STOCK MARKET PREDICTION AND ANALYSIS – WEB APPLICATION

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I. ABSTRACT

With the rising inflation in prices of all commodities, it is now essential for people to have some sort of investments whether it be in the form of physical assets or stocks in addition to their regular income. The stock market provides a platform for everyone to invest their money in companies which can bring them profits. However, there is a general sense of apprehension towards the stock market and any sort of investment in general. Most people label it as a risk, a gamble. This stems mostly due to the lack of knowledge on how stocks work or how to make safe investments. To give users a helping hand and an introduction to the stock market, I have to create a Stock Market Prediction and Analysis Web Application using Python and Streamlit framework. Our application will provide both novice and experienced traders valuable information about the stock prices predictions of major companies, and analyses such as Relative Strength Index (RSI), Momentum indicators and other such technical indicators often used by professional traders. Our application will also provide explanations on how to understand the visualization and the inferences that can be obtained from them. This will provide users a platform to both check the latest trends as well as a single web application which can provide them information about the indicators of a particular stock. In this project, our objectives are: To create a web application that predicts the stock price of company's stock. Creating an LSTM neural network to predict the stock price time series data. Providing technical analysis of the stock price by indicators such as RSI, Bollinger Bands and other Momentum Indicators. Providing detailed visualizations and explanation of the technical analysis so that both experienced and novice users can get meaningful information from the graphs and charts. Providing details about listed companies such as their business summary, sector of operation etc. Creating an interactive and easy to use User Interface that will let users easily choose the options that they want to select and will display the necessary outputs in a clean and ordered way.

II. INTRODUCTION

With the growing cost of all commodities, it is now necessary for people to have some type of investment in addition to their regular income, whether it is in the form of physical assets or stocks. The stock market allows everyone to put their money in firms that will reward them in the long run. However, there is widespread fear about the stock market, as well as any type of investing in general. Most people consider it a gamble or a danger. This is mostly due to a lack of understanding of how stocks function and how to make secure investments. People are also extremely conservative when it comes to any sort of financial investments. With the emergence of search engines, the world now has an abundance of information, particularly when it comes to stocks and shares, as well as the stock market in general. The analytical information surrounding stock data has no evident limit, with all kinds of various qualities being captured.

Analysts and investors are always seeking for ways to foresee stock market movements since the stock market is so vital to the economy.

Consumers are currently responsible for interpreting this information. With this in mind, we have constructed a Stock Market Prediction and Analysis Web Application using Python and the Streamlit framework to provide users a helping hand and an introduction to the stock market. Our software will give both rookie and expert traders with useful information regarding major company stock price predictions, as well as analysis such as the Relative Strength Index (RSI), Momentum indicators, and other technical indicators often employed by professional traders. Our programme will also give instructions on how to interpret the visualisation and the conclusions that can be drawn from it. Users will have access to a single online application that will offer them with information about a stock's indicators as well as a platform to examine the newest developments. Our application consists of three parts namely, the Stock Prediction Module followed by the company information module and finally the technical analysis of stocks module. The stock data for the entire project is obtained from the yfinance library (Yahoo finance) which provides historical stock and company data from companies listed on the New York Stock Exchange. We use an LSTM model with 2 LSTM layers for prediction of stock price. Stock price is predicted for testing data (20% of selected range) as well as for the day after the last selected range. The second aspect of our project provides information about selected company as per the requirements and wants of the user of the application. In the third section, 4 technical indicators are used to analyse the stock data. The analysis is conducted using Relative Strength Index, Bollinger Bands, Exponential Moving Average and Moving Average Convergence Divergence. All these three modules are packaged together in an intuitive application which allows users to easily get to their required section with no distraction. With a minimalist and easily understandable user interface, the process of selection and visualization becomes extremely simple for the user.

III. LITERATURE SURVEY

1. Study on The Prediction of Stock Price Based on The Associated Network Model of LSTM (2020).

In this study, a multi-value associated network model of LSTM-based deep-recurrent neural network (Associated Net) is developed to predict multiple stock values at the same time. The model's structure, algorithm framework, and experiment design are all discussed in detail. The model's feasibility and correctness are confirmed by comparing the Associated Net to the LSTM network model and the LSTM deep-recurrent neural network model. Multiple data sets were being used to test the applicability of the Associated Net model. Experiments show that the Associated Net model has higher average accuracy than the other two models. It can also predict a large number of values at once, with an average accuracy of over 95% for each predicted value. Although the model has a nice effect, there are still certain elements that might be improved. In the training phase, for example, basic arithmetic means algorithm is employed to calculate total loss, to optimize the model by lowering total loss. The relationship between each sub-loss, as well as some details when the overall loss is the smallest, such as the severe circumstance of each sub-loss and the oscillation in the loss reduction process, are not taken into account by this loss calculating approach. The next stage will be to investigate the dimension reduction of the input parameters and the optimization of the loss calculation approach to increase the model's average accuracy.

2. A Novel Improved Particle Swarm Optimization with Long-Short Term Memory Hybrid Model for Stock Indices Forecast (2021)

In this research, the authors focused on a one-of-a-kind IPSO-LSTM hybrid model for forecasting stock exchange indices. The researchers demonstrated that by using a novel inertia weight, by using a non-linear approach and an adaptive mutation to use Particle Swarm Optimization, they were able to find better hyperparameters for the LSTM network, which improved forecast accuracy. In order to avoid the premature convergence problem in certain algorithms, the authors made use of an adaptive mutation factor. They tested the new IPSOLSTM method against well-known algorithms or SOTA deep-learning models, such as SVR and PSO optimised LSTMs, on five key exchange indexes (ASX200, DJI, IXIC, HSI, N225) using four performance measures (RMSE, MAE, MAPE, and R2). According to the authors, the developed IPSO-LSTM method is quite good and reliable, and it better generalizes and comes with good forecasting power. The model developed by the authors was tested with a consistent look back time of 20 days and tested against several stock indices. The results were found to be extremely optimal (around 1% MAPE for all indices – 0.72% MAPE for XJO stock index. Although the forecasting capacity of the model is great, the authors list out some drawbacks namely, long training time ad large resource requirement which could hamper its real-world usability. Another inevitable drawback is the effect of external factors which haven't been considered on the stock market. On the whole, the authors found that the IPSO-LSTM method was generally better than pre-existing solution and was suitable to use in several stock market indices.

3. Fractional Neuro-Sequential ARFIMA-LSTM for Financial Market Forecasting (2020)

In this paper, the authors come up with a novel solution for the forecasting of highly volatile financial data by presenting a hybrid ARFIMA-LSTM model. The ARFIMA-LSTM model is a combination of both the ARFIMA (Autoregressive Fractional Integrated Moving Average) statistical, traditional model used for time series predictions and LSTM (Long Shot Term Memory) Networks which have recently gained popularity. The ARFIMA section of the model is used for the linear sections of the data and sends the residual data over to the LSTM section which obtains the non-linearity in these values with the help of external dependent variables. These exogenous variables help increase the accuracy of the novel hybrid model. Through testing the model, it was found to have a lowest MAPE of 0.002% and ;lowest RSME of 0.0539 which significantly outperforms the existing traditional models used on their own. Traditional models used for comparison were ARIMA, ARFIMA and GRNN models. The authors mention the application of this hybrid ARFIMA-LSTM model in solving non-linear mathematical model and hence nod towards it applications in the field of applied sciences.

4. Discovery and Prediction of Stock Index Pattern via Three-Stage Architecture of TICC, TPA-LSTM and Multivariate LSTM-FCNs (2020)

In this paper, the authors come up with a novel approach for stock index pattern discovery and prediction by creating a three stage architecture consisting of Toeplitz Inverse Covariance

based Clustering (TICC), TPA – LSTM and a multivariate LSTM Fully Connected Network (FCN) consisting of both MLSTM-FCN and MALSTM-FCM and this is applied for pattern identification. The fist stage involves using the TICC model to identify repetition in stock index patterns. Past this stage is the TP-LSTM that predicts multivariate stock prices by also taking the weak patterns discovered into account. Finally, the final stage LSTM-FCN is used to predict the patterns in stock indices. The main stock index used is the Hangseng Stock Index along with 11 sub-indices. Through the results obtained from experimentation, the authors conclude that the three layer architecture is empirically better than traditional methods such as SVM, RF and Naïve Bayes. The authors state that their proposed architecture could potentially be a viable strategy for forecasting recurring stock index patterns and they also go over extension to their work such as conducting proactive stock index tracking or other such trading strategies to further improve the existing system. The results of their tests shows that the architecture gets a best possible accuracy of 77.48% for the HSCI stock index which significantly outperforms NB, SVM, RF, XGB, CNN and RNN which all range from 61.5% (SVM) to 74.3% (RNN).

5. Replicating a Trading Strategy by means of LSTM for Financial Industry Applications (2018)

In this paper, the authors use an LSTM model to explore the possibility of obtaining a new trading method or rule by using market indicators, position based decisions (buy, sell or hold) and the relationships between them. The ultimate goal of the proposed model being a Deep Learning machine capable of identifying the relationships of the market mood obtained from technical indicators to the position decision aka the trading strategy or an investment decision. The authors use the 30 Dow Jones stocks as data for their experiments. They utilize three strategies namely Random Choice (RC), Moving Average (MA) and MACD (Moving Average Convergence Divergence). The tests are also carried out in two different scenarios namely with no early stopping and with early stopping each scenario tested with 1, 5, 10, 15 and 20 days of lookback. The results from their tests suggest that their goal is achievable. The authors were able to successfully link their goals for simple behaviours but there are also complications which can arise such as if there is an increase in input feature such as technical indicators, it leads to shorter training which results in overfitted models giving undesirable outputs. The authors also propose further improvements to their work by mentioning the addition of a convolution step for more complex behavioural patterns. Adding convolution could help in local feature correlation hence improving feature selection. The authors also suggest that by enabling numerous LSTMs, each of which are dedicated to small number of indicators and coupled by additional stacked LSTM layers can help improve the network performance.

IV. REQUIREMENTS ANALYSIS

A. FUNCTIONAL REQUIREMENTS

The main requirements from our project are:

- Language: Python
- Framework: Streamlit
- Data: yfinance
- Styling: CSS
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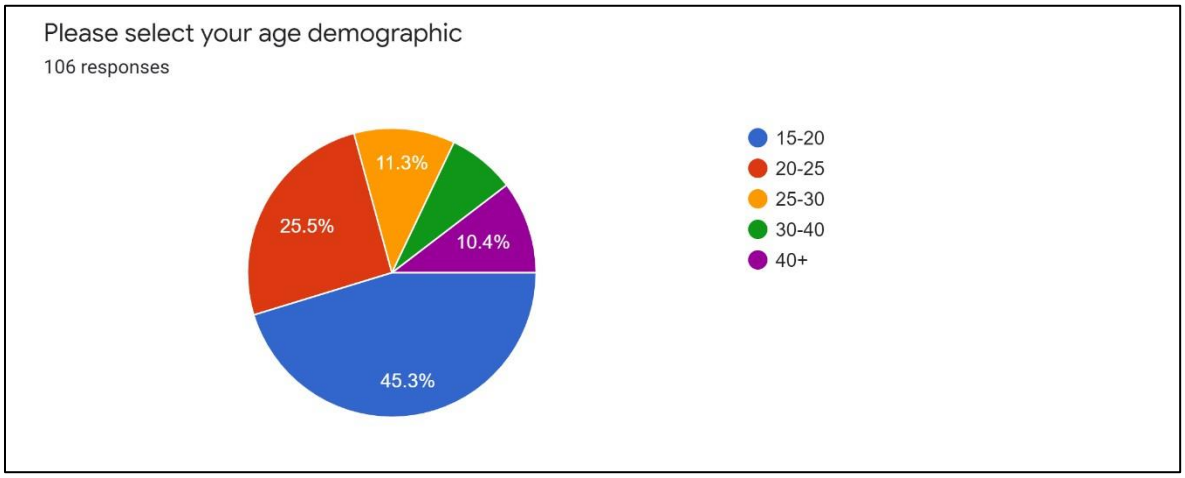
Functional Requirements for the modules are as follows:

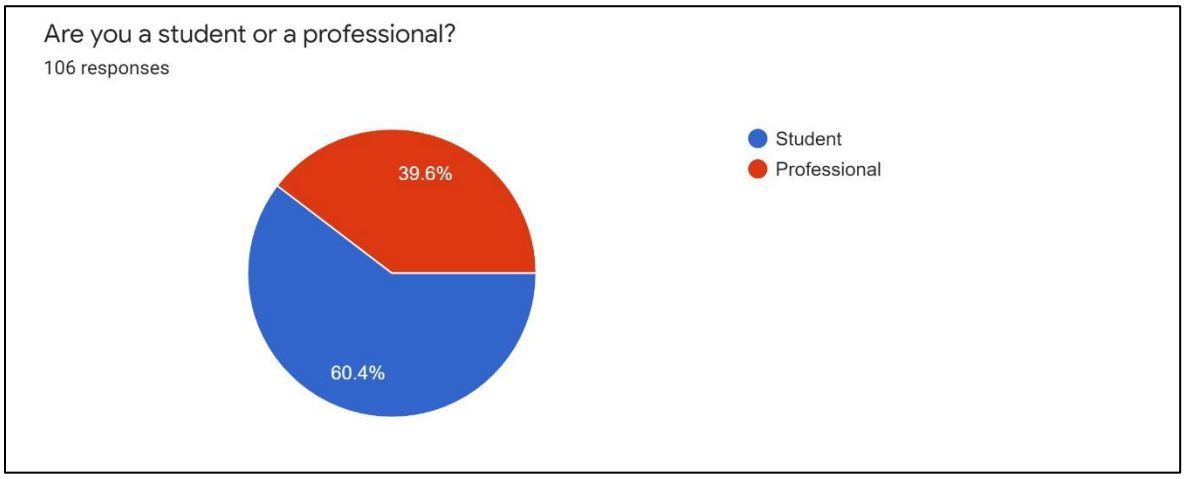
- Prediction Module: Long Short Term Memory (LSTM) using keras -LSTM is a special form of a Recurrent Neural Network (RNN) that is especially great at learning long term trends or data such as forecasting time series data. Stock market prediction is one such example of time series prediction and analysis. LSTMs utilize a chain like structure with each segment of the chain performing slightly different tasks. LSTMs specialize in handling long term dependencies and trends.
- Visualization: Various Graphs and Charts -Python libraries such as matplotlib and plotly will be used for creating the charts and graphs.
- The application must have a stock prediction module which uses Long Short Term Memory (LSTM) model to accurately predict the stock price for a particular company.
- The stock prediction module should be able to visualize the predicted stock price and display it in the form of a line chart as well as display the predicted stock price for a particular date as per user requirement.
- The company information module must provide the business summary of selected company, along with their main sector of operations, approximate number of employees, main website, market cap and other such details.
- The technical analysis of stocks module must be able to clearly visualize different types of technical indicators such as Relative Strength Index (RSI), Moving Averages (MA), Bollinger Bands, Moving Average Convergence Divergence (MACD). The visualizations must be accurate and easily viewable and interpretable.
- The technical analysis of stocks module must also provide explanations on how to interpret technical indicators correctly and what the trends in each indicator signify.
- All the above modules must integrate together seamlessly and provide the user with a good experience.

B. NON-FUNCTIONAL REQUIREMENTS

- The User Interface must be easy to navigate and should be interactive. Each component of the UI should be clear and accessible.
- The application should be able to display clearly visible and understandable visualizations.
- The application must also be reliable and provide the necessary outputs consistently.
- The application should be responsive while in use.
- The different modules of the application should be appropriately segregated and all of them should integrate together to function seamlessly.
- The application should be thoroughly tested and be bug free.

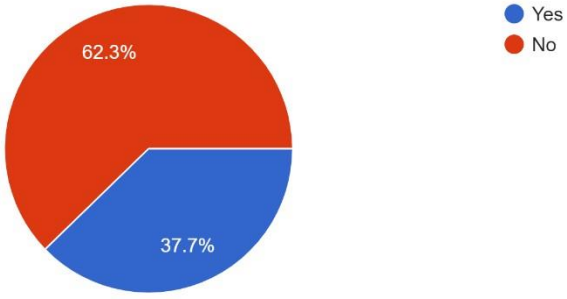
C. USER PROFILES AND SURVEY





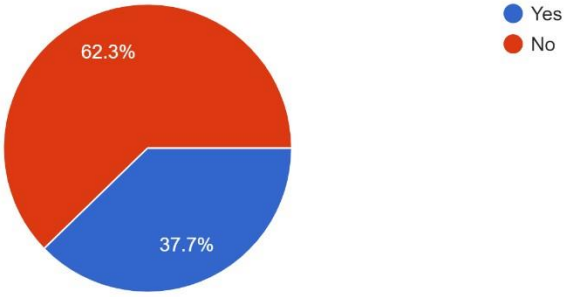
Do you invest in stocks or in any form of assets?

106 responses



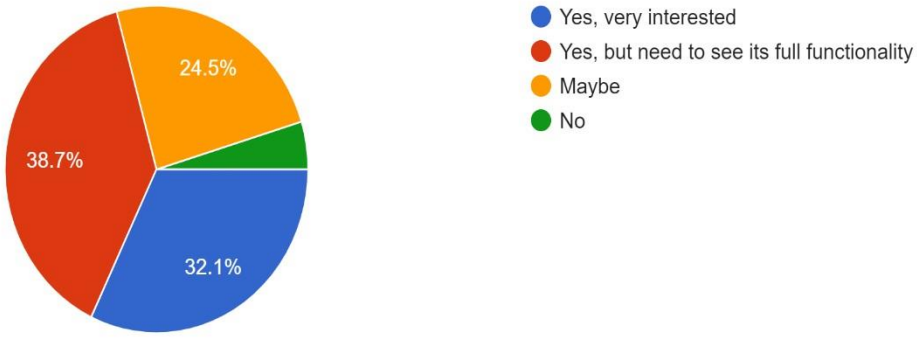
Do you invest in stocks or in any form of assets?

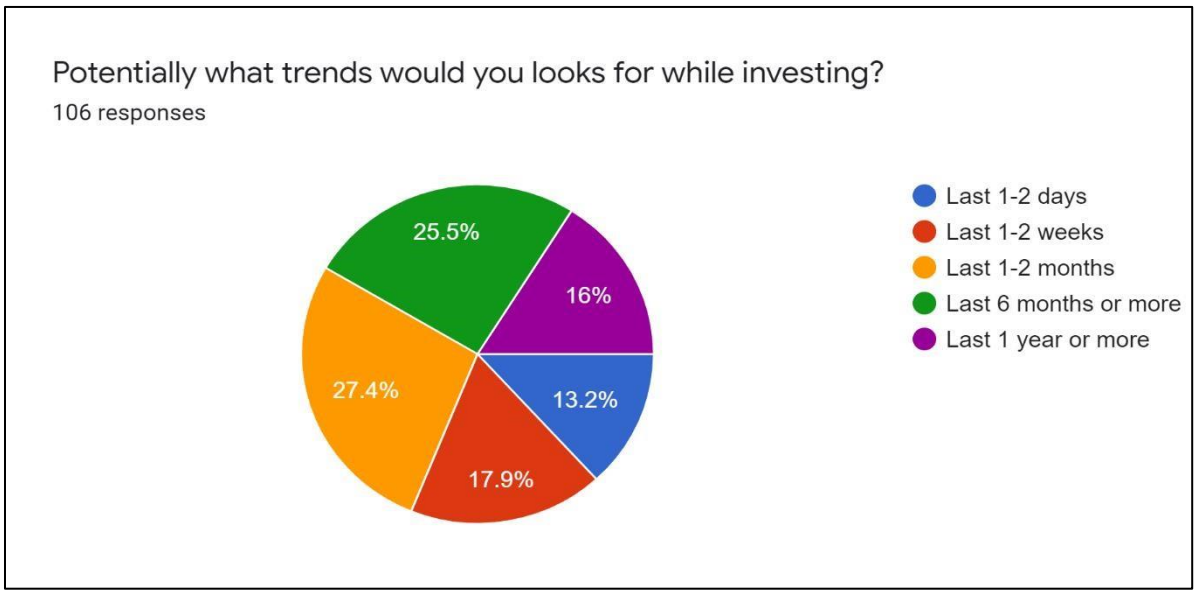
106 responses

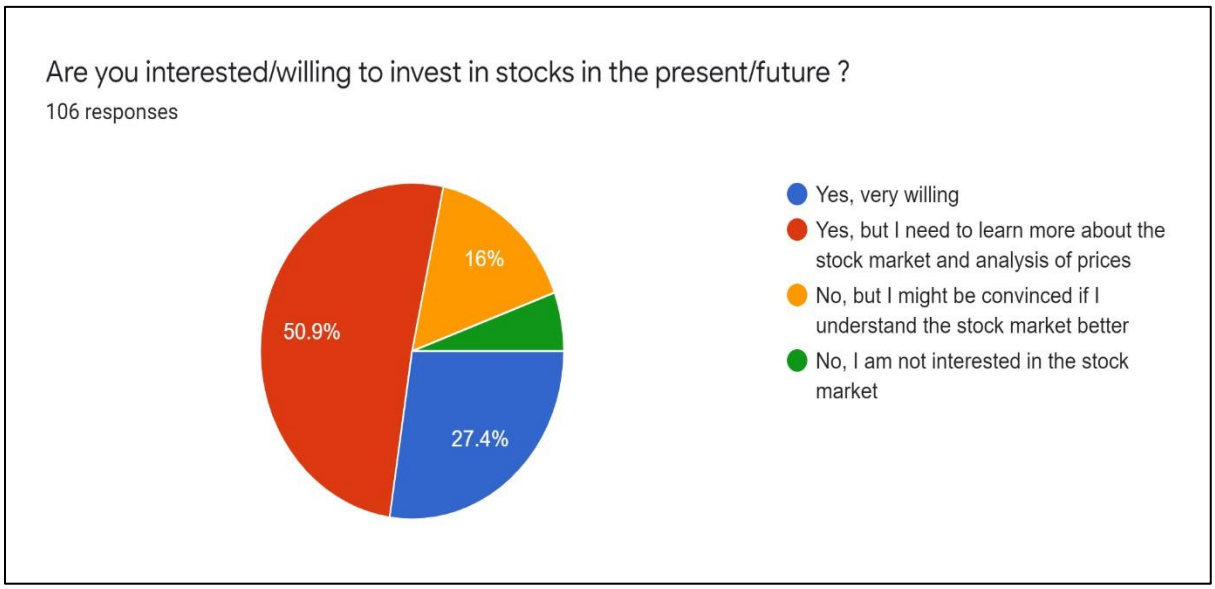


Would you be interested in using an application that predicts stock prices and provides analyses and technical visualizations of stocks?

106 responses



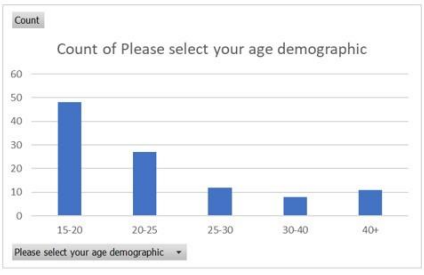




D. STATISTICS OF USER RESPONSES

Are you a student or a professional?	Count
Professional	42
Student	64

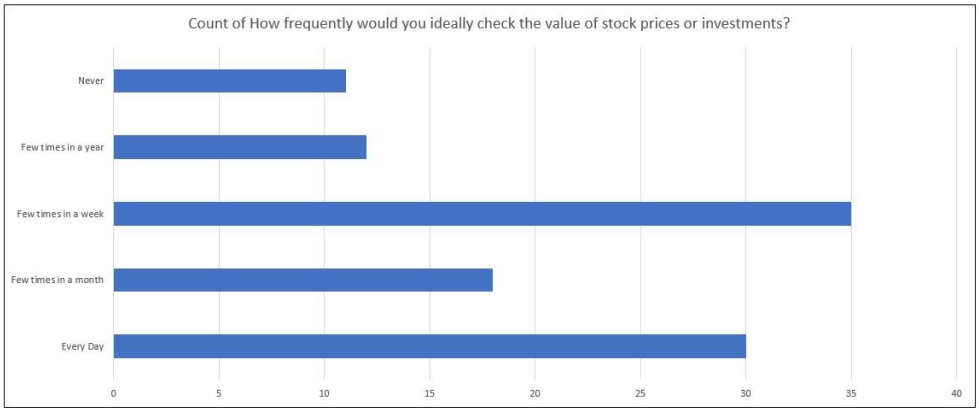
Please select your age demographic	Count
15-20	48
20-25	27
25-30	12
30-40	8
40+	11



Do you invest in stocks or in any form of assets?	Count
No	66
Yes	40

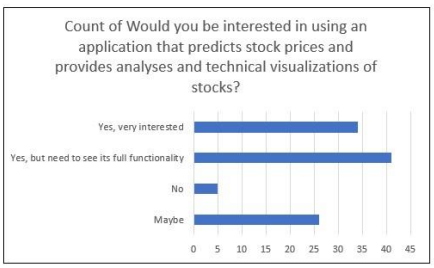
Are you interested/willing to invest in stocks in the present/future ?	Count
No, but I might be convinced if I understand the stock market better	17
No, I am not interested in the stock market	6
Yes, but I need to learn more about the stock market and analysis of prices	54
Yes, very willing	29

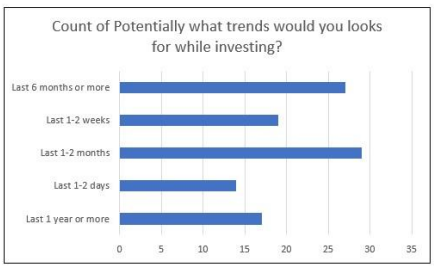
How frequently would you ideally check the value of stock prices or investments?	Count
Every Day	30
Few times in a month	18
Few times in a week	35
Few times in a year	12
Never	11



Would you be interested in using an application that predicts stock prices and provides analyses and technical visualizations of stocks?	Count of Would you be interested in using an application that predicts stock prices and provides analyses and technical visualizations of stocks?
Maybe	26
No	5
Yes, but need to see its full functionality	41
Yes, very interested	34

Potentially what trends would you looks for while investing?	Count
Last 1 year or more	17
Last 1-2 days	14
Last 1-2 months	29
Last 1-2 weeks	19
Last 6 months or more	27

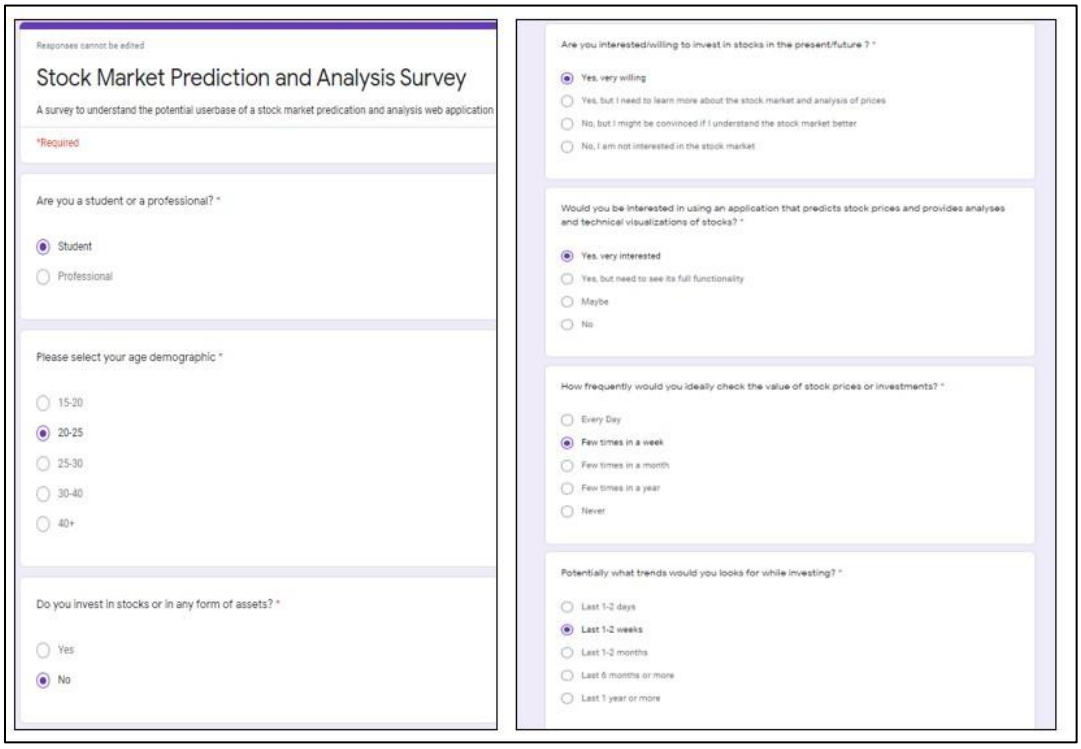


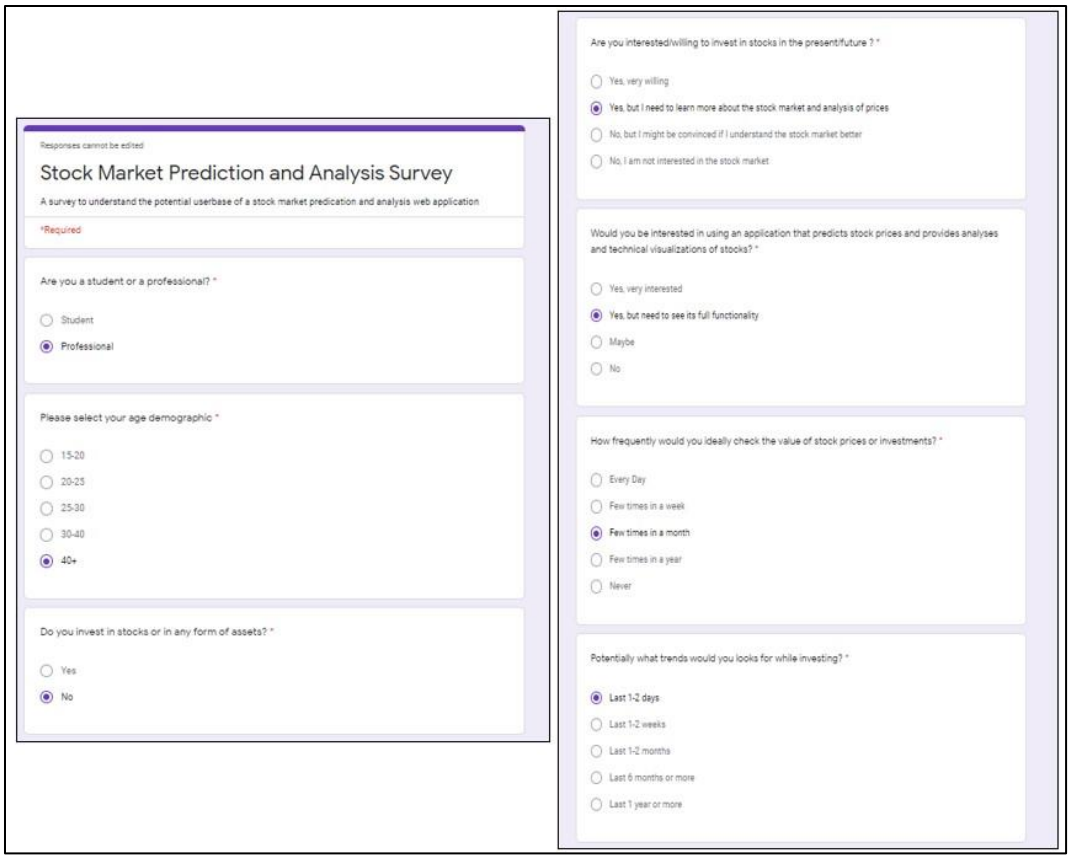


E. GENERATED USER PROFILES

1. Based on Profession and Age Demographic
    a. Students – Age Demographic: 15-25 (15-20, 20-25)
    b. Professionals – Age Demographic: Above 25 years of age (25-30, 30-40, 40+)
2. Based on Past Experience of Investments
    a. No experience (62.3%) – Most students and some professionals fall in this category
    b. Have experience (37.7%) – Mostly professionals
3. Based on willingness to invest in stocks in the present/future?
    a. Very willing
    b. Willing but lack of knowledge (Majority – 50.9%)
    c. Not willing due to lack of knowledge
    d. Not willing at all
4. Based on frequency of checking stock prices
    a. Frequently (Every day or few days in a week) – (Majority)
    b. Infrequently (Few times in a month)
    c. Very Infrequently (Few times in a year)
    d. Never
5. Based on willingness to use the application
    a. Very willing
    b. Willing but need to see the full functionality – (Majority)
    c. Maybe
    d. Not willing
6. Based on trends preferred in the stock market
    a. 1-2 days trends
    b. 1-2 weeks trends
    c. 1-2 months trends – (Majority)
    d. 6 months or more
    e. More than a year

SAMPLE FORM ENTRIES



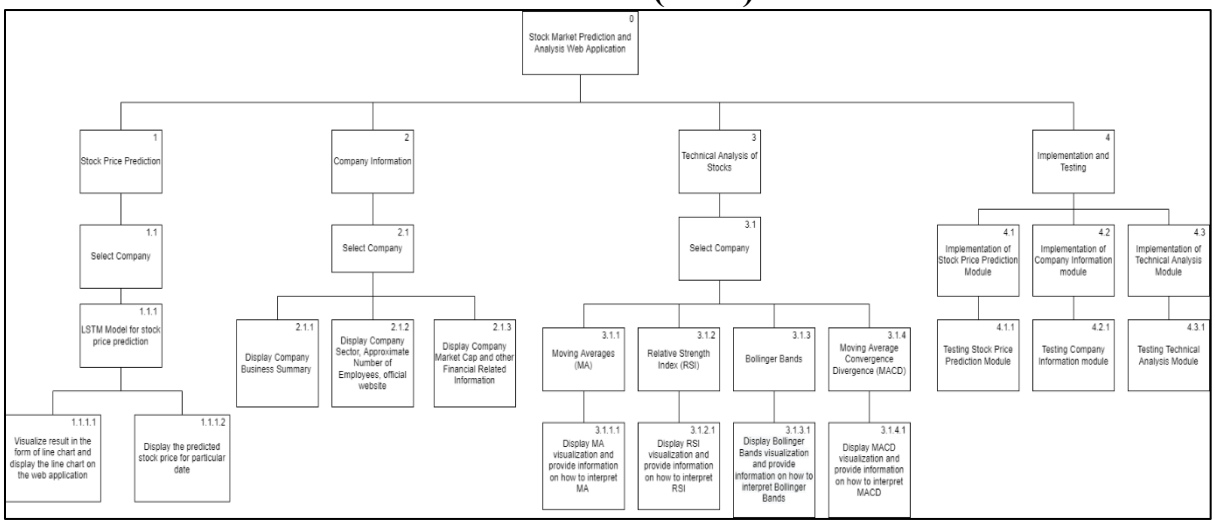


V. TASK ANALYSIS

- **Obtaining Stock Price Data for the Companies chosen by Users**: We will be getting stock market data form the yfinance library of Python. This library provides a large range of historical stock data such as Opening and Closing price, Volume traded and other suck data.
- **Providing Information on the Company selected**: Yfinance offers background or summaries of companies present in the Yahoo Finance database. We will be providing users a short brief on the particular company chosen by them such as which sector they operate in, Business Summary, sustainability of the stock and others.
- **Technical Analysis of Stock Prices**: A technical insight into the trends of a particular stock is highly essential to decide whether a stock should be sold, bought or held. Our application will provide several technical indicators such as RSI , Bollinger Bands and more Momentum Indicators. The analysis will be helpful for both experienced and novice traders as we will be providing details on how to interpret the visualization of these indicators.
- **Stock Prediction**: For predicting the stock price of a particular company, we will be using Long Short Term Memory (LSTM) which is a type of RNN specializing in predicting long term dependencies and trends. LSTMs use a chain like structure with slight differences in each segment to determine trends in the data and to forecast time series such as stock prices.
- **Designing a Clean and Interactive User Interface**: By using Streamlit we will be designing clean user interface but providing all the functionalities without appearing clumsy and crowded. The interface design will allow users to easily choose what options they want without over complicating things. The necessary results will also be displayed in an ordered manner.
- **Creating Informative and Meaningful Visualizations**: The application will provide a lot of important information about the stocks by means of visualization such as graphs and charts, hence it is important that these visualizations are displayed properly and that they can be interpreted correctly.

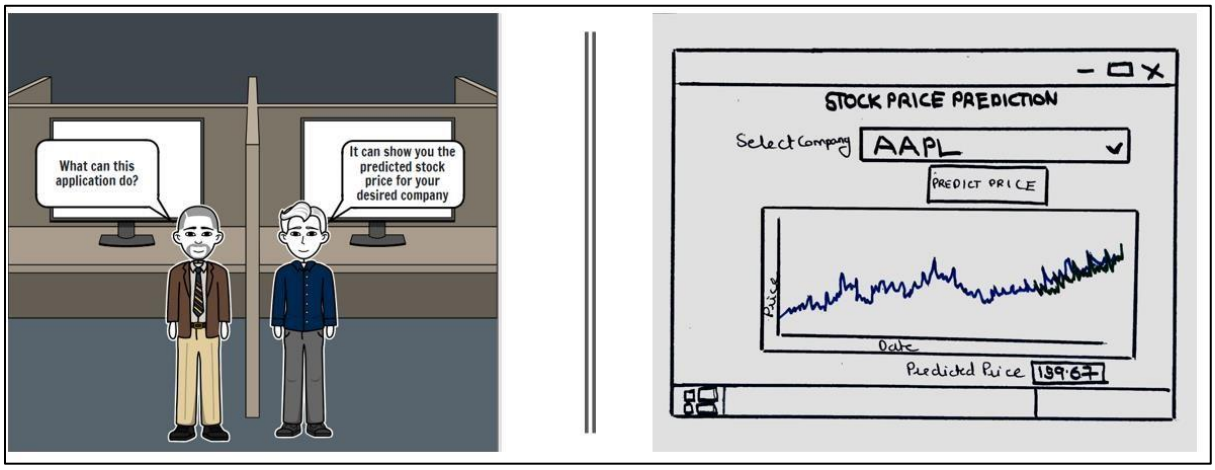
VI. DATA FLOW

A. HIERARCHICAL TASK ANALYSIS (HTA)



B. STORYBOARD

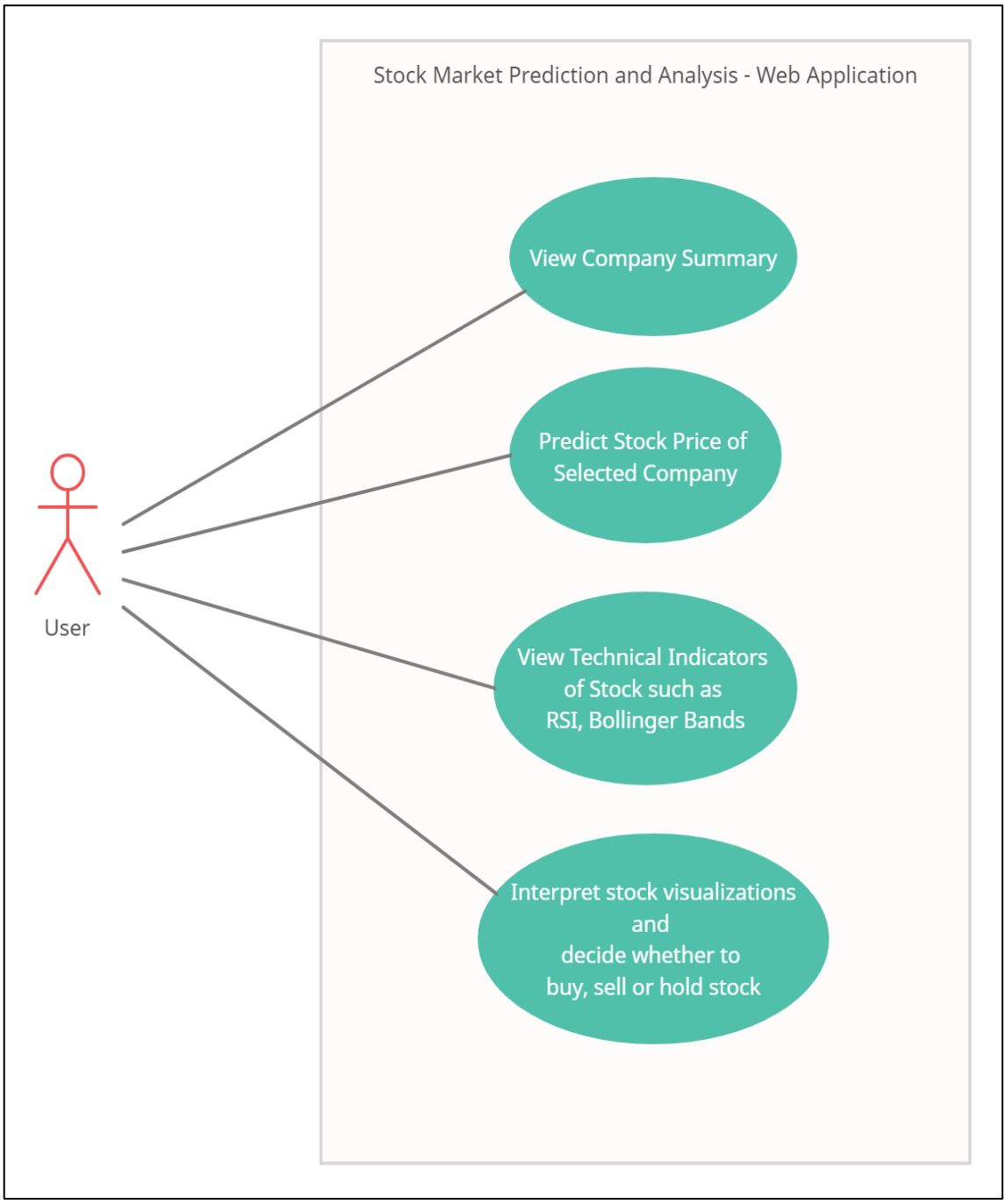
Predicting the Stock Price for companies in the yfinance library



Displaying Company Information

Technical Analysis of Stocks

C. USE CASE DIAGRAM



VII. MODULE DESCRIPTIONS

A. STOCK PRICE PREDICTION MODULE

In the stock price prediction module, Long Short Term Memory(LSTM) is used to predict the closing price of selected company stocks. In this module, the necessary libraries are imported (such as math, numpy, pandas, datareader and other libraries. Keras library is used to implement the LSTM model and matplotlib and plotly are used for visualizing the results. A company ticker is selected from the Yahoo finance database and the start and end dates for obtaining the stock data is selected. The necessary data is obtained from the Yahoo Finance database. Brisk details of the obtained data will be displayed as output. This is followed by a simple plot of the Closing Price of the stock of selected company.

For creating the LSTM module, the data is split into train and test sets in a 80-20 split. The data is also fit into a Standard Scaler to scale the data into values between 0 and 1(data normalization). MinMax Scalar is used which subtracts the minimum value of a feature from the values and divides by range to obtain values between 0 and 1. This makes the data easy to fit into the LSTM model. The training data is then split into x_train and y_train in batch size of 60 entries and reshaped to fit LSTM.

A Sequential model is initialized. First layer added is an LSTM layer with 50 cells and return sequences enabled. The next layer is an LSTM layer with 50 cells and no return sequences. This is followed by a Dense layer of 25 units to reduce from 50 to 25. Final layer is a dense layer of 1 unit which will contain the final outputs of the model. The model is compiled using Adam optimizer (which uses 2 gradient descent techniques for best optimization) and optimized to minimize the mean squared error. Predictions are made for test data and the rmse is calculated. The final plot contains the line graphs of the Training Closing Price, The true closing prices and the predicted closing prices of the stock.

To make predictions for a particular date, the last 60 days stock values are considered and scaled. This is fed as test data to the created model to predict stock value of the selected date.

B. COMPANY INFORMATION MODULE

The company information module provides various details on the company selected from the Yfinance database. First a ticker object is created of the selected company using its special symbol. From that ticker object, the stock data of the company can be obtained. This is followed by obtaining the logo of the company and displaying it. The yfinance library provides the logo url of the companies and the necessary python functions are used to obtain the logo image and display it. The info function of the ticker object can be used to obtain information such as the Business summary, Market Cap, Revenue, Sector and other such details of the selected company. Lastly, the open, high, low and closing price of the stock is plotted and the graph is displayed.

C. TECHNICAL ANALYSIS OF STOCKS MODULE

This module focuses of 4 technical indicators of stock price namely Exponential Moving Average (EMA), MACD (Moving Average Convergence Divergence), RSI (Relative Strength Index), Bollinger Bands.

EMA: EMA is a moving average indicator that places more importance on more recent data points. It is used for getting buy and sell signals when calculating the MACD. Most common metrics of EMA are 12-day EMA and 26-day EMA. The 12-day and the 26-day EMA are calculated using the ewm() function and calculating its mean over specified span (12 or 26). The 12-day and 26-day EMA are plotted along with the closing price.

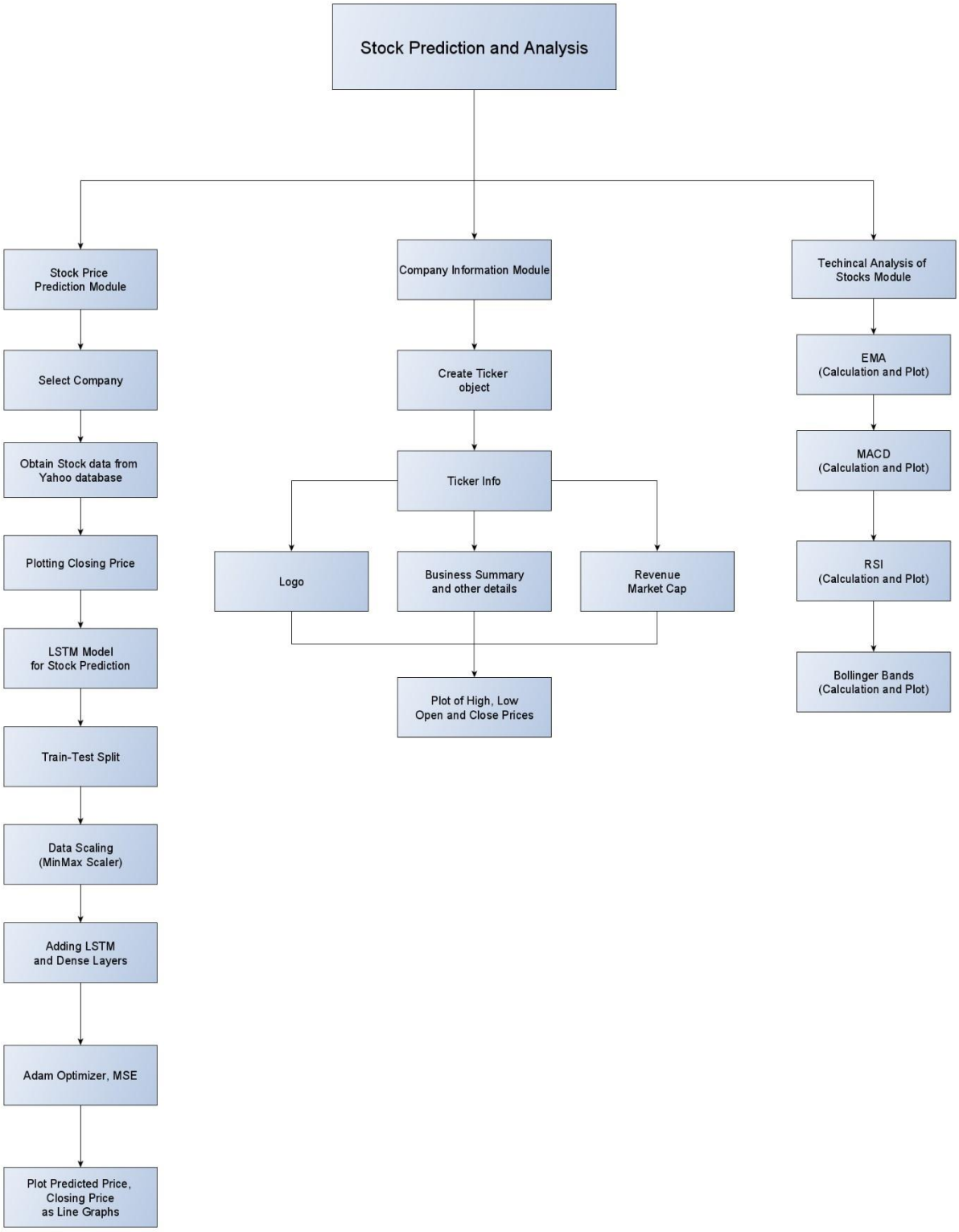
MACD: MACD stands for Moving Average Convergence Divergence. It is a momentum indicator that is used to recognize buy or sell signals. MACD is calculated by subtracting 26day EMA from 12-day EMA. Then the signal line needs to be calculated. The signal line is the exponential moving average of the MACD values taken over a span of 9 days. Both the MACD and the signal line are plotted. When the MACD lines falls below signal line, it indicates a sell signal and when the MACD line is above the signal line it indicates a buy signal. The buy and sell signals are plotted with respect to the closing price.

RSI: RSI stands for Relative Strength Index. RSI is a momentum oscillator for obtaining the speed and change of price fluctuations. RSI moves between 0 and 100. Stock is considered overbought when RSI>70 and oversold when RSI<30. The RSI is calculated using simple moving average, exponential moving average and the relative moving average. The RSI calculated using these averages are plotted separately as line graphs and the indicator lines of 70 and 30 are plotted as well.

Bollinger Bands: Bollinger Bands are limits which are plotted using the standard deviation of the simple moving average of a particular stock. There exists two such bands, one is the upper Bollinger band and the other the lower Bollinger band which are plotted at standard deviation to the simple moving average. Bollinger bands are used to determine whether the price is high or low relatively. When the bands are tight, it raises the likelihood of a sharp price move and when the bands are far apart also signals the end of an existing trend.

VIII. FLOWCHARTS

A. FLOWCHART OF STOCK MARKET PREDICTION AND ANALYSIS WEB APPLICATION



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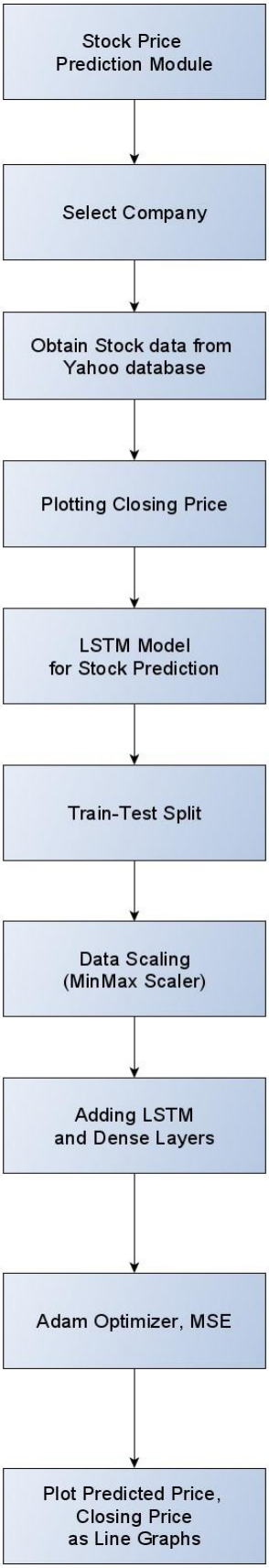
B STOCK PREDICTION MODULE



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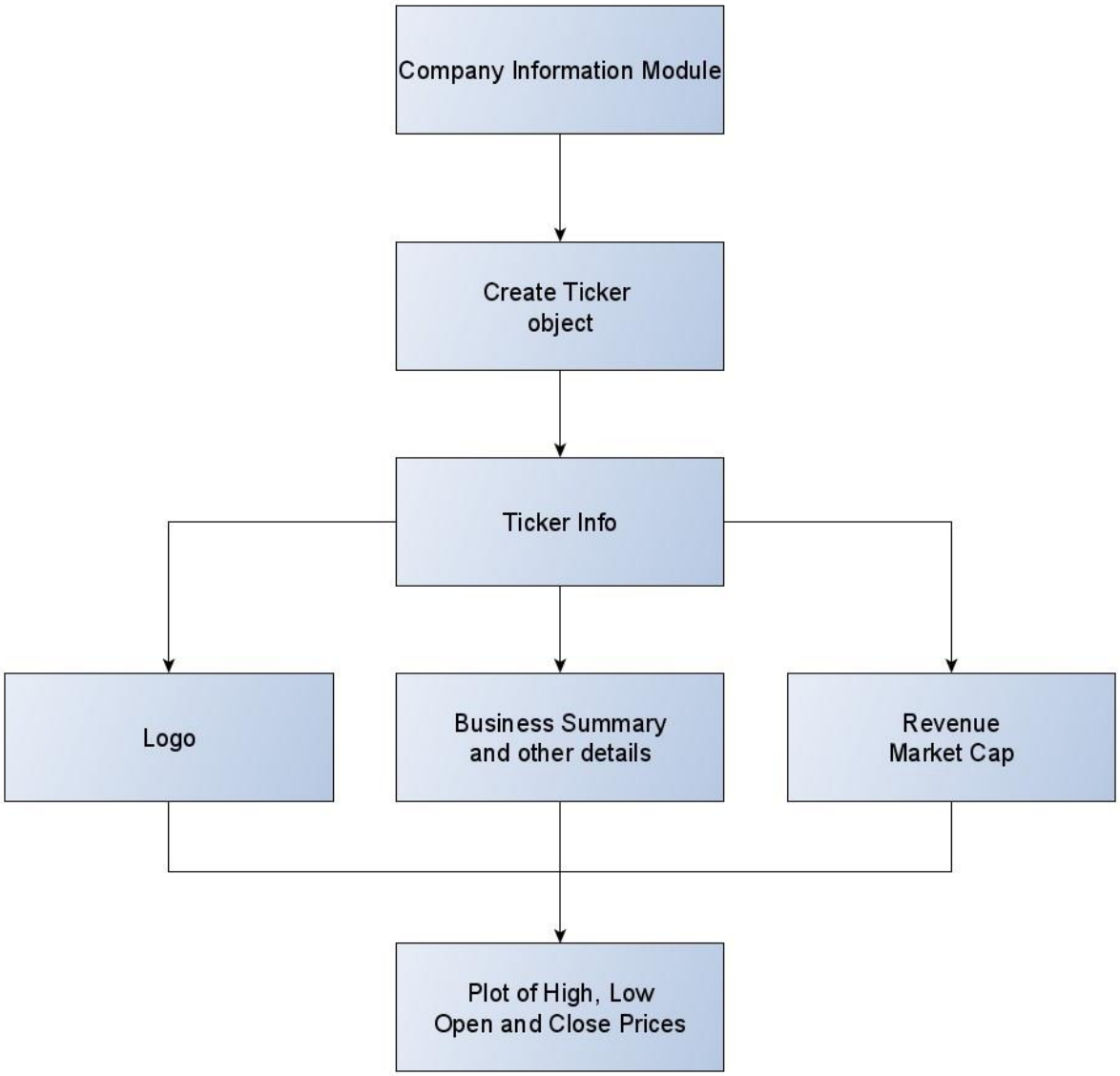
C COMPANY INFORMATION MODULE



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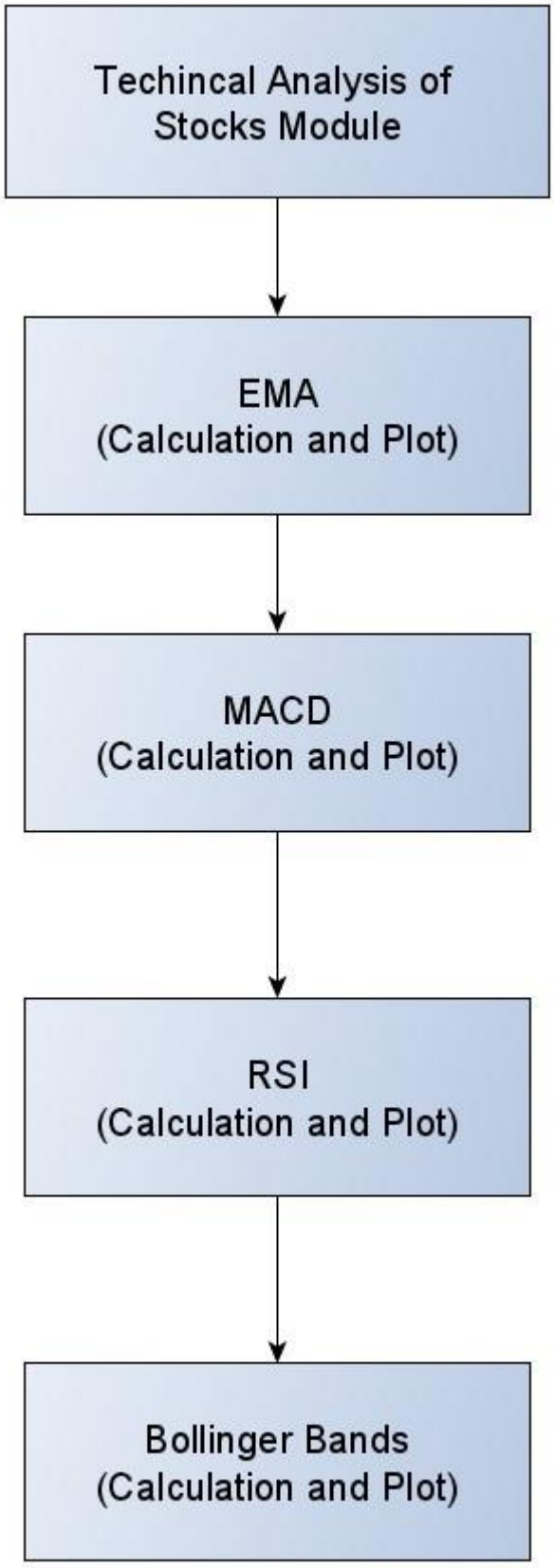
D TECHNICAL ANALYSIS OF STOCKS MODULE



IX. HEURISTIC EVALUATION

1. Visibility of System Status

The stock market prediction and analysis application keeps the users informed about the entire process from selecting the parameters to navigation through the modules of the application. The user is provided visual feedback on their choice as well as interactive selection mechanisms which are easy to access and understand. The outputs are also displayed fast and loading times can be visually seen with the screen going translucent for certain loading durations. The outputs are also clearly labelled, and the results and visualizations can be easily seen and obtained.

Severity Rating: 0 – No change necessary and no usability problem.

2. Match between System and the Real World

The created stock market application uses simple user understandable language and clear sections and directions for the user to easily choose their options. The different modules have clearly defined headers so which can be easily recognised by the user. The results and outputs also occur in a natural and straightforward way. The user is provided visual feedback on their choice as well as interactive selection mechanisms which are easy to access and understand.

Severity Rating: 0 – No change necessary and no usability problem.

3. User Control and Freedom

The user is given freedom to choose the company , the date range (start and end date) and other parameters on their will. Users can easily navigate to whatever module they want and view what information they want or require as well. They can also easily undo their choices or refresh the screen without having to go through any tedious process. All the content is dynamically generated on the webpage without the need for refreshing. The user can also easily double check selected options by pressing the ”Confirm” button present in some form in each module. The designed application provides users a great degree of freedom.

Severity Rating: 0 – No change necessary and no usability problem.

4. Consistency and Standards

The user interface is consistent in its options and information that is being delivered. A similar style is used all across the application to provide for consistent design and ease of use for the user. Users do not need to worry about same options referring to different things as consistency is maintained throughout the UI design. The application follows a consistent style approach with similar elements of UI used in multiple pages of the application for simpler and more effective user engagement.

Severity Rating: 0 – No change necessary and no usability problem.

5. Error Prevention

The stock market prediction and analysis web application has several error prevention methods. Some such methods are: i) If a user tries to input a company ticker symbol not present, the application automatically selects a default value from the list and tells the user that no results are available for searched ticker. ii) The start date and end date fields are self-validated such that the user cannot select incorrect date values. The application runs without any errors as most input fields are validated. The application provides the error message which are generated directly from python and through Streamlit, it is provided to the user in text format followed with erroneous code messages. This can be somewhat disorienting to the end-user of the application. Hence, an error generation and display module needs to be developed to streamline the display of error message and implementing it to be part of the UI itself.

Severity Rating: 2 – Minor Usability Problem; Better to fix the issue (low priority).

Proposed Solution: Development of an error handling module that displays errors if any to the end-users in easy and plain language that they can understand.

6. Recognition rather than Recall

Our web application performs recognition rather than recall quite well. The options the user selects on one particular page (eg company, start date and end date) are carried over when the user navigates to another page (eg from stock prediction to technical analysis). By this, the user does not have to remember what options they selected over and over again while navigating to different parts of the application. This is turn enables the user to efficiently navigate through the application and enjoy its various functionalities without having to deal with the hassle of repeatedly selecting option.

The usage of the system is extremely easy and does not require too many difficult instructions as everything is quite self-explanatory and can be easily accessed by most age groups. However, if need, a cosmetic upgrade can be created whereby on each page, a menu appears if the Instructions or Help button is pressed. This section will display all the instructions regarding the usage of system.

Severity Rating: 1 – Cosemetic Problem; Not essential to fix at all.

Proposed Solution: Implementation of a help or instructions section in the web application.

7. Flexibility and Efficiency of Use

The stock market prediction and analysis web application streamlines the process of usage of the application by providing easily visible and easy to understand selectors which are simple for the user to access. The application has multiple accelerators in place for increasing efficiency of use. The selection of company ticker symbol is done via a dynamic search wherein if the first few letters typed, it automatically gives suggestions for the most appropriate company ticker symbol. Date selection is also easy and streamlined and can be done both via manually entering the date or via an interactive calendar from which users can select the start

and end dates. The application also keeps user choices in memory while navigating from one section to another (eg from stock prediction to technical analysis). Another accelerator is the fact that the application does not need reloading to perform and does not reload the page while navigating to other parts of the web application.

Severity Rating: 0 – No change necessary and no usability problem.

8. Aesthetic and Minimalist Design

The user interface of the stock market prediction and analysis web application is highly aesthetic and minimalist in nature. Only required information is displayed without any for of clutter. A consistent theme is followed for the UI. The selection sidebar is minimalist in nature while having the necessary functionality required for the web app. In the company information section, user can select the information about the company that they desire instead of being cluttered with the entirety of the company information. The visualisations present in the web app are aesthetically placed and match with the design of the UI. All UI elements follow a consistent format (centered). Dark theme, light theme and custom themes can be selected by the users. Only relevant information to the user is provided and no unnecessary information is provided to the user.

Severity Rating: 0 – No change necessary and no usability problem.

9. Help Users Recognise, Diagnose and Recover from Errors

Our application does not have a dedicated error handling module. Error messages come from the Streamlit framework. The error messages can be quite confusing to the end-user and also can contain erroneous code. The errors however are quite precise and indicate the problem to the user. Solutions are also suggested to the user by Streamlit for specific errors thrown by the application if there are any. In normal running conditions, the applications works perfectly without any errors. Most input fields are validated to make sure that no bad input can be selected.

Severity Rating: 2 – Minor Usability Problem; Better to fix (low priority)

Proposed Solution: Development of error handling module to handle errors as well as help users to recover from errors. This module can also display errors to users in plain language.

10. Help and Documentation

The web app can be used easily without the need for any documentation. There is no specific documentation for the stock market prediction and analysis web application that provides users with information about things they may want to know. This project report provides some semblance of documentation. Specific Documentation and Help sections are lacking in the web application.

Severity Rating: 1 – Cosmetic problem; Not essential to fix at all

Proposed Solution: Development of a help section and instructions section. Proper documentation to be provided for the stock market prediction and analysis web application.

X. CONCLUSION AND FORSEEABLE ENHANCEMENTS

With rising inflation in all sectors of the economy, the stock market has presented itself as one of the most promising avenues of wealth generation. However there still remains tangible apprehension towards any sort of investment or stock purchasing. This arises due to a lack of information and avenues for pursuing stock investments and lack of proper information and analysis of trends and in stock prices. To address these issues and to provide novice as well as professional stock traders alike with meaningful information with respect to stock market predictions as well as company information and technical analysis of stock. In this project, we have successfully developed a Stock Market Prediction and Analysis Web Application. The application is able to successfully and accurately able to predict the stock price for selected company data using LSTM model as its base and able to visualize and output the results in a clean and approachable manner. The related company information is also provided such as company logo, summary, and information that the user wishes to view about selected company. Lastly, our application allows users to easily view technical analysis of selected company stock price for user-selected range of dates. The technical indicators implemented in our application are Relative Strength Index (RSI), Bollinger Bands, Exponential Moving Average (EMA) and Moving Average Convergence Divergence (MACD). These indicators are visualized and presented neatly to the end-user with the necessary information for interpretation of said indicators. The application developed by us also provides users with a clean, intuitive and accessible user interface that adheres to the heuristics of evaluation and guidelines for good UI design. The UI can be accessed by anyone regardless of experience in stocks. All planned modules have been successfully developed, executed and tested for adherence to evaluation heuristics and general usability and functionality testing. The developed application is able to provide the users an easy way to accurately predict stock prices, view company information and technically analyse selected company stock.

We are looking to improve the developed application. One avenue that we plan for as future work is using real-time stock data via the use of paid APIs that refreshes every set time interval to provide users a dynamic stock prediction and analysis application. Further optimisations to the LSTM model can also be considered to improve accuracy and reduce the time required for predictions. Another enhancement that we aim for as future work is to implement more technical indicators such as Aroon and Stochastic Oscillators for the stock price to provide users with as much knowledge and information as possible. An error handling module also needs to be designed to help users recognize and recover from errorrs. Further enhancements to usability and UI design can also be considered for future work.

XI. REFERENCES

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