Visualizing and Predicting Stocks Using Dash

Karrar Ahmed

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GIK Institute of Engg. Sciences & Tech., Topi, Khyber Pakhtunkhwa, Pakistan

Abstract: Stocks are at the heart of contemporary finance; they represent a relatively high-risk/return proposition. This work illustrates the creation of a web application based on the Dash, a Python framework, focused on stock price analysis and forecasting. It uses the yfinance library for the current stock and the might of Plotly for advanced graphical interfaces. In addition, the Long Short Term Memory (LSTM) network is used to forecast the future stock price. The purpose of this project demonstrates how a dynamic web app benefits investors and investors by giving real time stock performance with prediction that goes a long way in assisting the decision making process of an investor.

Keywords—Stock Price Prediction, Dash, yfinance library, Plotly, Long Short-Term Memory (LSTM) Network, Machine Learning, Data Visualization.

1. Introduction

The stock market retains a central position in the current economy; investors may gain potential sources of wealth; however, the subject implies high risks because stock prices fluctuate frequently. The constantly changing value of the stocks pose difficulty to investors given the amounts of historical as well as real time data available for analysis. The traditional black box models like linear regression and time series models have their weaknesses especially in terms of capturing the stock market behaviors of the market since these models do not incorporate the aspect of non-linear system dynamics while equally do not incorporate the factor of market sentiment and other global factors. But with the basic help of latest machine learning and data visualization tools research and making guesses regarding the stock market have become more advanced and easy.

This research aims at filling the existing gap between the conventional approaches of financial analysis and the advanced trend of machine learning by creating an interactive web application based on Dash, which is a powerful package in python. Dash provides an environment on top of Python package for developing highly interactive web applications, with a strong emphasis on analysis, which makes Dash a perfect tool for visualizing and forecasting stock prices. This project's purpose is to use real-time data from yfinance library and forecast future stock prices using the Long Short-Term Memory (LSTM) networks in order to assist investors in making correct decisions on stock buying and selling through an easily understandable UI (User Interface).

The application implemented during the present project employs a machine learning model, namely LSTM Networks, to predict the future stock prices based on the past data. This method has attracted considerable interest in the arena of financial forecasting because of its capability to model temporal data characteristics such as long-term dependencies that are beneficial for stock price prediction problem. The use of these predictive models in conjunction with real-time data using interactive charts and graphs is the vision and goal of the application, which polishes the tool for user's trinity to analyze and invest in stock market. This work also seeks to investigate the possibility of extending the features to include other parameters like indicators and sentiment that will improve on the forecasts and give better understanding of market conditions.

2. Literature Review

Financial modeling through the use of predictive modeling has received a lot of attention in the past few years especially due to the enhanced machine learning and deep learning approaches that can be used. Those that entails the Autoregressive Integrated Moving Average (ARIMA) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) have been used in forecasting stock prices in time series (Babu & Reddy, 2014). These models although useful in many occasions are fixed with linear characteristics and are not capable of capturing the existence of non-linear polynomials with the financial time-series data. As such, other sorts of models like Long Short-Term Memory (LSTM) networks have been adopted because of demonstrated capability in capturing chronological data characteristics and temporal structure in stock prices (Ding et al., 2015). Of these, LSTMs have merits for analyzing long-term trend data for the time series and are even better than the original models (Xu, 2024).

There has also been various researches on the combination of machine learning for stock market forecasting. Neptune.ai (2023) underscores the fact that while machine learning methods such as support vector machines (SVM), random forests, and deep learning provide a high predictive accuracy compared to statistical models. These models have the ability to manipulate large batches of financial and other information as well as respond to changes in the market, which is the reason they are so useful for investors when predicting future price changes of stocks. In contrast, deep learning methods like the use of neural network is capable of identifying complicated patterns and hence makes them suitable models for this kind of datasets.

Moreover, data visuals serve as integral to the financial decisions. Analyses of this type of big data often involve using interactive visualizations, which can provide investors with clear patterns or discrepancies in large sets of financial information. There are many powerful tools available today including Plotly and Dash for generating real time interactive dashboard which give dynamic view on stock performance and trends (Sharma et al., 2017). In this regards, Dash offers a solution in the form of an open source software that allows developers to build applications for the web in ways that can be easily interacted with and used by the average user. The integration of machine learning models with data that include an interface for data representation to the investor forms a definite solution.

As Nature(2024) has also pointed out later development of deep learning has enhanced financial analytics even further. Basically, Recurrent Neural Networks and better known as CNN and LSTM have proved effective in the prediction of trends and thus, stock price prediction. These models are able to identify patterns within large volume, multivariate data sets which are appropriate for use within the financial markets where past data can often be used to predict future movements in prices.

Thus, the analyzed literature proves the existing tenancy towards integrating machine learning and deep learning with financial forecasting tasks. While difficult to dismiss models such as ARIMA or GARCH, the superiority of ml models especially LSTM network for the prediction of stock prices is gradually coming to light in stock price prediction tasks. An integration of such models with innovative techniques in the development of interactive visualizations offers a more effective solution in prediction to the investors. Additionally, increasing features from outside

sources, for instance the sentiment of the news, adds more features, thus making the future of financial prediction even more data-driven, online and highly accurate.

3. Methodology

3.1. Application Architecture: The web application was developed by using Dash, a framework that is used for the purpose of creating analytical web applications in the Python programming language. The architecture of the application consists of the following components:

- **Frontend**: Created by integrating Dash HTML and its core pieces, the frontend enables users to type stock codes, set date orders, and choose the parameters of predictions. The user interface has Bootstrap along with custom CSS to style the application.
- **Backend**: The backend features Python scripts that engage the yfinance library to pull real time and historical trading data. It should also be noted that the application also has a machine learning model, more specifically LSTM, for stock price forecasting.

3.2. Data Acquisition: The historical as well as the real-time data of stocks is obtained using yfinance library owing to its easy and efficient data extraction. The data includes the stock performance along with other basic info of the companies and other factors . This information is then analyzed and utilized for more displays and forecasts.

3.3. Exploratory Data Analysis (EDA): Exploratory Data Analysis (EDA): Further, before training the predictive model, exploratory data analysis was performed to the historical stock data. This included:

- **Data Cleaning**: Addressing cases of values being missing and any outliers from the data set as well.
- **Data Transformation**: Scaling the stock prices into a fixed range of MinMaxScaler so as to normalize the value.
- **Feature Engineering**: Adding the Moving averages as features and as a way of improving the model, technical indicators are included to the calculation.

3.4. Predictive Model

The model is developed under Long Short-Term Memory (LSTM) which is most favorable in case of time series data. For stock price prediction, the LSTM model is used to learning and identifying the historical stock prices and make predictions.

Steps involved:

1. **Data Preprocessing**: Standardize the stock price and then, divide the data into training and testing data set.

2. **Model Architecture**: two LSTM layers are stacked, and the output LSTM layer undergoes dense layers to make prediction.
3. **Model Training**: he model used for training is the past data and the forecast is done on the test data.
4. **Evaluation**: While assessing the independent model, common parameters such as Mean Squared Error (MSE) and Mean Absolute Error (MAE) are used.

4. Results and Discussion

By focusing on the stock data visualization and price prediction, the application works efficiently. The following results were obtained:

1. **Interactive Visualization**: Real-time stock data is visualized with the help of line charts and candlestick charts, allowing users to observe price trends over a specified period.
2. **Technical Indicators**: The application also solves and graphically displays such technical periodical indicators as, for example, the Exponential Moving Average (EMA), act as buying or selling signals.
3. **Stock Price Prediction**: Recently, LSTM model has exhibited high performance for predicting the next n_days stock prices. The Mean Squared Error (MSE) of the model used in the current work was determined to be 0.020, which is ideal for short-term predictions. While some of the anomalies occurred in the model, the forecast was basically sound for short term prediction.

5. Conclusion

The authors of this project effectively prove how Machine Learning, and Long Short Term Memory networks in particular, can be combined with Dash for predicting stock prices as well as identification of market trends. The application offers the latest stock information, graphical representation of various stocks and credible short term forecasts in MSE 0.020 which is a desirable characteristic for stock price estimation.

5.1. Future Work

The scope of this project can be expanded in several directions:

1. **Sentiment Analysis**: With reference to the external data, sentiment analysis from news or from trending topics on social media can improve the prediction capability.
2. **Macroeconomic Data**: Preliminary results imply that adding some macroeconomic indicators like interest rates or GDP can build a stronger model.

3. **Real-Time Trading Integration**: Potential future enhancement that may be added include integrate of APIs from brokerage firms to handle real time stock trading and other related decisions

Thus, the findings of this project indicate the applicability of machine learning and data visualization techniques in financial forecasting and can be of use to investors

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