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# Stock Market Analysis and Forecasting using Machine Learning and Deep Learning Algorithms

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**Abstract:** Nowadays, everyone wants to invest their money where they can get the most profit and benefits with high returns for their amount. In this application, the stock market analysis and forecasting are performed using different machine learning and deep learning algorithms, which helps the person who is investing in the stock market. Users can make the smart decision to get higher profit using machine learning and deep learning algorithms. This application uses LSTM (Long Short-Term Memory), CNN (Convolutional Neural Network) models from deep learning, and RF (Random Forest), ARIMA models from machine learning are used for understanding stock market scenarios. The proposed method provides better performance, which is calculated using MAE (mean absolute error) and RMSE (root mean square error). The proposed system provides investment suggestions based on stock prices, so this system is more safeguard for market risks as well as decisions related to finance that can be taken based on more knowledge with high perfection.

**Keywords***: Stock Market Analysis, Stock Market Price Forecasting, Machine Learning , Deep Learning , Performance Metrics , RMSE, MAE.*

## I. Introduction

The stock market is a complex and ever-changing system, making accurate prediction a challenging task for investors and analysts. In recent years, Machine Learning (ML) and Deep Learning (DL) techniques have emerged as powerful tools for analyzing stock trends due to their ability to capture hidden patterns in large and noisy datasets. Nabipour et al. demonstrated that deep learning models like RNN and LSTM outperform traditional ML models when applied to both continuous and binary stock data formats, achieving significantly higher prediction accuracy [1]. Similarly, Nikou et al. found that deep learning algorithms consistently performed better than machine learning approaches in predicting stock prices, especially in handling non-linear and non-stationary data commonly found in financial markets [2].

Recent studies further reinforce the growing significance of DL models in stock market forecasting. Sonkavde et al. provided a comprehensive review of ML and DL methods, highlighting that DL models offer more consistent performance across diverse datasets [3]. Mukherjee et al. also supported this view, noting that deep learning models adapt better to market fluctuations and achieve improved results in real-world scenarios [4]. Verma et al. emphasized the importance of input indicators in forecasting models and observed that most existing studies heavily rely on technical indicators while underusing fundamental and sentiment-based data. They suggest that incorporating a broader range of inputs along with metaheuristic-optimized DL frameworks could lead to more accurate and robust stock prediction systems [5].

The stock market plays a major role in the global economy, influencing financial decisions made by millions of people and institutions every day. However, predicting stock prices remains incredibly challenging. This is mainly because prices are affected by a mix of unpredictable factors like political events, economic changes, and investor sentiment. These elements make stock data highly volatile and complex, which makes it hard for traditional models to capture accurate trends and patterns [6].

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In recent years, technologies like Machine Learning (ML) and Deep Learning (DL) have emerged as powerful tools for analyzing stock markets. These methods can handle large amounts of data and are especially good at spotting complex relationships that older models like ARIMA and Moving Averages usually miss. Algorithms like Random Forest, LSTM (Long Short-Term Memory), and CNN (Convolutional Neural Networks) are particularly effective because they don't rely on the assumption that stock prices behave in a straight line or follow simple rules [7].

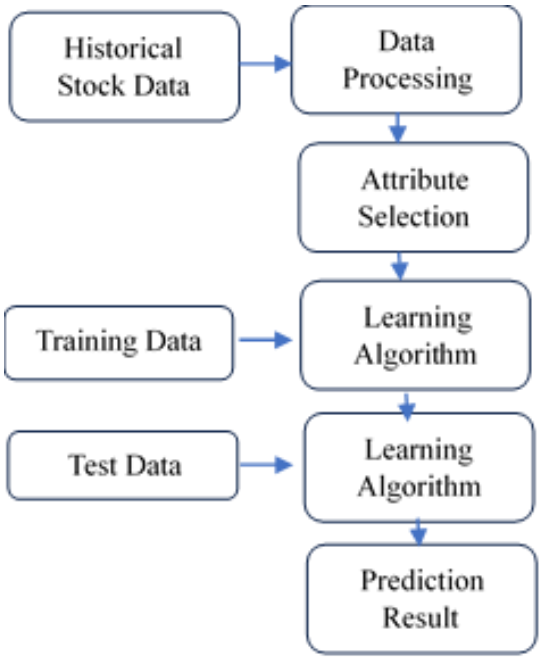


**Fig.1.1 Basic Stock Market Price Prediction Strategy**

Every stock market price prediction strategy has a similar workflow, as shown in the above figure. The data collected may be in rough format, so data processing and attribute selection is required.

One of the key ideas behind this system is recognizing patterns in stock price trends. To do this, the project uses a three-step approach involving TICC (a clustering method), TPA-LSTM (a special kind of LSTM that pays attention to important time-based patterns), and Multivariate LSTM-FCNs. These models help break down stock data into useful patterns that can be used for more reliable predictions [8].

The system is also designed to work with real-time data and is optimized to run efficiently even when handling large datasets. This means investors can get up-to-date forecasts quickly, which is crucial in today's fast-moving markets. To check how well the system performs, it uses common error measurement tools like RMSE (Root Mean Square Error) and MAE (Mean Absolute Error), which help assess the accuracy of the predictions [9].

## II. Literature Survey

The study by Nabipour et al. (2020) explores how machine learning and deep learning algorithms can improve stock market trend prediction, a task often complicated by numerous unpredictable factors. Focusing on four sectors from the Tehran Stock Exchange, the researchers evaluated nine machine learning models and two deep learning methods RNN and LSTM using technical indicators derived from ten years of historical data. These indicators were tested in both continuous and binary formats to assess prediction performance. The results showed that deep learning models, particularly RNN and LSTM, significantly outperformed others when using continuous data. While they still led in binary format predictions, the performance gap narrowed due to improved results from the machine learning models, demonstrating the potential of both approaches depending on the data format used. [1]

Security indices play a crucial role in assessing the health of financial markets, and since stock market investments form a significant part of a country's economy, accurately predicting market trends can help investors maximize returns. However, predicting stock behavior is challenging due to the nonlinear and nonstationary nature of financial data. This study evaluates the effectiveness of machine learning models in forecasting stock market trends using daily closing prices of the iShares MSCI United Kingdom ETF from January 2015 to June 2018. Four machine learning algorithms were tested, and the results showed that deep learning offered the most accurate predictions, followed by support vector regression, while neural networks and random forest models performed with comparatively higher error rates. [2]

The financial sector significantly influences the economic well-being of individuals and institutions, and with the advent of artificial intelligence, machine learning and deep learning are reshaping how financial markets are analyzed and predicted. These advanced techniques are increasingly used for stock price forecasting, market trend analysis, investment decision-making, and portfolio optimization. Recognizing the

growing reliance on AI in finance, this study provides a comprehensive review of key machine learning and deep learning models, including supervised, unsupervised, ensemble, and time series algorithms. It also proposes and evaluates a hybrid ensemble model—combining Random Forest, XGBoost, and LSTM—for predicting the stock prices of TAINIWALCHM and AGROPHOS, demonstrating its effectiveness compared to other widely used models in the domain. [3]

Predicting the stock market is difficult because of its unpredictable nature, but using deep learning can make it more accurate. This study tested two models—ANN and CNN—to forecast stock prices based on past data. The CNN model, which used 2D histograms to analyze patterns, performed better with a 98.92% accuracy compared to 97.66% from ANN. Even during the unstable COVID-19 period, the CNN model still gave good results with 91% accuracy, showing that deep learning can be a powerful tool for stock prediction. [4]

Machine learning and deep learning are widely used in stock market prediction, but building an accurate and reliable forecasting model is still a challenge. Researchers constantly aim to improve on existing models, but the first step is always identifying the right problem and choosing the best approach to solve it. This review paper helps new researchers understand the current landscape by analyzing past studies on stock prediction using different types of input indicators—like historical data, technical and fundamental factors, and public sentiment. It highlights that most existing research focuses on technical indicators and sentiment analysis, while financial ratios and other key factors are often overlooked. The paper concludes that future models should be more accurate and efficient by using optimized deep learning techniques, and recommends a metaheuristic-based deep learning framework that can include a wider range of input data for better predictions. [5]

Big Data Analytics helps in collecting and analyzing huge amounts of data, and Deep Learning is especially useful for finding valuable insights within that data. This is particularly relevant in the stock market, where predicting when to buy or sell is still a challenge. Deep Learning handles unstructured data well and can improve the accuracy of stock price predictions. This paper uses Deep Learning algorithms to better classify and forecast stock trends beyond current prediction methods. [16]

Big Data Analytics is essential for gathering and analyzing vast amounts of information, and Deep Learning plays a key role in making sense of this data. In the context of the stock market, where large volumes of complex data are generated daily, knowing the right time to buy or sell remains uncertain. Deep Learning helps uncover patterns in unstructured data, making it a powerful tool for predicting stock trends. This paper uses Deep Learning algorithms to enhance the accuracy of stock price predictions by improving data classification. [17]

Financial markets are highly unpredictable and influenced by many factors like company performance, past trends, market value, news, and timing. While trend analysis can help anticipate stock movements, predicting stock prices is complex due to the unique behavior of each stock. Machine learning models can forecast future prices, but one model may not work accurately for all stocks due to varying trends and influencing factors. This study addresses the challenge by analyzing historical stock data and applying various machine learning and deep learning techniques—such as Linear Regression, LSTM, and tools like Modern Portfolio Theory and Bollinger Bands—to improve prediction accuracy. [18]

## III. PROPOSED METHOD

The proposed system is designed to predict stock market trends more accurately by combining both traditional machine learning and modern deep learning techniques. It uses historical stock data, technical indicators, and market sentiment to make predictions. Algorithms like ARIMA and Random Forest handle structured, numerical data, while advanced models like LSTM (Long Short-Term Memory) and CNN (Convolutional Neural Network) are used to capture patterns over time and across different inputs. The system goes beyond just analyzing past prices—it also includes news and social media data to understand how market sentiment might influence future movements. This mix of approaches helps the model identify both short-term fluctuations and long-term trends in stock behavior.

The entire process starts with collecting and cleaning the stock data. The model then clusters similar stock patterns using TICC (Toeplitz Inverse

Covariance Clustering), which helps organize the data into meaningful groups. TPA-LSTM is applied next, focusing on important time-based patterns in the data. Finally, the Multivariate LSTM-FCN model processes all the extracted features to make accurate predictions. To evaluate how well the models perform, the system uses error-checking tools like RMSE (Root Mean Square Error) and MAE (Mean Absolute Error). By comparing results from different models, the system selects the best one for forecasting. This setup provides users with a powerful, real-time tool that supports smarter and faster investment decisions.

The proposed method block diagram consists of two stages

a) Training Stage
b) Testing Stage

The first training stage is to train the machine learning and deep learning classifiers. And after that, testing takes place, which will help you to predict stock index prices for a few days based on training performed. All the machine learning and deep learning algorithms are trained with different classifiers, and their performance is calculated. Among all those classifiers, one classifier is selected that has higher accuracy or higher performance compared to the state-of-the-art techniques.

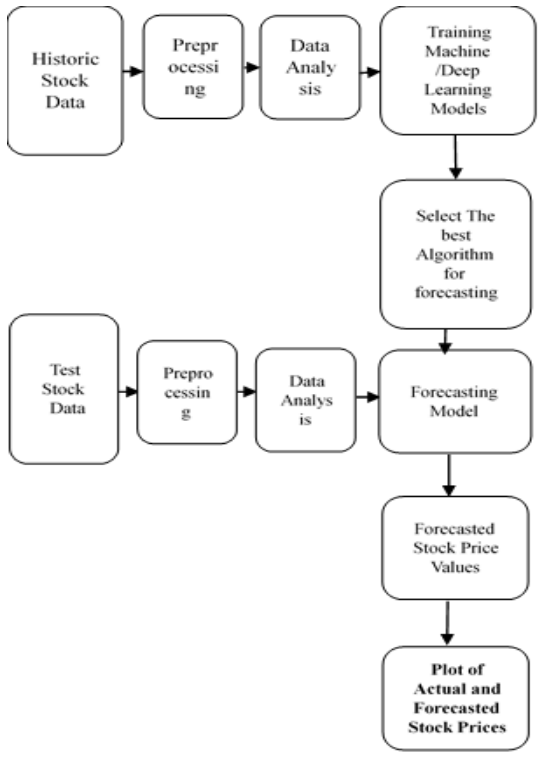


**Fig.3.1 Proposed Method Block Diagram**

Proposed method steps are explained in the below paragraphs in detail.

### 3.1 Selected Stock Dataset

The selected dataset has different stock values with respect to dates. First, train to the machine learning and deep learning classifiers using these values given in the data set.

The selected stock has the data of each stock of the past few years. The data of the past year is used to train the models. In the proposed method Hang Seng dataset is used for complete analysis.

### 3.2 Preprocessing

Preprocessing is performed to get the values in standard format, well as null values will be removed. Preprocessing even includes data normalization and data splitting.

### 3.2 Data Visualization

Data visualization is performed to show the dataset that is selected for analysis. and graphs are plotted to understand w.r.t. the dates how the stock index is varying. It is observed that w.r.t. dates the stock indices are varying. Visualization gives us better understanding about stock prices varying.

### 3.3 Training Machine/Deep Learning Models

In this application, different machine learning and deep learning algorithms are used for performance analysis. And then performance matrices are calculated on the test data to get the best algorithm among all. It is observed that the CNN-LSTM algorithm is working better compared to state-of-the-art algorithms.

### 3.4 Select the Best Algorithm for Prediction

Among all learning and deep learning classifiers, it is observed that the proposed method outperforms state-of-the-art techniques. CNN-LSTM algorithm is selected for further prediction as it has better performance.

### 3.5 Prediction Model

New test data is provided to the classifier that is working best. The proposed classifier is stock prices for the given inputs with higher accuracy compared to the existing algorithms. The CNN-LSTM algorithm performs better than state-of-the-art techniques.

The above steps are performed to get at the end stock index variation for given dates. Deep learning algorithm LSTM helps in understanding the sequence of variation in data.

**LSTM** (Long Short-Term Memory): It is a special type of Recurrent Neural Network (RNN) designed to handle sequences of data and remember patterns over long periods. In stock market prediction, it's important to consider past price trends over time. Regular models struggle with long-term dependencies, but LSTM can "remember" previous stock movements to make more accurate predictions.

It works by using a memory cell and three main gates:

- Forget Gate – decides what information to discard.
- Input Gate – decides what new information to store.
- Output Gate – decides what part of the memory to pass on as output.

This allows LSTM to capture the time-based behavior of stock prices, making it an excellent tool for analyzing and forecasting market trends.

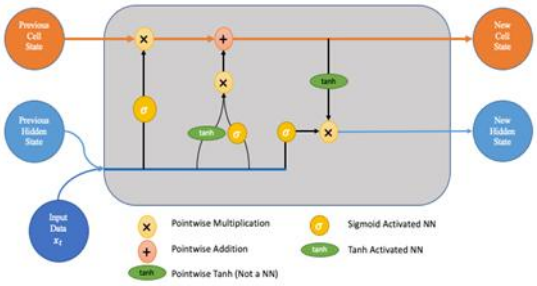


**Fig.3.2 LSTM Networks**

## IV. Results Analysis

The proposed system is designed for stock market price prediction using different machine and deep learning techniques. Performance visualization is shown in the below results.

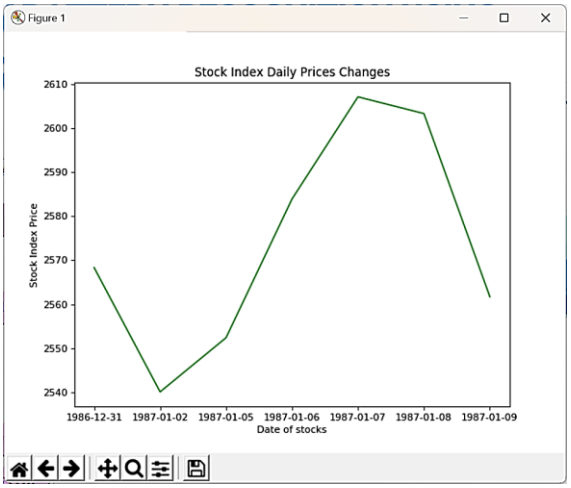


**Fig. 4.1 Hang Seng Dataset is selected.**

The x-axis represents the dates, and the y-axis represents the stock index price in the above figure. The Hang-Seng Dataset is selected, which has stock and price details with respect to dates.

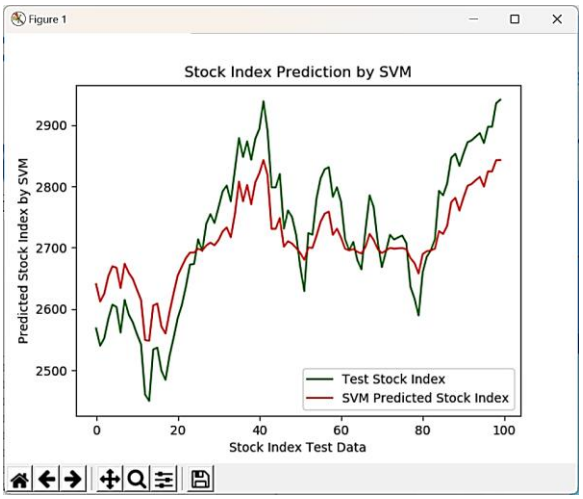


**Fig. 4.2 Prediction Results by SVM Classifier**

About results shows the actual values of stocks with respect to dates as well as svm predicted stock index with respect to dates. It is observed that S VM classifier is not more efficient to predict the stock index.

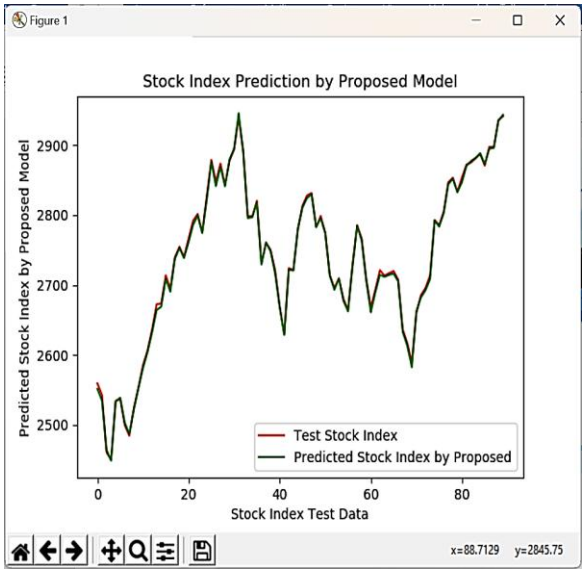


**Fig. 4.3 Prediction Results by Proposed Classifier**

It is observed that in the above figure test stock index and the predicted stock index by the proposed method are almost overlapping, which means the values are predicted very near. Hence, the method is more accurate than the state-of-the-art existing methods.

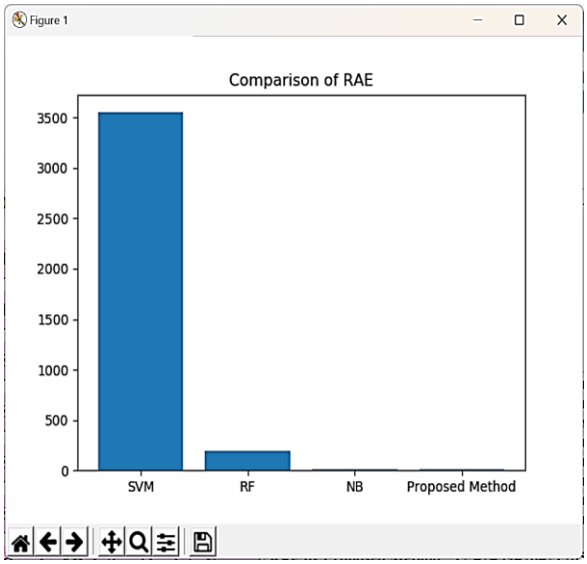


**Fig. 4.4 Performance Analysis of Different Techniques**

In the above figure, different classifiers are compared based on their performance analysis. Machine learning classifiers such as support vector machine, random forest and deep learning algorithms CNN and LSTM are used for prediction.

## V. Conclusion

The proposed system uses machine learning and deep learning to provide a more scalable as well as accurate solution for the prediction of stock market prices. The existing system has limitations in that it cannot work on nonlinear data. The proposed system has the capability to work with nonlinear data and provide user-friendly visualizations. In the proposed system, machine learning and deep learning are incorporated to perform a more feasible solution for stock market price prediction. It is observed that CNN and LSTM models outperform the existing state-of-the-art machine learning models. This application is user-friendly as well as less complex for the users, so it can be easily accessible by anyone.

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