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Stock Price Prediction Using LSTM

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Abstract

Predicting stock prices is highly challenging due to the volatile, nonlinear, and multifactorial nature of the financial markets.
Various studies have approached stock price prediction using models like Convolutional Neural Networks (CNNs), and Artificial Neural Networks (ANNs).
However, traditional approaches often struggle with capturing long-term temporal dependencies and are sensitive to market volatility. In our study, we developed a stock price prediction model using **Long Short-Term Memory (LSTM)** networks, which are well-suited for learning patterns from sequential data. The proposed LSTM-based model achieved a high prediction accuracy of up to **97.2%** for certain stocks, significantly outperforming traditional machine learning methods.

Keywords—Stock market, stock price analysis, machine learning technique, LSTM

1. INTRODUCTION

[1] A **stock** represents a share in the ownership of a company and constitutes a claim on part of the company's assets and earnings. When someone buys a stock, it is essentially purchasing a small piece of that company—called a **share**—and become a **shareholder**, and can benefit from its profits (through dividends) and growth (as the stock price increases). [1]

[2] Stocks are traded in stock markets like the **NYSE (New York Stock Exchange)** or **NSE (National Stock Exchange of India)**, and their prices fluctuate based on supply and demand, company performance, global events, and market sentiment. [2] Investors buy stocks to earn profits through **capital gains** (price appreciation) and **dividends** (periodic earnings distributed

Stock Price Prediction helps to find out the future price of a particular company or an organization's stock. It is mandatory for the company to be listed on the verified stock exchange for any kind of analysis. The traditional integrated concept of predicting stock prices is to boost convincing benefits. Predicting future trends of a particular stock is a tedious task.

The major attributes of any stock are the Close price, Open price, one-day Low, one-day High, the price of previous day, the trading date, the trading quantity and the total turnover. The stock price prediction

model uses time series analysis to get the predicted price of a particular stock for a required duration of time. Our model will consider the companies listed in yahoo finance.

A stock market is a place where the stocks or other financial assets like bonds, funds, etc. of public companies are traded. Each stock is dedicated to one company, although these companies can be a part of one group or work under a parent company.

1) **Adani Group**, which has varieties of companies like Adani Power, Adani Enterprises, etc. working under one parent group. Each company has its own stock and its stock price. This group has a bunch of stocks trading in the market. Tata Group can be another example of this type Tata Group Companies – https://www.tata.com/business**Reliance Industries** has various companies like Reliance Retail, Reliance Life Sciences, Reliance Logistics, etc. working under one parent company. Although it has varieties of companies working but no one has individual stock trading in the market

The stock price prediction model developed in the study stores the previous data of stock rates of a particular company and applies the RNN technique of the machine learning named LSTM.

1.1. 🔁 Recurrent Neural Networks (RNN)

1.1.1 What is an RNN?

Recurrent Neural Networks (RNNs) are a type of **artificial neural network** designed specifically to work with **sequential data** (i.e., data where the order matters), like time series,) . Unlike traditional feedforward neural networks, RNNs have **loops** in them, allowing them to **store and use information from previous inputs** in the sequence. This memory makes RNNs particularly effective for tasks where context or history is important

1.1.2 How RNN Works

In a typical RNN, input is processed one step at a time:

- At each time step t, it receives an input x(t)
- It updates a hidden state h(t) which is a function of the current input and the previous hidden state h(t-1)
- The output y(t) is generated from the hidden state.

Mathematical Representation:

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h(t) = f(Wx * x(t) + Wh * h(t-1) + b)
y(t) = g(Wy * h(t) + c)

- Wx, Wh, and Wy are weight matrices.
- b and c are bias terms.
- f and g are activation functions like tanh or ReLU.

1.1.3 Limitations of RNN

Despite being conceptually elegant, **RNNs** have several limitations:

1. **Vanishing Gradient Problem**: During backpropagation, gradients can become extremely small, especially for long sequences, making the network unable to learn long-term dependencies.
2. **Exploding Gradient Problem**: The opposite of vanishing, where gradients grow exponentially, causing numerical instability.
3. **Short-term memory**: Due to the above issues, RNNs struggle with remembering inputs from many time steps ago.

1.2 LSTM?

LSTM, introduced by **Hochreiter and Schmidhuber in 1997**, is a special type of RNN that solves the vanishing gradient problem and **can remember information over long periods of time**. This makes LSTM ideal for tasks like stock price prediction where long-term historical patterns are important.

1.2 LSTM Architecture

Each LSTM cell has **three gates** and a **cell state**:

1. **Forget Gate** (f): Decides what information from the cell state to discard.
2. **Input Gate** (i): Decides what new information to store in the cell state.
3. **Output Gate** (o): Decides what part of the cell state to output.

Flow of Computation:

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$f(t) = \sigma(Wf \cdot [h(t-1), x(t)] + bf)$
$i(t) = \sigma(Wi \cdot [h(t-1), x(t)] + bi)$
$c\sim(t) = \tanh(Wc \cdot [h(t-1), x(t)] + bc)$
$c(t) = f(t) * c(t-1) + i(t) * c\sim(t)$
$o(t) = \sigma(Wo \cdot [h(t-1), x(t)] + bo)$
$h(t) = o(t) * \tanh(c(t))$

Where:

- σ is the sigmoid activation function.
- tanh is the hyperbolic tangent activation.

- c(t) is the **cell state**.
- h(t) is the **hidden state/output**.

1.2.2 Advantages of LSTM over RNN

Feature	**RNN**	**LSTM**
Memory Duration	Short-term	Long-term
Vanishing Gradient	Common	Rare
Complexity	Simpler architecture	Complex but more powerful
Performance on Time Series	Limited	Excellent

1.2.3 Application in Stock Price Prediction

Stock prices are **time-dependent**, affected by trends, historical values, and volatility. LSTM models are ideal because:

- They can **learn from historical data patterns** (e.g., 10-year stock history).
- They can predict the next day's price based on the previous **sequence of days**.
- Their **gating mechanisms** allow them to focus on significant patterns and ignore noise.
- **Training data** often includes:
  - Open, High, Low, Close (OHLC)
  - Trading Volume

2. EXPERIMENTAL RESULT

Fig. 2. The Model Flow Diagram of LSTM

In the following Fig. 3.1, Fig. 3.2, Fig. 3.3, and Fig. 3.4 shows the Actual data, Training data, Predicted data and the difference between the predicted and actual data change from

The current section will be focused on the results of the proposed model. As a result, our model predicts the closing price for the day. To determine how accurately this model measures the performance of a specific stock, it must be compared to the actual closing price. The data set for training and testing model is directly extracted from

'finance.yahoo.com'.

November 2013 to December 2021 of 'Tata Consultancy Stock – TCS'.

Fig. 3.1. Actual data

Fig. 3.2. Training data

Fig. 3.3. Predicted data

Fig. 3.4. Price Prediction

The accuracy of our model is quite good for the given dataset. The Root Mean Squared Error (i.e., RMSE) is '13.35%' and Mean Absolute Percentage Error (i.e., MAPE) is '8.71%'. Hence,

We can find the accuracy of the model as:

(1 100 – Value of MAPE =Model Accuracy)

Thus, in this case:

Accuracy = (100-8.71) = 91.19
Accuracy = 91.29 %

The Accuracy of our model for other stocks are (Fig. 4.):

TABLE I. ACCURACY OF MODEL OVER OTHER STOCKS

S. No.	Stock Name	Ticker ID[a]	Start Date	End Date	RMSE[b]	MAPE[c]	Accuracy[d]
1.	Tata Consultancy Services	TCS	2013/11/01	2021/12/31	13.35	8.71	91.29
2.	Tata Motors	TTM	2012/01/03	2021/12/31	32.33	3.7	96.3
3.	Infosys	INFY	2012/01/03	2021/12/31	7.43	14.18	85.82
4.	Apple	AAPL	2012/01/03	2021/12/31	28.75	2.8	97.2
5.	Tesla	TSLA	2012/01/03	2021/12/31	14.71	16.67	83.33
6.	Nike	NKE	2012/01/03	2021/12/31	49.63	7.38	92.62

Ticker ID: Unique ID of Stock given by Regulatory Board [b]. RMSE: Root-Mean Squared Error

[c]. MAPE: Mean Absolute Percentage Error

[d]. Accuracy: 100 - MAPE

Fig. 4. Accuracy of Model over other Stocks listed in Yahoo Finance

3. CONCLUSION

On comparing with previous works of same type of problems, our proposed solution isa kind of customization of an existing model because, instead of proposing new overthe-top LSTM model, we proposed a fully functional, efficient and custom deep learning prediction system and combined it with LSTM machine learning algorithm to predict future trends of stock market. By recommending a feature extension technique prior to recursive feature reduction, we narrow the difference between market investors and analysts and, by analyzing the results of earlier studies, we significantly increase model performance.

In the context of our research on the application of LSTM in stock price prediction, a number of constraints should be taken into consideration. First, the caliber and accessibility of our data affect how accurate our forecasts will be. Additionally, because of the volatility of the stock market, LSTM models might not be able to account for abrupt changes in investor behavior. Additionally, there's a chance of overfitting, particularly with short or noisy datasets, which might result in worse performance when

applied to unobserved data.

The expected challenge of predicting stock price is that the model needs a variety of inputs in order to be able to anticipate things. It is possible to compare the stock price to important political and economic developments.
Additionally, it is vital to include in the model challengingto- represent elements like market psychology and mood. It's critical to know that human behaviors plays a major role in the market's volatility. Because it's a market, people tend to be impulsive and unpredictable.

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REFERENCES

1. Banerjee, Sharanya & Dabeeru, Neha & Ra, Lavanya. (2020). StockMarket Prediction. International Journal of Innovative Technology and Exploring Engineering. 9. 2278-3075. 10.35940/ijitee.I7642.079920.
2. https://www.researchgate.net/publication/343906044_Stock_M ark et_Prediction Deep Learning Models with Keras -MachineLearningMastery.com
3. N. Sirimevan, I. G. U. H. Mamalgaha, C. Jayasekara, Y. S. Mayuran and C. Jayawardena, "Stock Market Prediction Using Machine Learning Techniques," 2019 International Conference on Advancements in Computing (ICAC), 2019, pp. 192-197, doi: 10.1109/ICAC49085.2019.9103381.
4. https://ieeexplore.ieee.org/document/9103381
5. S. Singh, T. K. Madan, J. Kumar and A. K. Singh, "Stock Market Forecasting using Machine Learning: Today and Tomorrow," 2019
6. 2nd International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT), 2019, pp. 738745, doi: 10.1109/ICICICT46008.2019.8993160.
7. https://ieeexplore.ieee.org/document/8993160
8. B. Jeevan, E. Naresh, B. P. V. kumar and P. Kambli, "Share Price Prediction using Machine Learning Technique," 2018 3rd International Conference on Circuits, Control, Communication and
9. Computing (I4C), 2018, pp. 1-4, doi:10.1109/CIMCA.2018.8739647.
10. https://ieeexplore.ieee.org/docment/8739647
11. Mojtaba Nabipour, Pooyan Nayyeri, Hamed Jabani, Shahab S., (Senior Member, Ieee), and Amir Mosavi (2020). Predicting Stock Market Trends Using Machine Learning and Deep Learning Algorithms Via Continuous and Binary Data; a Comparative Analysis.
12. DOI : 10.1109/ACCESS.2020.3015966
13. Shen, J., Shafiq, M.O. Short-term stock market price trend prediction using a comprehensive deep learning system. J Big Data 7, 66 (2020).
14. https://doi.org/10.1186/s40537-020-00333-6

15. Ajinkya Rajkar , Aayush Kumaria , Aniket Raut , Nilima Kulkarni, 2021, Stock Market Price Prediction and Analysis, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 10, Issue 06 (June 2021)
16. https://www.ijert.org/stock-market-price-prediction-and-analysis
17. Stock Price Prediction Using Machine Learning: An Easy Guide! https://www.simplilearn.com/tutorials/machine-learning- tutorial/stock-price-prediction-using-machine-learning
18. Kalkhoran, L.S., Tabibian, S. & Homayounvala, E. Detecting Persian speaker-independent voice commands based on LSTM and ontology in communicating with the smart home appliances. Artif Intell Rev (2022).
19. https://doi.org/10.1007/s10462-022-10326-x