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A Blend Methodology for Deep Learning-Based Stock Market Prediction

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ABSTRACT: The development of trustworthy and accurate predictive algorithms for stock price prediction has been actively studied for a very long time. Some experts dispute the efficient market hypothesis' proponents' assertion that it is impossible to predict stock prices with any degree of accuracy. Numerous methods for estimating a good business's cost have been investigated by researchers. Economists use economic forecasting to project the future worth of the company's financial goods. Proficient forecasting methodologies enable investors to gain a deeper comprehension of data, including future patterns. Analysis of the market for the future might also help investors. Estimating the future value of the financial institution's shares is the aim of market forecasting. This article's primary goal is to increase the effectiveness of asset utilization for product output prediction. A number of scholars have put forth numerous solutions to this issue; the majority of these are conventional techniques, such neural networks used in stock market prediction, which enable the model to conceal and segregate data. An alternative method for evaluating operating costs is provided in this article. Since the data cannot be fitted into a single model, we employ machine learning architecture to determine the most recent occurrences on the device. In this study, we estimate the value of firms listed on the National Stock Exchange (NSE) and distinguish their performance using Deep learning approaches: Long Short Term Memory (LSTM), Convolutional Neural Network (CNN), and blending of LSTM + CNN. The hanging window strategy is used in the long run, and the root mean square error is used to assess the performance of the proposed approach.

KEYWORDS: Stock market, prediction, financial stock, Long Short Term Memory, convolution neural network, blend approach etc.

I. INTRODUCTION

Stockbrokers, traders, and investors assemble in stock markets to buy, sell, or exchange stocks. Due of the abundance of businesses offering listings, investors find their products appealing. In an attempt to increase the return on their investments, investors started experimenting with various methods from the start of the 16th century to learn more about various businesses [1]. It is crucial to the economic advancement of developing nations like India. The stock market is seeing an increase in demand. It is known to stand out with its best results over the years. The stock market is regarded as one of the most profitable resources because immense quantities of wealth are purchased and sold there every day. The stock market is now one of the indicators of a nation's economic health. Many people have made large stock market investments, but occasionally they will lose a great deal of money because they trusted investors who gave them advice based on working hours, technology, and ideals. Companies are finding it difficult to come up with a clever plan of action to deal with these issues.

The necessity of predicting the stock price explains why price prediction is effective. The primary goal of predicting stock prices is to make precise projections about future financial performance. Many traders have incorporated machine learning algorithms into their operations since they are seen to have produced positive results in a variety of industries in recent years. A game-changer could be machine learning.

In order to forecast the opening price of American Airlines shares, this article trains various deep learning techniques. We employ Long Short Term Memory (LSTM), Convolutional Neural Network (CNN), and blending of LSTM + CNN algorithms. Because of its large returns, investing in the stock market is one of the most popular options. People search for methods to boost returns while lowering risk as the level of business and investment changes. The majority of trades on the Indian stock market occur on two stock exchanges: National Stock Exchange (NSE) and the Bombay Stock

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Exchange (BSE). In the Indian market, the Sensex and Nifty are two widely used indicators. Because stock market prices fluctuate, stock market forecasting is difficult.

II. PRIOR ART

Among time series predictions, stock market prediction is typically regarded as one of the most difficult problems [2] because of the noise and extreme volatility in the data. Machine learning techniques, such Support Vector Machines (SVR) [4] and Artificial Neural Networks (ANNs) [3], have been utilized extensively in the past few decades to predict financial time series with impressive accuracy. Deep learning models, which can represent intricate nonlinear topology, have been used to tackle this issue more recently. By extracting robust features that capture the pertinent information, deep learning models can successfully model difficult real-world data, outperforming typical machine learning models in the process [5][6]. Table 1.1 illustrates the summary of work done in the area of stock market prediction.

Table 1.1: Summary of Related work done for Stock Market Prediction

Sr. No.	Author	Year	Method	Review
1	Jai Jagwani, Hardik Sachdeva, Manav Gupta, Alka Singhal[7]	2018	time series algorithms (ARIMA and Holt Summer	The primary objective of the investment planning process is to figure out how current time series algorithms (such as ARIMA and Holt Summer) relate to stock prices. It was discovered that examining risk-free products increased the gender model's accuracy. By generating prices for the consumer market, the combination of two distinct analytical model periods was used in order to determine the primary results for the stock market. These models' primary benefit is their simplicity—they forecast prices exclusively using past non-seasonal stock prices or seasonality. This experiment has certain limitations, including the fact that other variables that could have an impact on the stock price, such media coverage of any company or news about novel business concepts, were not included.
2	Ishita Parmar, Ridam Arora, Lokesh Chouhan, Navanshu Agarwal, Shikhin Gupta, Sheirsh Saxena,Himanshu Dhiman[8]	2018	LSTM and regression based on machine learning.	In order to predict stock prices, the study for this article uses LSTM and regression based on machine learning. Opening price, closing price, low price, high price, and volume are examples of indicators. This article aims to improve confidence and accuracy in predicting a company's stock price in the future by utilizing machine learning techniques. When it comes to stock price prediction, the LSTM algorithm produces better and more accurate results.
3	Youxun Lei, Kaiyue Zhou, Yuchen Liu[9]	2018	competitiv e pricing model	This study developed a competitive pricing model using features from several media groups. Dictionary definitions serve as the basis for several activity categories. To examine the connection between market prices and news-specific variables, we employ support vector machines and neural network models. According to the results of the experiment, predefined multicategory news events outperform buzzwords in terms of stock price prediction. Based on this research, short-term forecasts perform better than long-term forecasts.
4	Jeevan B, Naresh E, Vijaya kumar B P, Prashanth Kambli [10]	2018	short-term memory (LSTM) and recurrent neural networks (RNN) Model	The primary focus of this article is a technique for predicting stock prices utilizing recurrent neural networks (RNN) and short-term memory (LSTM) that takes into account a number of variables, including current market values. In order to forecast the NSE stock price, these and pricing data are used. Using RNN graphs to compare actual and forecasted data, evaluate the performance of your model. Because the model gathers rich data and employs a variety of prediction techniques, machine learning is able to forecast stock prices that are reasonably close to the actual price.

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				All NSE data that is downloaded from the internet is subjected to model training, which also groups and identifies concepts according to user preferences. To prevent mixed data, the backpropagation system gathers and organizes data.
5	Mehak Usmani, Syed Hasan Adil, Kamran Raza, Syed Saad Azhar Ali[11]	2016	multilayer perceptron algorithm	This study's primary goal is to use machine learning algorithms to predict the Karachi Stock Exchange's (KSE) market performance at market close. by predicting different characteristics depending on the content and the positive and negative features of the work utilizing the forecasting model. The model takes into account many factors such as the price of oil, gold, and silver, interest rates, foreign exchange (FEX) rates, news, and social media. There is a comparison of machine learning techniques such support vector machine (SVM), radial basis function (RBF), single-layer perceptron (SLP), and multilayer perceptron (MLP). Out of all the techniques, the Multilayer Perceptron MLP algorithm performs the best. The price of oil is the most crucial factor to forecast. The study's conclusive findings validate machine learning's capacity to forecast market activity. The multilayer perceptron algorithm in machine learning makes a 70% prediction of market performance.
6	Jingyi Du, Qingli Liu, Kang Chen, Jiacheng Wang[12]	2019	LSTM neural network	By using single feature input variables and multi-feature input variables to confirm the forecast effect of the model on stock time series, LSTM neural networks are utilized to predict Apple stocks[7]. The experimental findings demonstrate that the model is accurate and in accordance with the real demand, with a high accuracy of 0.033 for the multivariate input. The projected squared absolute error for the univariate feature input is 0.155, which is less than the multi-feature variable input.
7	Shao-En Gao , Bo-Sheng Lin ,Chuin-Mu Wang[13]	2018	convolutional recurrent neural network (CRNN) with effective memory and short-term memory (LSTM)	The stock market often dominates all other financial markets, and one of the major scientific challenges is the forecast of exchange rate prices. Do a thorough analysis to determine the projected worth of the stock prices discussed in this article and use historical data to forecast future market values. Because past knowledge on stock prices frequently influences the price of products, this study not only gathers historical data for the designated period of time, but also uses neural network development to forecast the future market price. In order to reduce long-term reliance on conventional RNNs, this article's neural network proposes a convolutional recurrent neural network (CRNN) with effective memory and short-term memory (LSTM) as essential components. simultaneously enhancing the RNN LSTM architecture's stability and prediction accuracy. In order to test ten products, this article gathered historical data, and the average error was 3,449 RMSE.
8	Tingwei Gao, Yueting Chai, Yi Liu [14]	2017	RNN Model	This paper's primary objective is to assess a method that uses RNN in conjunction with various input data sources to anticipate work for the following day in a more efficient and effective manner. Long-term memory (LSTM) and basic business data are analyzed by the prediction model. The Standard & Poor's (S&P500) and Nasdaq are the sources of research data. Comparable models are not as good at predicting closing costs as next-day projections. This is the investigation's primary goal. To illustrate the efficacy of the system, they examined five distinct models, including the Moving Average (MA), Exponential Moving Average (EMA), Support Vector Machine (SVM), and LSTM. The goal estimate is the closing price on the next day.
9	Zang Yeze, Wang Yiying[15]	2019		The store is among the most crucial components of the financial system.Investors provide capital to the appropriate firm in order to support their endeavors and expansion. Artificial neural networks

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				and information theory are combined to construct machine learning architectures (ANN). This strategy is also helpful for neural network time series models, since it creatively uses the entropy information of both stock correlation and nonlinear causality. See what this learning device has to offer at the pricing listed on Amazon, Apple, Google, and Facebook. In order to describe the dynamics of stock prices, this research presents a time correlation method based on information theory and LSTM. In order to ensure that the prediction's correctness is generally acknowledged, the entropy change of pertinent correlations that aid in LSTM time prediction is integrated into the model architecture. The mean error (MAE) and root mean square error (RMSE) of the search result show a little difference between the market price pattern and the real market price.

III. METHODS AND MATERIALS

A. Algorithm of LSTM Model

Machine learning has made it possible for predicting future product prices, and techniques like long short-term memory (LSTM) can be used to execute machine learning tasks. The goal of this machine learning algorithm is to forecast future stock values as accurately as possible. During the time frame given in this quote, LSTM can identify changes in stock price. suggested standardizing machine learning-based stock price prediction [3]. Yahoo Finance chose the data that was utilized in the analysis. About 900,000 records of stock prices and other relevant data are contained in it. The information displays the stock price for every day of the year at the moment. It contains various information such as date, symbol, opening price, closing price, lowest price, highest price and trading volume. Here, information regarding a single company is considered. The Pandas Python module is used to read and create data frames from CSV files containing all of the data. With the help of the Python sklearn module, the data is standardized and divided into training and testing sets. 20% of the total data set was maintained as the experimental set. Two modeling techniques—the LSTM and the Regression Based Model—are the main topics of this essay. Given a set of control parameters, continuous values are predicted using regression-based models.

It is possible for the LSTM architecture to identify distinct differences in the results. Planning is thought to work best using the LSTM model. This demonstrates that some interactions in the data can be found using the suggested strategy. It's possible that the stock market cycle isn't always followed or advances steadily. The model's existence is dependent on the business and firm, and its duration will vary. For investors, the kind of diversification and assessment cycle will yield higher profits. Because networks like LSTM rely on current data to interpret large amounts of data, we ought to employ them.

B. Working of LSTM Model

Short-term memory is a neural network. In RNN, the last step's output serves as the current step's input. It addresses the issue of long-term dependency of RNNs, in which RNNs do not predict words stored in long-term memory but can make more accurate predictions based on recent data. As the length difference grows, RNN loses balance. LSTM defaults to storing long-term information. It is used for processing, prediction, and classification of runtime data, similar to CNN[3]. Figure 1.1 depicts the traditional Working of LSTM model.

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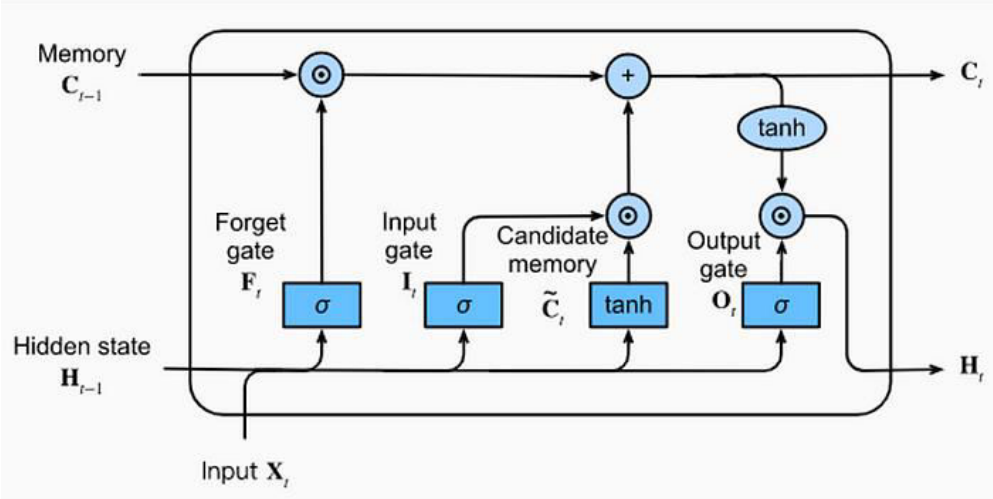

Figure 1.1: Working of LSTM Unit (Credits: https://d2l.ai/chapter_recurrent-modern/lstm.html)[16]

C. Layer of CNN Architecture

1. Convolutional Layer (Convolution): This layer applies the convolution function to the input and forwards the output to the subsequent layer. Convolutional layers analyze features in the input data. By sliding a narrow window, known as a filter or kernel, over the material, they perform the equation of the equation and then the calculation, resulting in a result in the output map.

2.Max Pooling Layer (Max Pooling): Maximum pooling is a low-level process that reduces the residuals of any given map. It works by dividing the input into a series of non-overlapping rectangles and calculating the maximum value in each subregion. This will help to reduce computational complexity and prevent overfitting.

3.Dropout Layer (Dropout): Dropout is a regularization strategy for neural networks that prevents them from overfitting. During training, some input units are randomly set to zero with a specific consequence, effectively "halting" a segment of the network. This drives the network to learn device vulnerabilities, hence increasing its robustness.

4.Flatten Layer (Flatten): This layer turns the output of the previous process into an array (vector) that may be fed into the complete (condensed) process. It actually reduces the multidimensional output to a one-dimensional array.

5.Dense Layer (Fully Connected Layer): Dense layers, also known as fully connected layers, are classic neural network layers in which each neuron is linked to every neuron in the previous layer. These layers change the incoming data based on previously gained weights and biases.

6.Activation Function: This is not a layer as such itself, but rather a partial application that comes after a density or convolution layer to add nonlinearity to the network. The activation methods are ReLU (rectified linear activation), sigmoid, and tanh. They introduce nonlinear elements into the model to help it learn about the material's relationships. Figure 1.2 depicts the traditional Working of CNN model.

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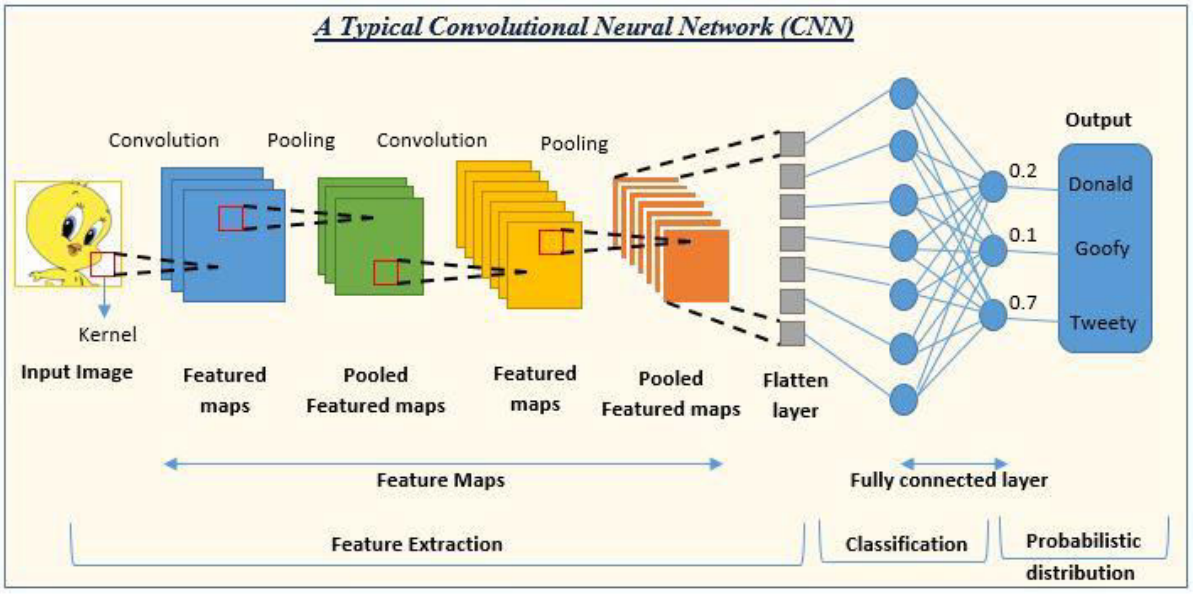

Figure 1.2: Working of CNN (Credits: https://www.analyticsvidhya.com/blog/2022/01/convolutional-neural-network-an-overview/[17]

D. Hybrid Approach of LSTM + CNN

To predict the stock market, an approach incorporating Long Short-Term Memory (LSTM) and Convolutional Neural Network (CNN) can take advantage of the strengths of each architecture. The following illustrates how such a strategy could function:

1.Data Preprocessing:

- Preparing stock market data, including historical prices, volumes, and other pertinent metrics.
- Normalize or scale data to ensure similar feature scales and faster model convergence.

2. CNN for feature Extraction:

- Employ a CNN architecture to extract spatial and temporal features from the raw input data.
- CNN layers may reveal patterns and correlations in input data, useful for time series analysis..

3. LSTM for Temporal Modeling:

- After feature extraction with CNN feed the output to LSTM layers.
- LSTM is ideal for modeling sequential data, including time series, as it can capture long-term dependencies and retain information across time.
- LSTM layers may identify temporal characteristics in stock market data, such as trends, seasonality, and patterns.

4. Combining CNN and LSTM:

- Merge the outputs of the CNN and LSTM layers either by concatenation or another method to combine the extracted spatial and temporal features.
- The merged representation captures both local and global patterns within data, improving the model's predictive capability.

5. Dense Layers and Output:

- After merging CNN and LSTM representation add fully connected layer for further processing.
- Finally use a dense output layer with an appropriate activation function to produce the models prediction.

6. Training and Evaluation:

- Employ statistical techniques like gradient descent and back propagation to train the hybrid model on historical stock market data.

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- Assess the model's performance using a different validation set and consider metrics that are pertinent to your prediction goal, such as mean absolute error and mean squared error.
- To optimize the model's performance, fine-tune the architecture, training parameters, and hyper parameters.

7.Testing and Deployment:

- After the satisfactory model's performance, a test is run using untested data to evaluate the model's capacity for generalization.
- Employ the hybrid LSTM-CNN model to make batch or real-time predictions on fresh stock market data in a production setting.

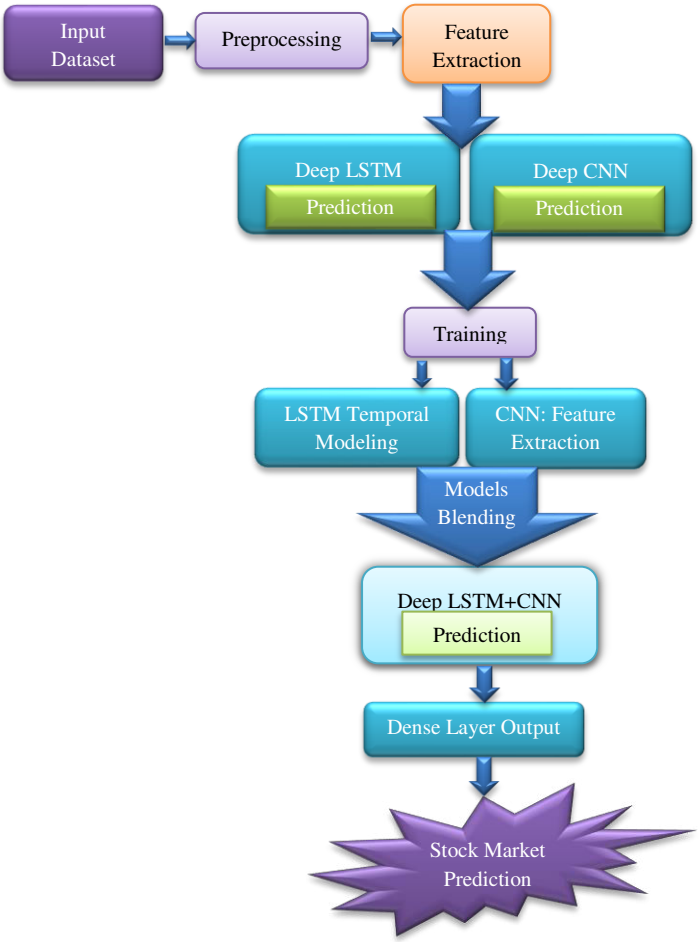

Figure 1.3: Process flow of Proposed Blend Approach for Stock Market Prediction

Through the amalgamation of CNNs' competencies in feature extraction and LSTMs' strengths in temporal modeling, the hybrid technique holds promise for enhancing the precision and resilience of stock market prediction systems Figure 1.3 depicts the process flow of proposed blend approach for stock market prediction. To get the best outcomes, it is crucial that you properly structure the architecture, preprocess the data, and adjust the model's parameters.

IV. CONCLUSION AND FUTURE WORK

Upon an investigation of learning models, including CNN, LSTM, and an amalgam of LSTM and CNN models, models for predicting future stock values are introduced using data from NSE-listed businesses. This demonstrates the plan's ability to identify relationships from the data. Furthermore, the outcomes demonstrate that the LSTM + CNN model combination is capable of identifying model modifications. The novel method, which combines CNN and LSTM, is deemed the best model for the projection method. It uses data provided for a specified time period to create

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predictions. Despite the fact that several LSTM and CNN models are employed in numerous real-time data analytics, this model is not more effective than the LSTM + CNN architecture combined.

Due to the stock market's rapid fluctuations, the market does not always undergo constant change or follow a set pattern. A model's lifetime and duration will differ depending on the firm and industry. By analyzing these cycles and patterns, investors can achieve more profitable outcomes. To increase the accuracy of stock price prediction, we will compare more models and integrate more stock market data in our upcoming work. In the future, more detailed and varied data can be used to train the model for improved accuracy. Additionally, a new hybrid model can be created by combining the recommended algorithms with additional ones.

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