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Research Paper

Simulation Based Exploration of Stock Market Using LSTM Model

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Abstract: In today's world the stock market has a huge impact on the economy making it difficult for stock market investors to predict stock prices. Financial market investors cannot use simple models to more accurately predict stock prices to invest in stocks. Deep learning helps computer to solve complex problems which humans takes more time to solve. This paper is based on developing a model to predict inventory value using **recurrent neural network (RNN)** and **long- short term memory model (LSTM).**

Keywords: Stock Market, Predicting, LSTM Model, RNN Model, Prices, Complex Data, Density

1. Introduction

Forecasting different prices of stocks is a very challenging and important task for financial institutions and private investors. Many researchers have proposed a large number of forecasting models to properly reduce investment risks and obtain stable investment returns [1].

Big data application technologies especially the application of machine and deep learning into finance has a huge impact on investors due to rapid growth. Low frequency and high frequency data are two types of data that can be used for research [2].

This paper has been organised into following parts:
Section 2 Contains Literature Review, Section 3 contains Methodology, Section 4 contains Result and Discussion Section 5 contains Conclusion and Section 6 contains References.

In recent years many scholars have used machine learning techniques such as hierarchical statistical methods of multi-core learning neural networks and deep learning to analyse and predict stock prices. Although many algorithms achieve good end results in some aspects, different parameter structures and data selection challenges in machine learning applications remain important research topics [3].

2. Literature Review

According to this paper the deep learning system which by the help of history of a particular stock listed on NASDAQ and gives the proper prediction of the stock. Model of this kind has been utilising the data of every possible smallest value and making an estimate to get correctly the next value of any particular stock [1].

The following features are included in the prediction using LSTM Model so that we can get the closest possible value to the actual value in the market of a particular stock, And also this approach helps to maximise the profit by buying and selling the stock according to the data shown by the model [2].

This research paper helps us to predict the stock price based on convolutional neural networks, which has a capability of learning on its own. This dataset is tested which relates the behaviour between Convolutional Neural Networks and the US stock market. Result of this model shows that it can effectively recognize the un-patterned stock price forecast. The accuracy of this model is about 90% and we can apply this model in the field of finance also [3].

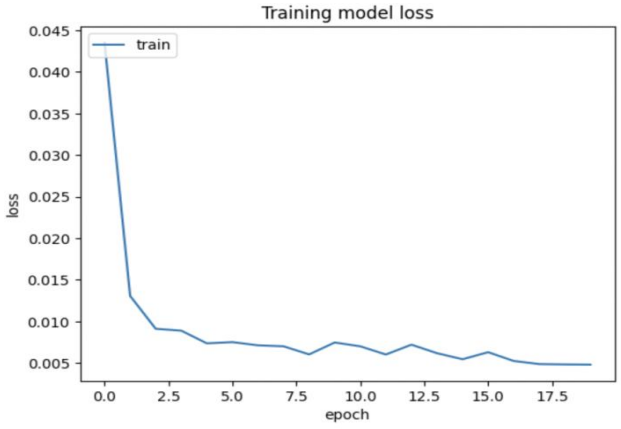

Figure 1 - Training of the Dataset

Long-term memory (LSTM) is a useful tool for working with statistics. Time series data includes stock price data. For these reasons many scientists use LSTM to analyse and predict stock values. Many studies have investigated the correlation between time series data and the results show that LSTM has a competitive advantage in this field. Researchers had used LSTM to estimate symbolic unit segmentation in the literature and experimental results have demonstrated the effectiveness of LSTM. LSTM is a reasonable fit as trend analysis of time series data can be used as an alternative to forecasting time series data [4].

Figure 2 - Stock Market at Different Point of Time

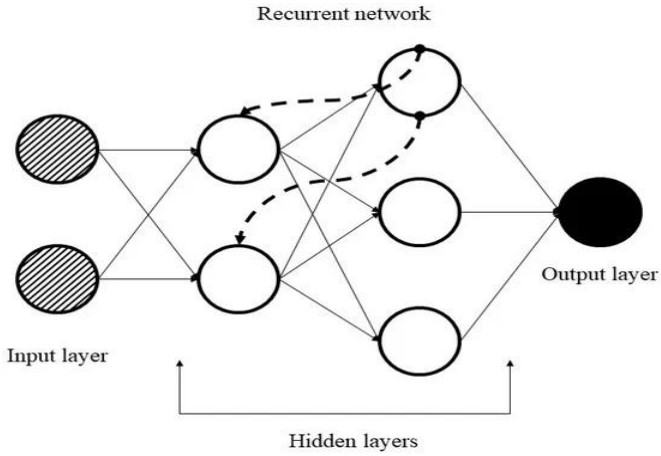

Figure 3 - shows structure of RNN.

LSTM is a particular type of RNN with several uses, including speech and voice recognition, document classification, time series analysis, and LSTM. RNN predictions, in contrast to feed forward ANN forecasts, rely on prior estimations. Since RNNs have a few flaws that make evaluations problematic, they are not frequently used in practice. Every neuron in LSTM is a memory cell, which distinguishes it from RNN. The LSTM connects the previous knowledge to the active neuron [5].

3. Methodology

Research Framework: LSTM is a specialised version of RNN to solve out-of-memory problems. RNN, LSTM, and CNN are three different deep learning architectures that we used for this assignment. When a prediction is necessary, such as when anticipating the next one, RNN are employed since all their inputs and outputs are independent of one another [1].

You need to remember the previous word because you need the previous word in the sentence. RNNs have a memory where they store all the information about what they are computing. It has been using the same points for each input because it does the same thing and produces output on all inputs or hidden layers. It reduces the complex nature of parameters. Fundamental analysis language processing on the other hand is mainly used to analyse financial news and financial reports of companies to predict long-term stock price trends [2].

Formula for Calculating Current Form:
HT= f(Ht-1, Xt)
HT = present for
HT-1 = Last Form XT =input Form
Activision Function(tanh) Formulas HT=tanh (Whh (HT-1)+ Wax) WHH=weight at recurrent
WXH = weight at input
Calculation Formulas:
YT = Why (HT)
YT = output
Why = weight at output layer

Neural Network Techniques:
We are going to take the dataset of google price, after using the LSTM model we will predict the stock's price.
Dataset:
We have train data of Google stock price US Stock Market Trend from 2012 to 2016 and we are using a test set of 2017.Our dataset contains 1259 rows and 6 columns.
Attributes in our datasets are:

Date: Date on which the stock traded.
Open: Initial price of stock on that day.
High: Stock's maximum price.
Low: Stock' lowest price.
Close: Last moment price of Stock.

In the data pre-processing part we import 3 libraries. We use the Numpy and Pandas library reading the data of stock prices at different date and time and mat-plot library for plotting the graph [2].
After training the dataset we will use Feature Scaling for Data Pre-processing. We use Normalisation as for Google's Stock Price Prediction we use the concept of LSTM Model in which there are many sigmoid functions as an activation function (which is 0 or 1) [3].
Normalisation = X(norm) = x-min(x)/max(x)-min(x)

Then we reshape our data as our data input has 2 dimensions. In which first we have to observe and second helps in converting our data into Three dimensional. The last 1 defines the time step because our input isY and output is Y+1.so, Y+1- Y=1.so the observation is 1257and,1=time step,1= feature scaling [4].

After that with the help of the imported libraries we built the RNN Model. After this with help of Keras Library we built a deep neural network and then were to trieve 3 modules from Keras. In which the first module helps us in initialising our

model whose name is Sequential and another model named as Dense which helps us in appending different layers of RNN and LSTM for using the model of RNN [5].

Then we will make the Prediction and Visualise our Result. After that we will Predict the Next Day Stock Price.

Table 1 - Our Target and Prediction for Google using LSTM Model

Date	Target	Predictions
2003-11-14 00:00:00-05:00	0	0.0
2003-11-17 00:00:00-05:00	0	1.0
2003-11-18 00:00:00-05:00	1	1.0
2003-11-19 00:00:00-05:00	0	0.0
2003-11-20 00:00:00-05:00	1	1.0
...	...	...
2022-11-09 00:00:00-05:00	1	0.0
2022-11-10 00:00:00-05:00	1	0.0
2022-11-11 00:00:00-05:00	0	0.0
2022-11-14 00:00:00-05:00	1	0.0

By using this table we are trying to show how many times our predictions have gone right or wrong.

These are the values at different dates and the same slot of time in which the market is open for investment and trading. If the value of the Target and the Prediction is same then our output is exactly the same as we predicted before otherwise our prediction for that instance is wrong [6].

4. Result and Discussion

With the help of this Machine Learning Model we are getting an accuracy of around 97.6635 % [1].

Company	MAPE
Google	18.32
Apple	19.67
Tesla	23.43

This Machine Learning model is helping us to predict the Open Value of the day and Closing value of the day for any given Stock listed into the Share Market. In this model with the LSTM model, our algorithm holds all the Open and Closing value of any given stock into the Long Memory for 30 days and after that these values got transferred into the Short-Term memory where our algorithm erases these values automatically [2].

In this paper we took the past 30 Days stock price of Google and predicted our stock price for 31st Day.

Figure 4 - shows our output of what we predicted and what the actual price was.

We got this output for Google stock of google with the help of MAPE (Mean Absolute Percentage Error).
The Formula is:

$$\text{MAPE} = \frac{1}{n}\sum\left(\frac{|Actual - Forecast|}{|Actual|}\right)$$

Here the Actual Values are the values which we got from the market and Forecast Values are the values which we predicted with the help of LSTM model [3].
The MAPE Values can be different for different companies listed into the market. For example: we calculate MAPE values for Google, Apple, and Tesla using the above given formula. And this is what we got [4].

Table 2 - Shows MAPE values calculated for Google, Apple, Tesla using LSTM Model

The Greater the values of MAPE the less is the chance of our model to calculate the odds and predict the values i.e the Stock price.

6. Conclusion and Future Scope

Here proposed is a self-learning LSTM model for the prediction of the prices of any Stock. We were able to train our model with help of the data of google stocks to predict the stock price for the google [1].
We took the past 30 days of stock opening and closing price and with the help of a neural network and LSTM model we predicted the price of the stock for 31st day [2].
For this we got our dataset containing values for the past 3 months using Yahoo Finance. In this we first analysed our dataset manually that it is either increasing or decreasing trend and then we feed our algorithm with this data as it is now slightly helpful for algorithms to predict the prices [3].
Our model can be used by financial institutions, day to day traders and long-term investment firms and individuals who want to learn about stock market and want to make profit in it [4].

Some of the Limitation of this LSTM backed Stock market prediction model is that here we took only 30 days of past data but if we take more than this data packet than our model will be overfitted. So we have to make an algorithm that can process more data [5].

Higher number of data packets that is analysed that more accurate our prediction will be.

This LSTM Model based prediction can be more accurate if we use more precise model were we can compute more data than this model [6].

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