a table as shown in Figure 4.3.4.2.

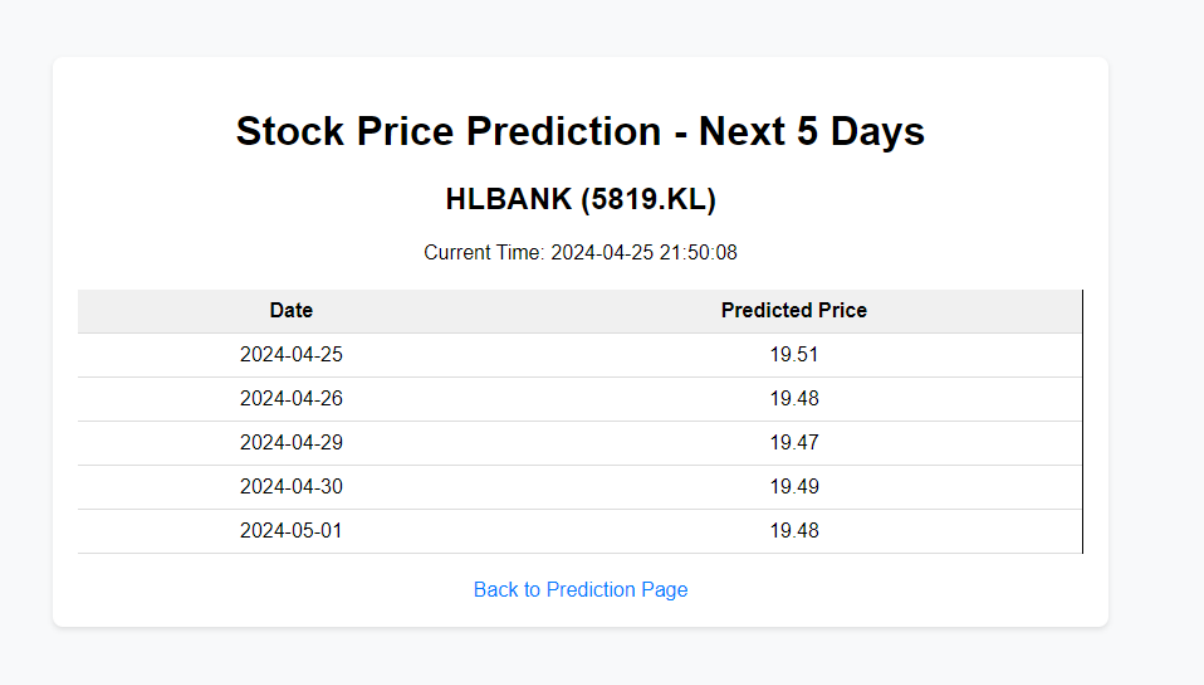

Figure 4.3.4.2 Output of Prediction for Next Five Days

Chapter 5 System Testing

As mentioned, the system development has been separated to two phases. In the model building phase, Maybank Bhd (1155.KL) from KLSE are selected to focus on the training and testing for the use as the stock that use to test for the model building. For the web application phases, 10 stocks from KLSE also have been selected to test for the accuracy of the model by comparing with investing.com. A simulation of the prediction test procedure and results are presented in this section.

5.1 Model Testing

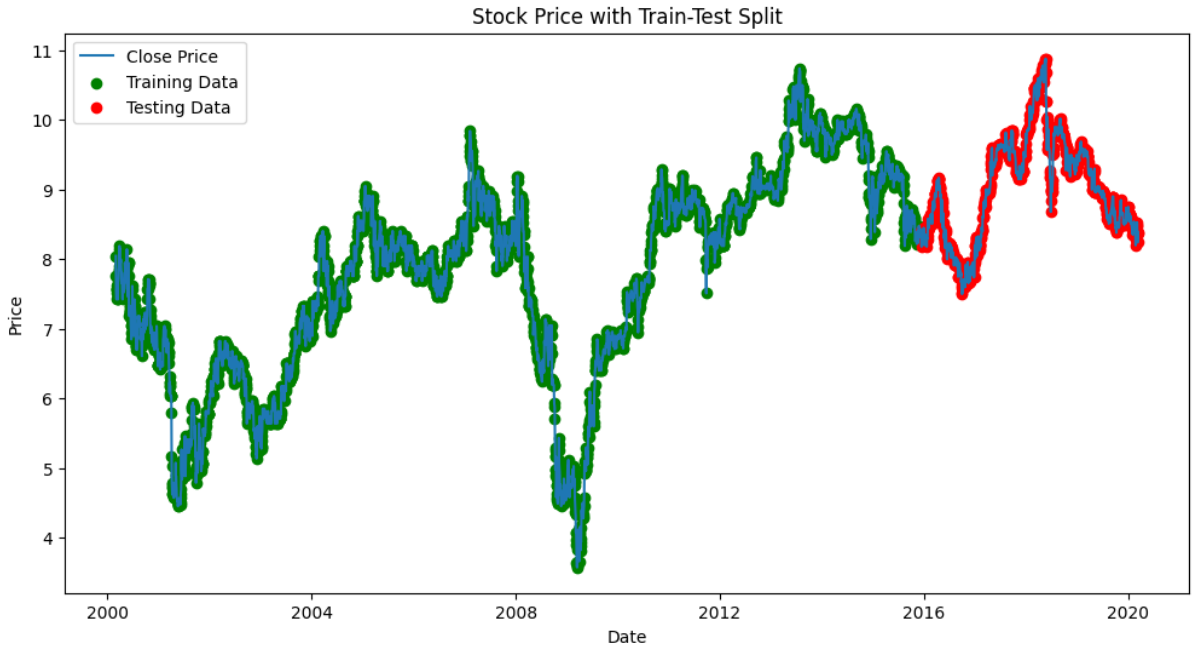

Figure 5.1.1 Train and Test Set

For the model testing the data that have been use is Maybank Bhd (1155.KL). The historical price from 2000 until 2020 have been use as the training and testing data for the model. The historical data which contain of data, open price, close price, volume, high, low and adjust close has been use in the ANN model. The data has been split into train and test set with 80% train set and 20% test set. Figure 5.1.1 shows the splitting of the training set and the testing set. Follow the figure above, it shows that the data between year 2000 until year 2016 has been use as the training data and year 2016 and above has been use as the testing data.

Table 5.1.1 Accuracy of Each Epoch

Accuracy/Epoch	100 epoch	1000 epoch	3000 epoch	5000 epoch
MSE	0.0103	0.0079	0.0078	0.0078
RMSE	0.1014	0.0890	0.0885	0.0886
MAE	0.0779	0.0651	0.0626	0.0644
R-Squared	0.9809	0.9853	0.9854	0.9854

After that, the train set will put into the ANN model to let the model learn and do the prediction. Table 5.1.1 shows the accuracy for each epoch. Epoch is a hyperparameter that defines the number times that the model will learn through the train set [9]. The model has been training by using four different epoch which are the 100, 1000, 3000 and 5000.

Stock prediction is a predictive model, the suitable measurement for accuracy is Mean Square Error (MSE), Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and R-Squared. The lower the number means the more accurate the prediction. In Table 5.1.1 shows that the numbers that get for each measurement are not more than 1. When the numbers of epochs increase, the return of the improvement generally increase. But after 3000 epochs, the diminishing happens to the return of the improvement of the performance and the improve are very slightly.

Overall, the model improves significantly with more training initially. But eventually, the additional training epochs for the model have minimal impact on the performance. It means that, the epochs can be decrease and enhance the training time for the time for train the model. Figure 5.1.2 shows the Maybank Stock Price Prediction. As the graph show, the actual price and the prediction price for the stock are almost same and accurate. It means that the accuracy of the model is high.

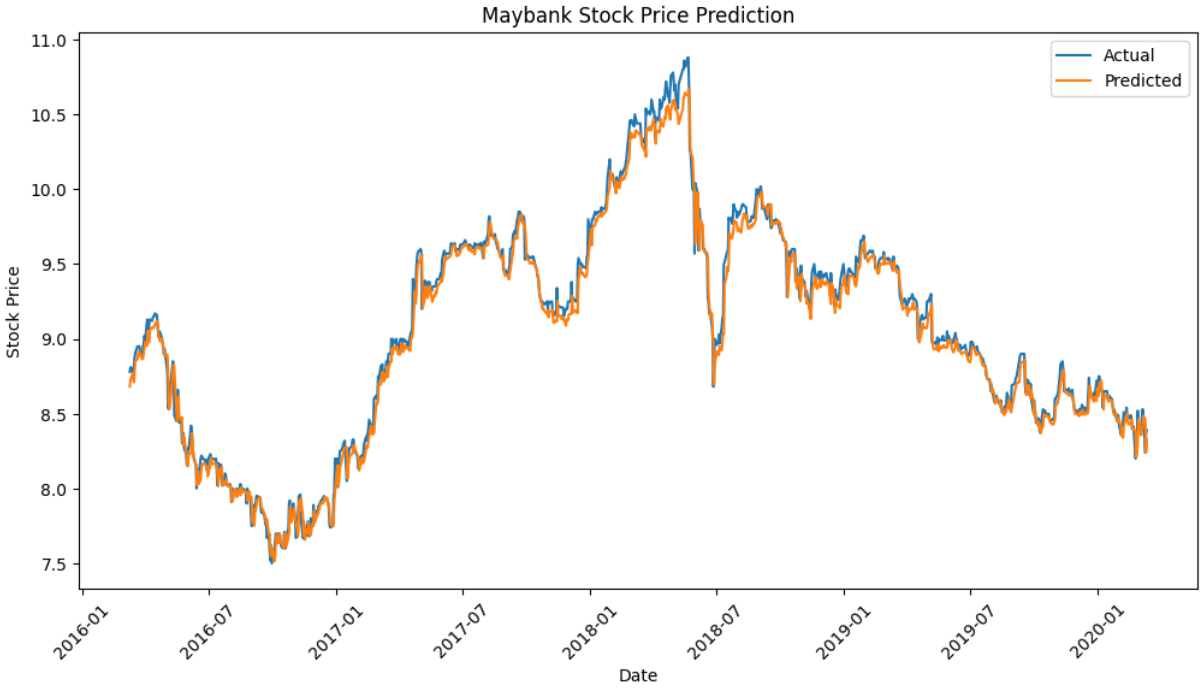

Figure 5.1.2 Maybank Stock Price Prediction

5.2 Accuracy Testing for Real-Time Prediction

For the real time prediction of the services that will let user to use. The system has been cloning from the flask app and put into jupyter lab for the system testing There are five stocks have been selected to do predictions and compare with Investing.com website as a reference of the accuracy. The stock has been selected randomly from KLSE (Malayan Bank, Celcom Digi, CIMB, HLBB, Petronas). Daily closing price and the recommendation has been recording down daily start from 18/3/2024 until 29/3/2024. The two weeks stock market data has been using for comparison of the accuracy. Based on the table below it shows that even the predicted price and the actual price and the predicted recommendation and the actual recommendation have some differences, but just a minor different. It didn't have any big different such like the actual price is going up, but the predicted price is going down. The recommendation also didn't like to have big error such as the actual showing the strong buy but the predicted showing strong sell. It proves that the accuracy of the ANN model is high which can compare with the accuracy of the existing system that use for prediction in the market now.

Table 5.2.1 Malayan Bank

Malayan Bank	Actual Price	Predicted Price	Actual Recommendation	Predicted Recommendation
18/3/2024	9.75	9.71	Neutral	Neutral
19/3/2024	9.65	9.68	Sell	Neutral
20/3/2024	9.57	9.50	Sell	Sell
21/3/2024	9.55	9.52	Neutral	Neutral
22/3/2024	9.59	9.55	Neutral	Buy
25/3/2024	9.62	9.60	Neutral	Neutral
26/3/2024	9.69	9.61	Neutral	Neutral
27/3/2024	9.65	9.63	Neutral	Buy
29/3/2024	9.69	9.67	Neutral	Neutral

Table 5.2.2 Celcom Digi

Celcom Digi	Actual Price	Predicted Price	Actual Recommendation	Predicted Recommendation
18/3/2024	4.38	4.30	Neutral	Neutral
19/3/2024	4.25	4.30	Neutral	Neutral
20/3/2024	4.23	4.20	Buy	Sell
21/3/2024	4.32	4.25	Buy	Buy
22/3/2024	4.40	4.35	Sell	Neutral
25/3/2024	4.26	4.25	Neutral	Sell
26/3/2024	4.28	4.27	Neutral	Neutral
27/3/2024	4.21	4.20	Neutral	Neutral
29/3/2024	4.19	4.20	Neutral	Neutral

Table5.2.3 CIMB

CIMB	Actual Price	Predicted Price	Actual Recommendation	Predicted Recommendation
18/3/2024	6.65	6.65	Neutral	Neutral
19/3/2024	6.61	6.65	Neutral	Neutral
20/3/2024	6.48	6.40	Buy	Sell
21/3/2024	6.55	6.50	Buy	Buy
22/3/2024	6.54	6.54	Sell	Neutral
25/3/2024	6.50	6.54	Neutral	Neutral
26/3/2024	6.50	6.54	Neutral	Neutral
27/3/2024	6.55	6.55	Neutral	Buy
29/3/2024	6.64	6.59	Neutral	Buy

Table 5.2.4 HLBB

HLBB	Actual Price	Predicted Price	Actual Recommendation	Predicted Recommendation
18/3/2024	19.36	19.30	Neutral	Neutral
19/3/2024	19.44	19.40	Sell	Buy
20/3/2024	19.32	19.35	Neutral	Sell
21/3/2024	19.32	19.33	Buy	Buy
22/3/2024	19.44	19.40	Sell	Neutral
25/3/2024	19.38	19.40	Neutral	Neutral
26/3/2024	19.38	19.39	Neutral	Neutral
27/3/2024	19.36	19.35	Neutral	Sell
29/3/2024	19.38	19.30	Neutral	Sell

Table 5.2.5 Petronas

Petronas	Actual Price	Predicted Price	Actual Recommendation	Predicted Recommendation
18/3/2024	21.44	21.43	Buy	Buy
19/3/2024	21.74	21.80	Buy	Neutral
20/3/2024	21.80	21.80	Buy	Neutral
21/3/2024	21.82	21.79	Neutral	Neutral
22/3/2024	21.80	21.80	Neutral	Neutral
25/3/2024	21.72	21.70	Sell	Neutral
26/3/2024	21.72	21.75	Sell	Sell
27/3/2024	21.50	21.45	Sell	Sell
28/3/2024	21.58	21.50	Neutral	Neutral

Chapter 6 Discussion

6.1 Project Challenges

In this project, the first challenge is developing a suitable NN model to do the stock prediction. The accuracy of the model needs to be optimized and get the more accurate model to use as the final model. To achieve this, a lot of time and exploration has been spent to try with different combination of the hyperparameter. The training time for some model will take long time but the outcomes with the high number of MSE and RMSE. It means that the selection of the hyperparameter is wrong and need to retry with other combinations.

The second challenge that faced is migrate the model code to the website. The ANN model was done in jupyter lab which only have the model for prediction. To move the things to the web app, the code need to review and filter out only the function that need by the system. The data visualization parts need to remove because it didn't used by the web app because the web app only need the ANN model to do stock prediction. When move to Flask platform, the new model need to be come out and need to allow the model to read the HDF file that contains the weights of the ANN model.

6.2 Objective Evaluation

1. **Enhancing Stock Market Predictions.** To develop a Stock Market Equity Advisory Tool that using of NN method to analyse stock market trends to improve the accuracy of the stock market forecasting.
2. **User-Friendly Interface for Actionable Recommendations.** This application is to develop a user-friendly application that help the investor and traders to make decisions in the stock market. Some new investors and traders who not willing to analyse the data by their own can get a way to do the stock analysing. The tool will assist the users to reduce the risk of investment.
3. **Model Optimization.** To systematically explore and experiment with the NN model and parameter combinations. The aims to enhance the model optimization is to improve the stock market predictions accuracy through the fine tuning to the NN model.

For the first objective, the objective has been achieved successfully. The system able to use the built ANN model to do market analysis and generate the prediction prices and recommendations that help the investors or traders to do market forecasting.

For the second objective also achieved successfully because the web app is built with easy to operate. User just need to click one click and will get their result of stock prediction. User didn't need to do the analysing by their own because all the analysing will be done by the system with the ANN model.

For the last objective also achieved successfully. The ANN model is built and try with different parameters. After the explorations the final model have been come out and with the high accuracy. The model has been optimising and can help to improve the accuracy of the stock prediction.

6.3 Limitation of the System

The limitation of the system is it only applicable to Malaysia stocks which form the KLSE. When the system tries to analyse with others stock such as APPL, Gold etc., it will return with error or high MSE and RMSE. This will consider as the limitation of the system because it only can analyse KLSE stocks. The second limitation is the user unable to choose their favorite parameters to do stock prediction. The model is prebuilt, and the user only can insert the stock code for analysing the stock market trends. The last limitation is the equity advisory tool only focus for short-term investment. It only able to analyse for next day and next five days.

6.4 Future Enhancement

For the future enhancement of the system, the first things can be done is provide the stock prediction not only for Malaysia stock but also for the overseas stock market such as Singapore, Thailand, Hong Kong, Japan, China and the largest stock market in the world, United State (New York Stock Exchange (NYSE)).

Besides that, user only can input the stock code to do stock prediction and the prediction are done by the built model. For future enhancement, the system can let the user customize their prediction by using different indicators such as Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), Exponential Moving Average (EMA) and other indicators. This will enhance the user experience that the user can have more interaction with the system and do the prediction based on own favorite indicators. As the return, the system will become more dynamic for the prediction part.

Other from that, the system now only supports for stock prediction that made by the ANN model. For future enhancement, the system can import the chart system. The chart system can

let the user learn the stock market trend by themselves. The chart system can allow the user to do own prediction manually by using different indicators. This will let the user have more example and comparison between the prediction from the ANN model and their own analysing to have more idea when do stock market investment.

In addition, the future enhancement that can be made is allow the system to do long-term prediction. For now, the system only applicable for short-term prediction. If the user wishes to predict for weekly prices and yearly prices, there are no function provided to them. The future enhancement can let the user to predict for the long-term investment to increase the assistant at the stock prediction to the investors and traders.

The other future enhancement that can made is add in more features into the system such as the chart system, news, watchlist, notification that can make the system more interactive with the users.

CHAPTER 7 – Conclusion

In conclusion, the development of Stock Market Analysis Tool using Artificial Neural Network for Malaysia Stock Market is a substantial endeavor, the tool aims to enhance the stock market predictions and provide some investment recommendations to the users. The project has use the SDLC lifecycle methodology to plan for the whole project to ensure the completion of the project.

In the process of the development of the project, some challenges outbound such as the difficult of developing the NN network from scratch and the website development. However, the challenges have been overcome through the exploration and investigation when the project is ongoing.

The objectives of the project are successfully achieved. The tools provided user-friendly web app for investors and traders with just some buttons clicking and can access to the stock prediction already. The NN was optimized find out the higher accuracy model and provide the real-time predictions for Malaysia stocks listed on KLSE.

When there has success of the system, there also have some limitations such as it only focusses on the short-term predictions, it only applicable to KLSE stocks and lack of user customization for predictions parameters. But all the limitations can be overcome when there are some future enhancements done.

Finally, the Stock Market Equity Advisory Tool by Using Neural Network Method can provide some investment recommendations for the investors and trader to assist them when they do some investments decisions. The machine learning models will help to improve the area of stock forecasting.

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3, 3	**Study week no.: 2**
Student Name & ID: Ng Shun Yi 20ACB02277	
Supervisor: Ts Dr Ku Chin Soon	
Project Title: Stock Market Equity Advisory Tool by Using Artificial Neural Network Method	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]
Build web app.

2. WORK TO BE DONE

Design of Web Application

3. PROBLEMS ENCOUNTERED

Face challenge when find api to get the stock market data.

4. SELF EVALUATION OF THE PROGRESS

Even there are challenge when find the stock market data, but it overcome when found yfinance library.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3, 3	**Study week no.: 4**
Student Name & ID: Ng Shun Yi 20ACB02277	
Supervisor: Ts Dr Ku Chin Soon	
Project Title: Stock Market Equity Advisory Tool by Using Artificial Neural Network Method	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]
The simple UI of the web app

2. WORK TO BE DONE

Migrate the ANN model into the web app.

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3, 3	**Study week no.: 6**
Student Name & ID: Ng Shun Yi 20ACB02277	
Supervisor: Ts Dr Ku Chin Soon	
Project Title: Stock Market Equity Advisory Tool by Using Artificial Neural Network Method	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]
Continue migrate the model to the web app.

2. WORK TO BE DONE

Migration of the web app

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3, 3	**Study week no.: 8**
Student Name & ID: Ng Shun Yi 20ACB02277	
Supervisor: Ts Dr Ku Chin Soon	
Project Title: Stock Market Equity Advisory Tool by Using Artificial Neural Network Method	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]
Successfully migrate the model into the web app
Web app design done.

2. WORK TO BE DONE

System testing

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3, 3	**Study week no.: 10**
Student Name & ID: Ng Shun Yi 20ACB02277	
Supervisor: Ts Dr Ku Chin Soon	
Project Title: Stock Market Equity Advisory Tool by Using Artificial Neural Network Method	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]
Successfully migrate the model into the web app
Web app design done.
System testing

2. WORK TO BE DONE

Write report

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3, 3	**Study week no.: 12**
Student Name & ID: Ng Shun Yi 20ACB02277	
Supervisor: Ts Dr Ku Chin Soon	
Project Title: Stock Market Equity Advisory Tool by Using Artificial Neural Network Method	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]
Finalize report writing.
Finalize Web App design.

2. WORK TO BE DONE

Finalizing report

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3, 3	**Study week no.: 14**
Student Name & ID: Ng Shun Yi 20ACB02277	
Supervisor: Ts Dr Ku Chin Soon	
Project Title: Stock Market Equity Advisory Tool by Using Artificial Neural Network Method	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]
Completion of Report Writing

2. WORK TO BE DONE

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS

Ready for report Submission

Supervisor's signature

Student's signature

POSTER

SMEAT

STOCK MARKET EQUITY ADVISORY TOOL

DEVELOPER: NG SHUN YI
SUPERVISOR: TS DR KU CHIN SOON

INTRODUCTION:

Stock market predictions always be a hot topic among the investors and traders. A accurate predictions can help the investors and traders to prevent loss in stock market. This Stock Market Equity Advisory Tool will use Neural Network to do predictions and generate a investment recommendations to the users.

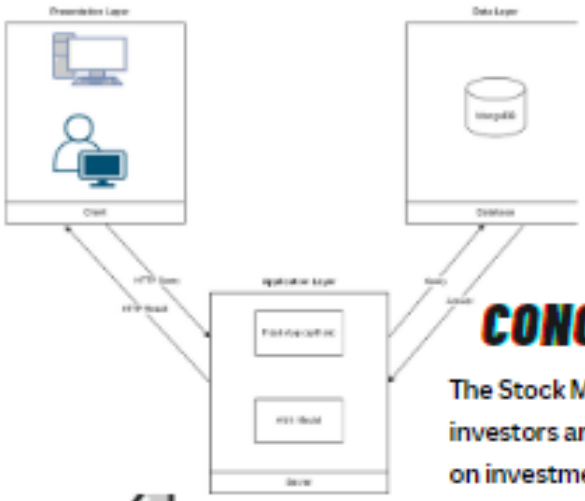
OBJECTIVES:

To develop a stock market equity advisory tool
Do stock prediction by using Neural Network method

METHEDOLOGY:

AGILE

METHODS:



CONCLUSION:

The Stock Market Advisory Tool can help to assist the investors and traders to improve their decision making on investment. The tool will utilize the Neural Network model to make predictions to market trends to get a better accuracy of predictions.

PLAGIARISM CHECK RESULT

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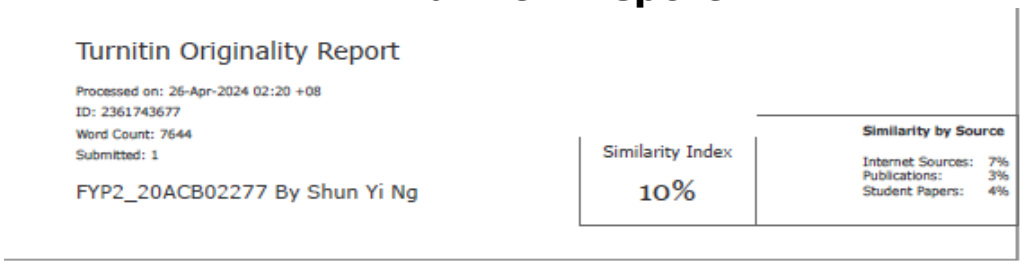

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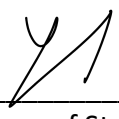

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