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A Deep Learning Framework for Stock Price Prediction Using LSTM And CNN Models

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Abstract

Researchers have explored many ways to estimate the cost of a good business. The purpose of economic forecasting is to estimate the future value of the organization's financial products. Effective forecasting techniques allow investors to better understand data such as future trends. Investors can also benefit from future market analysis. The purpose of market forecasting is to estimate the future value of the financial institution's shares. One way is to use machine learning algorithms to make predictions. Machine learning uses different models to make predictions easier and more accurate. The main purpose of this article is to improve the quality of use of assets to predict the output of products. Many researchers have proposed many ways to solve this problem; Most of these are traditional methods, such as neural networks used to predict the stock market, which allow the model to hide and separate information. This article offers a different approach to estimating operating costs. It is not possible to fit the data into a specific model, we use machine learning architecture to identify the latest events on the device. In this paper, we use machine learning architectures Long Short Term Memory (LSTM), Convolutional Neural Network (CNN) and hybrid approach of LSTM + CNN to predict the value of companies listed on NSE and differentiate their performance. In the long term, the hanging window approach is adopted and performance is evaluated using the root mean square error.

Keyword:-Stock market, prediction, financial stock, convolution neural network , hybrid approach etc

I. INTRODUCTION

A stock market is a place where stockbrokers, traders and investors come together to sell, buy or share stocks. There are many companies in the market that offer listings, making their products attractive to investors. Starting from the beginning of the 16th century, investors began to try many strategies to obtain information about different companies in order to get a return on their investments[1]. It plays an important role in the economic development of developing countries like India. Demand is increasing in the stock market. It is known to stand out with its best results over the years. A huge amount of wealth is bought and sold in the stock market every day, which is why the stock market is considered one of the most profitable resources. Now the stock market has become one of the features that show the economy of a country. Many people have invested a lot of money in the stock market, but sometimes they will suffer huge losses because they trust investors who advise investors based on principles, technology and working hours. Business people are struggling to find a smart strategy to overcome these problems.

The reason why price prediction works is that it is necessary to predict the stock price. The main idea of stock price forecasting is to accurately predict future financial results. Over the past few years, machine learning algorithms are considered to have achieved good results in many industries and hence many traders have used this technology in their operations. Machine learning can be a game changer. This article conducts some experiments using different machine learning to predict the opening price of American Airlines shares. The machine learning (ML) algorithms we use are Random Forest (RF), Decision Trees (DT), Support Vector Regression (SVR) and Artificial Neural Networks. The stock market is one of the most popular investments due to its high returns. As the level of business and investment evolves, people look for ways and means that can increase returns while reducing risk. Two stock exchanges, the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE), are where most of the transactions in the Indian stock market take place. Sensex and Nifty are two popular indices in the Indian market. Stock market forecasting is complex because stock market prices are dynamic.

II. LITERATURE SURVEY

Stock Price Forecasting Using Data From Yahoo Finance and Analysing Seasonal and Nonseasonal Trend:
Publication Year: 2018
Author: Jai Jagwani, Hardik Sachdeva, Manav Gupta, Alka Singhal[2]
Journal Name: 2018 IEEE

Summary: Determining the relationship between existing time series algorithms (ARIMA and Holt Summer) and stock prices is the main goal of the investment planning process. It was found that the accuracy of the gender model was improved by analyzing risk-free products. In order to find the main results for the stock market, the combination of two different periods of the analytical model was chosen by creating prices for the consumer market. The main advantage of these models is that they are not complex in nature and predict the price based solely on historical non-seasonal stock prices or seasonality. Some limitations in this experiment are that the study did not take into account other factors such as news about new business ideas or media related to any company that would affect the stock price.

Stock Market Prediction Using Machine Learning:
Publication Year: 2018
Author: Ishita Parmar, Ridam Arora, Lokesh Chouhan, Navanshu Agarwal, Shikhin Gupta, Sheirsh Saxena, Himanshu Dhiman[3]
Journal Name: 2018 IEEE
Summary: The research of this article used machine learning-based regression and LSTM to predict stock prices. Indicators include opening price, closing price, low price, high price and volume. This article attempts to use machine learning techniques to increase accuracy and confidence in determining the future price of a company's stock. The LSTM algorithm achieves better and more accurate results in predicting stock prices.

Multi-Category Events Driven Stock Price Trends Prediction:
Publication Year: 2018
Author: Youxun Lei, Kaiyue Zhou, Yuchen Liu[4]
Journal Name: 2018 IEEE
Summary: In this paper used multiple media groups as features to develop the competitive pricing model. Many activity categories are based on dictionary definitions of certain words. We use both neural network and support vector machine models to analyze the relationship between market prices and news-specific variables. Experimental results show that predetermined multicategory news events provide greater improvement in predicting stock prices than buzzwords. Short-term predictions based on this research are better compared to long-term predictions.

Share Price Prediction using Machine Learning Technique:
Publication Year: 2018
Author: Jeevan B, Naresh E, Vijaya kumar B P, Prashanth Kambli [5]
Journal Name: 2018 IEEE
Summary: This article is mainly based on a method of predicting stock prices using short-term memory (LSTM) and recurrent neural networks (RNN) using various factors such as current market prices. This and price data to predict the stock price of NSE. situation. Check your model's performance by comparing actual and predicted data using RNN graphs. Machine learning predicts stock prices because the model is able to predict stock prices close to the real price, the model captures detailed information and uses different strategies for prediction. Model training for all NSE data retrieved from the internet, identify and group ideas, and provide ideas based on user settings. The backpropagation mechanism aggregates and groups data to avoid mixed data.

Stock Market Prediction Using Machine Learning Techniques:
Publication Year: 2016
Author: Mehak Usmani, Syed Hasan Adil, Kamran Raza, Syed Saad Azhar Ali[6]
Journal Name: 2016 IEEE
Summary: The main objective of this study is to predict the market performance of Karachi Stock Exchange (KSE) during market closing using machine learning algorithms. By using the forecasting model to predict various attributes based on the material and predict the good and bad aspects of the job. Factors used in the model include oil prices, gold and silver prices, interest rates, foreign exchange (FEX) prices, news and social media. Machine learning algorithms such as single-layer perceptron (SLP), multilayer perceptron (MLP), radial basis function (RBF), and support vector machine (SVM) are compared. The Multilayer Perceptron MLP algorithm shows the best performance compared to many methods. The most important thing to predict is the oil price. The final results of this study confirm the ability of machine learning to predict market activity. Machine learning's multilayer perceptron algorithm predicts market performance by 70%.

Forecasting stock price in two ways based on LSTM neural network:
Publication Year: 2019
Author: Jingyi Du, Qingli Liu, Kang Chen, Jiacheng Wang[7]
Journal Name: 2019 IEEE
Summary: LSTM neural network is used to predict Apple stocks by consuming single feature input variables and multi-feature input variables to verify the forecast effect of the model on stock time series[7]. The experimental results show that the model has a high accuracy of 0.033 for the multivariate input and is accurate, that is in line with the actual demand. For the univariate feature input, the predicted squared absolute error is 0.155, which is inferior to the multi-feature variable input.

Share Price Trend Prediction Using CRNN with LSTM Structure:
Publication Year: 2018
Author: Shao-EnGao , Bo-Sheng Lin ,Chuin-Mu Wang[8]
Journal Name: 2018 IEEE
Summary: All financial markets are generally dominated by stock markets, and one of the most important scientific problems is the prediction of exchange rate prices. Use historical data to predict future market prices and do in-depth study to find the estimated value of stock prices mentioned in this article. This paper not only collects historical data for the specified time, but also predicts the future market price by developing a neural network, because products are often influenced by previous information on stock prices. The neural network proposed in this article uses a convolutional recurrent neural network (CRNN) with effective memory and short-term memory (LSTM) as key components to improve Long-term dependence on traditional RNN. At the same time, improving the prediction accuracy and stability of the RNN LSTM architecture. This article collected historical data of 10 products for testing and obtained an average error of 3,449 RMSE.

Applying Long Short Term Memory Neural Networks for Predicting Stock Closing Price:
Publication Year: 2017
Author: Tingwei Gao, Yueting Chai, Yi Liu [9]
Journal Name: 2017 IEEE
Summary: The main goal of this paper is to evaluate a strategy that combines RNN with different input data and can provide an improved and effective way to predict the next day's work. The predictive model uses long-term memory (LSTM) and simple business data for analysis. Research data is based on Standard & Poor's (S&P500) and Nasdaq. Using next-day estimates can better predict closing costs than comparable models. This is the main point of this investigation. They tested five different models such as Moving Average (MA), Exponential Moving Average (EMA), Support Vector Machine (SVM) and LSTM to demonstrate the effectiveness of the system. The next day's closing price is the target estimate.

Stock Price Prediction Based on Information Entropy and Artificial Neural Network:
Publication Year: 2019
Author: Zang Yeze, Wang Yiying[10]
Journal Name: 2019 IEEE
Summary: [One of the most important parts of the financial system is the store.To support these activities and growth, investors bring money into the relevant business. A machine learning architecture is created by combining information theory and artificial neural networks (ANN). This method creatively uses the entropy information of nonlinear causality and stock correlation and is also useful for neural network time series models. Check out what this learning machine has to offer at Amazon, Apple, Google and Facebook prices. This paper introduces a time correlation method based on information theory and LSTM to model stock price dynamics. The entropy change of relevant correlations that helps in LSTM time prediction is incorporated into the model design, so that the accuracy of the prediction is widely recognized. The market price pattern is closely related to the actual market price, but differs slightly in the mean error (MAE) and root mean square error (RMSE) of the search result.

III. IMPLEMENTATION

IV. Algorithm of LSTM Model

Product price prediction through machine learning now allows predicting the future price of the product and existing tasks can be performed using machine learning such as LSTM. This machine learning algorithm is designed to make the best possible predictions of future stock prices. LSTM is able to detect changes in stock price during the time period specified in this quote. Proposed the standardization of stock price prediction based on machine learning [3]. The data used for the analysis was selected by Yahoo Finance. It contains approximately 900,000 records of stock prices and other related information. The data shows the price of the stock at a specific time for each day of the year. It contains various information such as date, symbol, opening price, closing price, lowest price, highest price and trading volume. Only information about one company is taken into account here. All data is provided as CSV formatted files, which are first read and converted into data frames using the Pandas library in Python. The data is normalized by the sklearn library in Python and split into a training set and a testing set. The experimental set was kept at 20% of the available data. This article focuses on two modeling approaches: Regression Based Model and LSTM. Regression-based models are used to predict continuous values given some control parameters. The LSTM architecture is able to detect obvious changes in the results. LSTM is considered the best model for planning. This shows that the proposed method can identify some interactions in the data. The same cycle in the stock market may not always be followed or progress regularly. The length of existence will vary and the existence of the model depends on the company and business. The type of diversification and evaluation cycle will be more profitable for investors. We should use networks like LSTM because they rely on up-to-date data to analyze a lot of data.

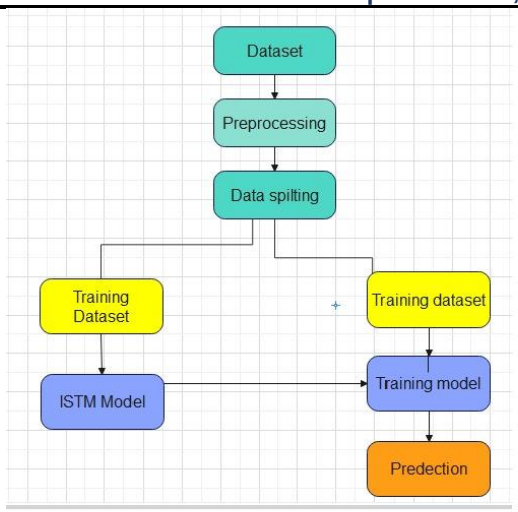

Figure 3.1: Algorithm of LSTM Model

B. Working of LSTM Model

Description:

Short-term memory is a neural network. In RNN, the output of the last step is used as the input of the current step. It solves the problem of long-term dependence of RNNs, where RNNs do not predict words held in long-term memory but can provide more accurate predictions based on recent data. As the length difference increases, RNN cannot maintain balance. LSTM stores long-term information by default. It is used for processing, prediction and classification based on runtime data like CNN[3].

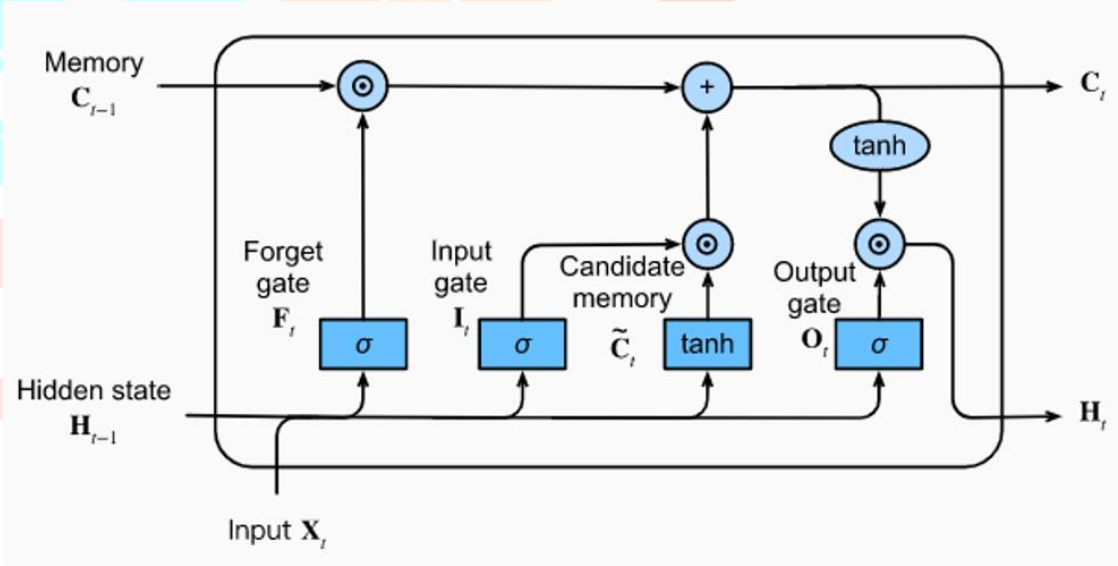

Figure 3.2: Working of LSTM

Layer of CNN Architecture:

1. Convolutional Layer (Convolution): This layer applies the convolution function to the input and passes the result to the next layer. Convolutional layers are responsible for analyzing features in the input data. By sliding a small window, called 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 operation that minimizes the residuals of each specified map. It works by splitting the input into a series of non-overlapping rectangles and extracting the maximum value for each subregion. This will help reduce computational complexity and control overfitting.

3.Dropout Layer (Dropout): Dropout is a regularization technique used to prevent overfitting of neural networks. During training, some of the input units are randomly set to zero with a certain result, thus "halting" part of the network. This forces the network to learn the vulnerabilities of devices, making it more robust.

4.Flatten Layer (Flatten): This layer converts the output of the previous process into an array (vector) that can be input into the full (condensed) process. It actually flattens the multidimensional output into a one-dimensional array.

5.Dense Layer (Fully Connected Layer): Dense layers, also known as fully connected layers, are the traditional neural network layers where each neuron is connected to every neuron in the preceding layer. These layers perform transformations on the input data using learned weights and biases.

6.Activation Function: This is not a layer per se, but a partial application after a density or convolution layer to introduce nonlinearity into the network. Activation methods include ReLU (rectified linear activation), sigmoid, and tanh. They allow the model to gain information about relationships in the material by introducing nonlinear features.

C.Hybrid Approach of LSTM + CNN

A hybrid approach combining Long Short-Term Memory (LSTM) and Convolutional Neural Network (CNN) for stock market prediction can leverage the strengths of both architectures. Here's how such an approach might work:

1.Data Preprocessing:

- Preparing the stock market data, including historical prices, volumes and other relevant features.
- Normalize or scale the data to ensure that all features are on a similar scale, which helps the model converge faster

2. CNN for feature Extraction:

- Use a CNN architecture to extract spatial and temporal features from the raw input data.
- The CNN layers can capture patterns and relationships within the input data, which can be beneficial for time series analysis.

3. LSTM for Temporal Modeling:

- After feature extraction with CNN feed the output to LSTM layers.
- LSTM is well suited for 146odelling sequential data such as time series due to its ability to capture long –term dependencies and remember information over extended time periods.
- LSTM layers can capture the temporal dynamics of stock market data, including trends seasonality and other 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.
- This merged representation captures both local and global patterns in the data, enhancing the models predictive capability.

5. Dense Layers and Output:

- After combining 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:

- Train the hybrid model using historical stock market data, employing techniques such as back propagation and gradient decent.
- Validate the model's performance using a separate validation set and evaluate metrics like mean Absolute Error , Mean squared error or others relevant to your prediction task.
- Fine tune hyper parameters, architecture and training parameters to optimize the model's performance.

7.Testing and Deployment:

- Once satisfied with the model's performance test is on unseen data to assess its generalization ability.
- Deploy the hybrid LSTM-CNN model in a production environment for real –time or batch predictions on new stock market data.

By combining the strengths of CNNs in feature extraction and LSTMs in temporal modeling, the hybrid approach can potentially improve the accuracy and robustness of stock market prediction systems. However it's essential to carefully design the architecture preprocess the data and tune the model parameters to achieve the best results.

IV. CONCLUSION AND FUTURE WORK

After comparing learning models such as LSTM model, CNN model and hybrid approach of LSTM + CNN model, like to use data of companies listed on NSE to introduce models for predicting future stock prices. This shows that the plan can distinguish relationships with the data. Moreover, it can be seen from the results that the combination of LSTM + CNN model can identify the changes in the model. For the projection method, the hybrid method consisting of LSTM + CNN is called the best model. It makes predictions using data given for a specific period of time. Although other models of LSTM and CNN are used in many other real-time data analyses, this model does not work better than the combination of LSTM + CNN architecture. Because of rapid changes in the stock market. Changes in the market are not always continuous and do not necessarily follow a sequence. The lifespan and duration of a model will vary by company and business. Analysis of these cycles and patterns can provide investors with more profitable results. In our future work, we will add more stock market data and compare more models to improve the accuracy of stock price prediction. In the future, for better accuracy model can be trained with more varied and detailed data. Also, other algorithms along with proposed can be used to create a new hybrid model.

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