Educational Administration: Theory and Practice
2024,30(5), 1340-1346
ISSN:2148-2403
https://kuey.net/

Research Article

Stock Market Price Prediction Using Gated Recurrent Unit Method

N. Arikaran[1*], G. Ashwin[2], M. Mohamed Salman[2], M. Arul Raj[2]

[1*]Assistant Professor, Department of Computer Science and Engineering, Manakula Vinayagar Institute of Technology, Kalitheerthalkuppam, Pondicherry University, Puducherry, India, a arikaran.n@gmail.com
[2]B.Tech, Manakula Vinayagar Institute of Technology, Pondicherry University, Puducherry, India,
[b]ashwingoby26@gmail.com, [c] mohammedsalman8229@gmail.com, [d] arulvijay2002.30@gmail.com

Citation: N. Arikaran et.al (2024), Stock Market Price Prediction Using Gated Recurrent Unit Method, *Educational Administration: Theory And Practice*, *30*(5), 1340-1346 Doi: 10.53555/kuey.v30i5.3086

ARTICLE INFO

ABSTRACT

The challenges faced in stock prediction due to intricate dynamics and the lack of interpretability in existing artificial intelligence (AI) models. Traditional models like Long Short-Term Memory (LSTM) and Convolutional Neural Networks (CNN) encounter limitations in capturing long-term trends and adapting to non-stationary data. To address these issues, this research proposes the utilization of Gated Recurrent Unit (GRU) algorithms, which excel in handling sequential data without the complexity of LSTM models. Additionally, the integration of sentiment analysis from news headlines is explored to enhance prediction robustness. By combining GRU models with sentiment analysis, this study aims to provide investors with more accurate predictions and timely notifications, thus improving overall user experience and trust in AI-driven stock market predictions. Through empirical evaluation, the effectiveness of the GRU-based approach in capturing stock market intricacies and enhancing predictability is demonstrated, offering a promising avenue for future research in financial forecasting.

Index Terms— Gated Recurrent Units (GRU), Artificial Intelligence (AI), Sentiment Analysis

I. INTRODUCTION

These relationships, along with random fluctuations or irregularities in data, known as noise, can make it challenging to accurately predict future stock prices using traditional methods alone. While artificial intelligence (AI) holds promise in this realm, concerns persist regarding the opacity of existing models, which can hinder trust and widespread adoption. Yet, they struggle to effectively capture long-term trends and adapt to the dynamic nature of market behavior. This underscores the need for AI algorithms that not only deliver robust predictions but also offer interpretability.

This study proposes leveraging Gated Recurrent Unit (GRU) algorithms, which strike a balance between computational efficiency and model complexity in processing sequential data. By addressing the limitations of LSTM models and streamlining training processes, GRUs emerge as a promising solution for enhancing stock market predictions. Furthermore, integrating sentiment analysis derived from news headlines introduces a nuanced understanding of market sentiment, augmenting the predictive capabilities of AI models. By combining historical stock data with real-time sentiment indicators, investors can gain deeper insights into market trends, empowering more informed decision-making.

This research aims to evaluate the effectiveness of the GRU- based approach in conjunction with sentiment analysis, with the goal of improving the accuracy and reliability of stock market predictions. Through empirical analysis, we seek to demonstrate the practical applicability of these methodologies and their potential to inspire confidence in AI-driven financial forecasting. Ultimately, this investigation contributes to advancing predictive analytics and enhancing decision-making in the financial domain.

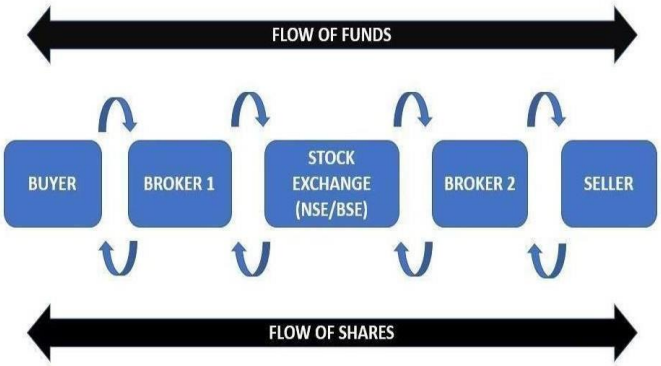

Figure 1.1 Traditional methods of stock marketing

I. RELATED WORK

A. Equitable Treatment in Stock Transactions:

It refers to the fair and impartial handling of buying and selling activities in financial markets. This concept is crucial for maintaining market integrity, transparency, and investor confidence.

B. Effective Price Determination:

A trustworthy system of pricing establishment is necessary for the efficient operation of the financial market. In addition to taking other pertinent factors that affect the value of securities into account, this process—known as price determination—involves striking a balance between the forces of market supply and demand.

II. PROPOSED METHODS AND TECHNIQUE USED:

The project addresses a critical need in the financial domain by proposing an advanced stock market prediction system. The stock market's inherently dynamic and complex nature poses significant challenges for investors seeking to make informed decisions. Traditional models often fall short in capturing relationships between stock prices and some external factors, such that news sentiment. By incorporating Gated Recurrent Units (GRU) in our Deep Learning-based model, along with the inclusion of sentiment analysis on news headlines, this project aims to fill existing gaps in prediction accuracy. Additionally, the inclusion of a notification system ensures that investors are promptly informed about critical price points, facilitating timely decision-making. In essence, the project addresses the pressing need for a more sophisticated and reliable tool that empowers investors with accurate predictions and timely insights in the ever-changing environment.

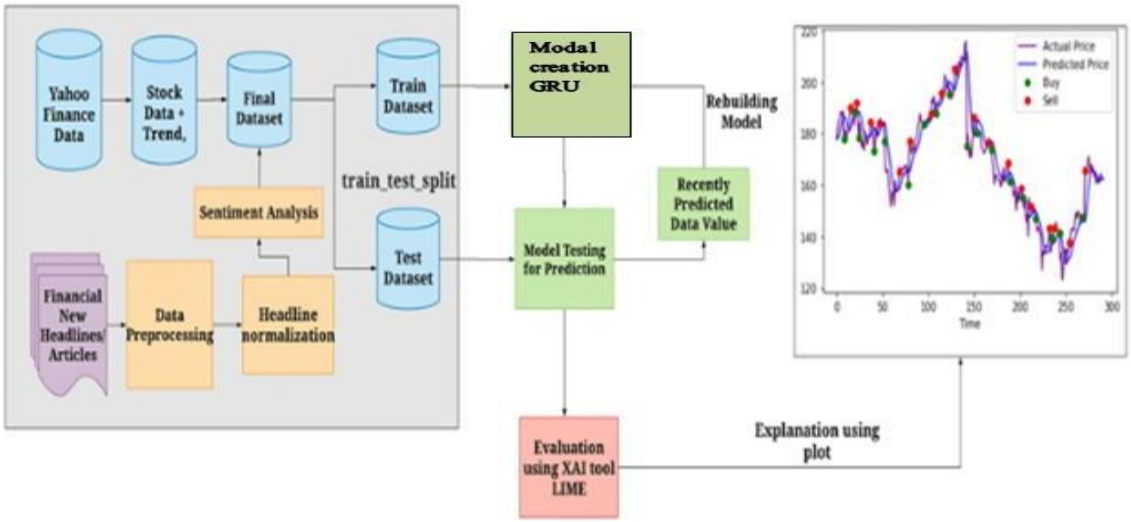

Figure 3.1 Architecture Proposed

III. PROBLEM IDENTIFICATION AND DEFENTION: The current approach to stock price prediction faces

significant hurdles related to training time and memory usage,
particularly when employing LSTM models. These models, though effective in capturing sequential dependencies, come with drawbacks. Their training process is notably time- consuming due to their recurrent nature, often leading to slow convergence. Additionally, LSTM models demand substantial memory

resources, especially when handling large datasets, which poses scalability challenges.
Furthermore, the existing system lacks the ability to forecast the range of stock values and does not incorporate real-time stock data. This limitation hampers its effectiveness in adapting to the dynamic nature of financial markets.
To overcome these shortcomings, there's a need to enhance scalability by integrating live stock data into the model. By leveraging real-time information, the model can better adapt to market changes and potentially reduce both training time and memory usage. Moreover, exploring alternative machine learning algorithms or optimization techniques could offer viable solutions. These approaches may provide improved efficiency and performance in stock price prediction tasks, thereby addressing the current challenges more effectively.
In this tackling the issues of training time, memory consumption, and the lack of real-time data integration is pivotal for advancing stock price prediction models.
Doing so would not only enhance their accuracy but also make them more adaptable to the ever-changing dynamics of financial markets is shown in fig 4.1 Prediction of stocks.

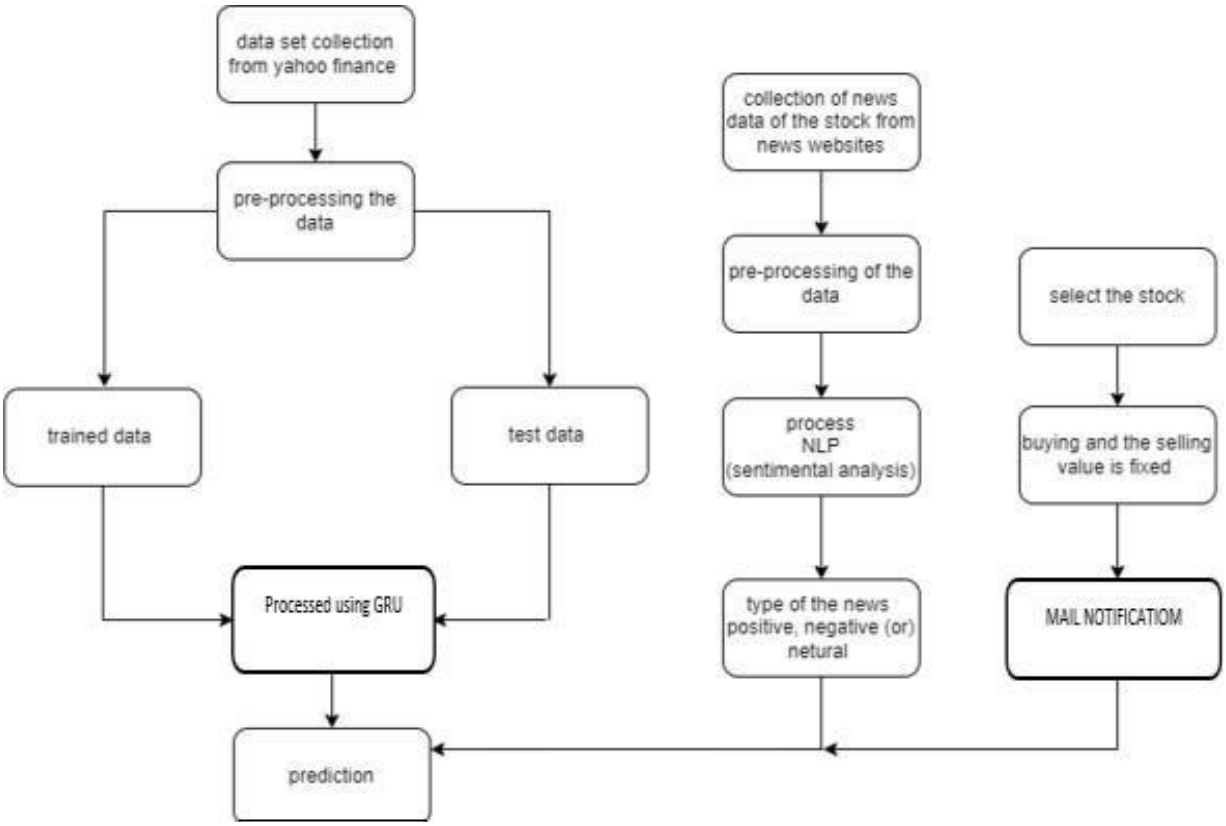

FIGURE 4.1 Prediction of stocks

The stock market is a dynamic arena where prices of publicly traded company share constantly change due to the interplay of supply and demand. Predicting these price movements accurately is a tough nut to crack and maximize returns.
To tackle this challenge, Artificial Intelligence (AI) techniques, specifically Gated Recurrent Unit (GRU) models, are being harnessed to improve accuracy & efficiency of price predictions. These AI tools empower investors by providing them with advanced prediction capabilities that aid in decision-making. By integrating mechanisms to collect real- time stock data and analysing the sentiment of news articles, AI models can stay updated with the latest market information.
This ensures that predictions are based on the most current data available, enabling investors to make more precise and timely decisions. Incorporating techniques like interval forecasting or uncertainty estimation allows AI models to provide insights into the potential range of future stock prices. This helps investors manage risks better and make more informed choices.
In essence, Artificial Intelligence especially through GRU models, offers promising avenues for enhancing stock market prediction accuracy. By leveraging real-time data and sophisticated forecasting techniques, investors can gain valuable insights to optimize their investment.

IV. RESULT AND DISCUSSION

A. Stock Grouping Dataset:

Data from Yahoo Finance, covering the past year, has been gathered for companies such as Apple, Adani Power, and Google. This dataset includes a wide range of metrics, such as stock prices, trading volumes, and other pertinent financial indicators.

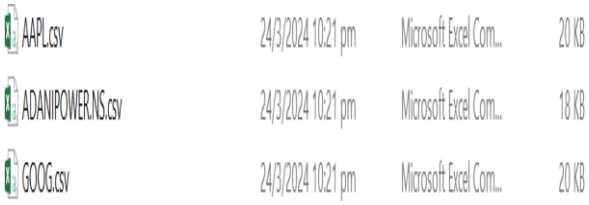

Figure 6.1 Dataset

This dataset from Yahoo Finance covering the past year for companies like Apple, Adani Power, and Google offers valuable insights into their performance trends. This analysis serves as a powerful resource for investors and analysts, enabling them to make informed decisions regarding investment strategies, risk assessment, and market trends. By delving into metrics such as stock prices, trading volumes, and other relevant financial indicators, stakeholders gain a deeper understanding of these companies' financial performance. This understanding allows them to gauge each company's market position and anticipate potential future trajectories. Key parameters within the dataset include stock prices, which reflect trading volumes, indicating investor interest and activity. Additionally, financial indicators like earnings, revenue, and profit margins provide insights into the companies' financial health and profitability. Utilizing this dataset and conducting thorough analysis empowers investors and analysts to stay informed about market dynamics, identify emerging trends, and make well- considered decisions to optimize their investment strategies and its shown in below fig 6.2.

	Date	Open	High	Low	Close	Adj Close	Volume
0	13/3/2023	147.81	153.14	147.7	150.47	149.671097	84457100
1	14/3/2023	151.28	153.4	150.1	152.59	151.779861	73695900
2	15/3/2023	151.19	153.25	149.92	152.99	152.177719	77167900
3	16/3/2023	152.16	156.46	151.64	155.85	155.022537	76161100
4	17/3/2023	156.08	156.74	154.28	155	154.177048	98944600
5	20/3/2023	155.07	157.82	154.15	157.4	156.564301	73641400
6	21/3/2023	157.32	159.4	156.54	159.28	158.434326	73938300

Figure 6.2 Future Prediction of Stocks.

B. Characteristics of Dataset:

In financial datasets like this, essential features often include attributes such as Open, High, Low, Close prices, and Volume. Feature extraction entails converting raw data into a format that is better suited for analysis or modelling. This transformation may involve methods like scaling, normalization, or creating new features derived from existing ones (e.g., moving averages, relative strength index). The objective is to extract meaningful information that can improve the efficacy of machine learning algorithms or facilitate dataset analysis.

C. Model Creation:

Creating a stock market prediction model with GRU involves collecting historical stock data, including features like open, close, volume, and technical indicators. After preprocessing—normalization and splitting into training/testing sets—a GRU neural network model is built using TensorFlow or Py-Torch. The model typically comprises GRU layers followed by dense layers for prediction.

```
# Function to create sequences for the GRU model


def create_sequences(data, time_steps):
    x, y = [], []
    for i in range(len(data) - time_steps):
        x.append(data[i:(i + time_steps), 0])
        y.append(data[i + time_steps, 0])
    return np.array(x), np.array(y)
```

Figure 6.3 GRU Model Creation

During training, the model learns from historical data, adjusting its settings like GRU units and learning rate to improve performance. After training, the model's accuracy is evaluated using a separate testing dataset. Once trained, the model can predict future stock prices to assist investors. Regular updates and retraining are

necessary for the model to adapt to changing market conditions. Although GRU models can capture patterns over time, achieving precise predictions requires continuous improvement and understanding of market dynamics.

D. Graph Predictions:

The trajectory of the stock market is a daunting given numerous dynamic factors influencing market behavior . Despite the capabilities of advanced models like GRU neural networks to review the previous data and to identify patterns, they cannot guarantee accurate predictions of future stock prices.
These factors contribute to significant volatility and uncertainty, rendering precise forecasting a challenging Endeavor.

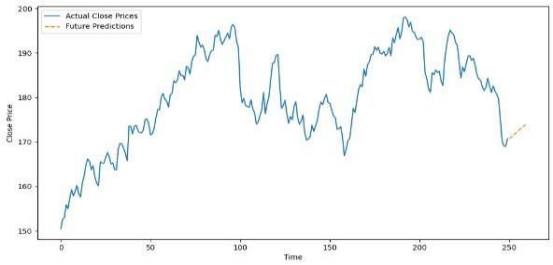

Figure 6.4 Future Graph Prediction of Stocks

Investors are advised to blend quantitative analysis with qualitative research, fundamental and technical analysis, and robust risk management strategies. By combining these analytical methods and can identify potential investment opportunities. Additionally, diversifying their investments across various asset classes and maintaining a long-term investment horizon can help them manage the volatility of the stock market and minimize the impact of short-term market fluctuations. These prudent approaches empower investors to navigate market uncertainties more effectively and achieve their financial objectives with greater resilience.

E. News Collection:

Obtaining data from newspapers is crucial for market research, ensuring the accuracy and relevance of insights. Initially, newspapers are either scanned physically or accessed digitally to gather articles, headlines, and relevant information.
This process involves using automated tools or manual methods to extract key elements such as company names, stock symbols, and significant events. Natural Language Processing (NLP) techniques are commonly employed to analyse the collected articles, categorizing them based on predefined criteria such as financial news or market analysis.

	title	publishdate
0	"stock" - Google News	Mon, 11 Mar 2024 10:43:09 GMT
1	Closing Bell: Sensex falls 617 pts, Nifty below 22,350; sma	Mon, 11 Mar 2024 09:56:59 GMT
2	Mukul Agrawal portfolio stock tanks 10% despite order w	Mon, 11 Mar 2024 10:26:09 GMT
3	US billionaires sell $11 billion in stock. Is a financial disast	Mon, 11 Mar 2024 10:45:30 GMT
4	Stock market update: Sugar stocks down as market falls -	Mon, 11 Mar 2024 01:01:32 GMT
5	Stock to Buy Today: 11th March 2024 - Infibeam Avenues	Mon, 11 Mar 2024 05:49:04 GMT
6	Tata Stock Has Surged Up 23% In 5 Days, Brokerage Sees (	Mon, 11 Mar 2024 07:51:04 GMT
7	Tata Group stocks dip as Tata Sons IPO outlook dims; Tat	Sun, 10 Mar 2024 07:59:48 GMT
8	Technical Breakout Stocks: How to trade Rallis India, Tata	Mon, 11 Mar 2024 05:12:10 GMT
9	1:10 Stock Split: Re 1/Share Dividend: Pharma Stock Falls	Mon, 11 Mar 2024 05:41:39 GMT
10	HDFC Bank shares decline after CLSA downgrades stock, c	Mon, 11 Mar 2024 04:46:51 GMT

Figure 6.5 News Collection Details

Additionally, sentiment analysis plays a crucial role in understanding the tone and sentiment expressed in articles, offering valuable insights into potential market impacts. Following sentiment analysis, the collected data is organized into a structured database or dataset, enabling further analysis, integration with other data sources, or utilization in predictive models.
Ensuring, cross-referencing, and addressing biases or inaccuracies resulting from editorial stances or reporting styles. Regular updates and maintenance of the dataset are vital to accurately reflect the dynamic nature of news and market trends.

F. Segmentation of News:

Classifying news based on a polarizing score entails evaluating the sentiment or bias conveyed in articles to categorize them according to their ideological orientation. This method heavily relies on Natural Language Processing (NLP) techniques, which enable the analysis of text sentiment and tone. The process typically begins with text preprocessing to remove noise and irrelevant information, ensuring the accuracy of subsequent analysis.

```
i = 0  # counter
compval1 = []  # empty list to hold our computed 'compound' VADER scores
while i < len(headlines):
    k = analyser.polarity_scores(headlines.iloc[i]['title'])
    compval1.append(k['compound'])
    i = i + 1
compval1 = np.array(compval1)
len(compval1)
```

Figure 6.6 News Segmentation

Following preprocessing, sentiment analysis algorithms are employed to ascertain the polarity of the text, discerning whether it conveys positive, negative, or neutral sentiment. Advanced techniques such as opinion mining may also be utilized to identify subjective statements within the text and assess their polarity accordingly.

G. Live Notification About ongoing Stocks:

Receiving timely email alerts empowers traders and
investors to stay informed about market movements and potential trading opportunities. This enables them to react promptly to changes and execute their investment strategies effectively.
Additionally, users can customize the frequency and specificity of alerts to align with their preferences and trading objectives. Setting up email notifications for stock buying and selling involves configuring automated alerts triggered by specific conditions in the stock market. Users start by defining criteria such as price thresholds, volume changes, or technical indicators that signal opportune moments for trading. These conditions are typically based on personal trading strategies, market analysis, or algorithmic signals. This process may entail accessing the platform's settings or utilizing APIs to integrate external alerting systems. The notifications typically include details such as the stock symbol, current price, recommended action (buy or sell), and any additional context or analysis.

V. CONCLUSION

The proposed system for stock market prediction and trading automation utilizes advanced machine learning models like GRU (Gated Recurrent Unit) neural networks and natural language processing (NLP) techniques. These tools enable the analysis of historical data and categorization of news sentiment, providing actionable insights for investors. While the system offers valuable capabilities for enhancing trading efficiency and risk management, it's important to acknowledge the uncertainties and complexities of the stock market. Therefore, it should be used in conjunction with thorough research, market analysis, and prudent investment principles. Continuous refinement and validation of the system are necessary to adapt to changing market conditions and optimize performance over time. Overall, the proposed system presents a promising approach to empowering investors with actionable insights in navigating the dynamic landscape of the stock market.

VI. REFERENCES

1. AbdelKawy, R., W. M. Abdelmoez, and Shoukry, “A synchronous deep reinforcement learning model for automated multi-stock trading”, Progress in Artificial Intelligence, Volume 10, Springer, (2021).
2. Abinaya, P., V. S. Kumar, P. Balasubramanian, and V. K.Menon – “Measuring stock price and trading volume causality among nifty50 stocks: The toda yamamoto method”, In 2016 International Conference on Advances in Computing, Communications and Informatics IEEE, (2016).
3. Albelwi, S., and M. Ausif. “A framework for designing the architectures of deep convolutional neural networks”, Entropy, Volume 19, MDPI, (2017).
4. Ashfaq, R. A., W. Xi-Zhao, H. J. Zhexue, A. Haider, and H.Yu-Lin, ”Fuzziness based semi-supervised learning approach for intrusion detection system”, Information Sciences, Elsevier, (2017).
5. Gourav Bathla, "Stock price prediction using LSTM and SVR", IEEE explore, (2020).
6. Hiransha M, Gopalakrishnan E.A, vijay Krishna Menon, Soman.K.P – “NSE Stock Market Prediction using Deep Learning Models”, Procedia Computer Science, Volume 132, ScienceDirect, (2018).
7. Jaydip Sen - “Stock Market Prediction using Machine and Deep Learning Frameworks” Research Gate, (2018).
8. Jingyi Shen, M. Omair Shafq – “Short- term stock market price trend prediction using a comprehensive deep learning system”, Journal of Big Data, Volume 7, Springer, (2020)
9. Jooweon Choi, Shiyong Yoo, Xiao Zhou, YoungBin Kim, “Hybrid InformationMixing Module for Stock Movement Prediction”, IEEE, (2023)
10. Kittisak Prachyachuwong and Peerapon Vateekul – “Stock Trend Prediction Using Deep Learning Approach on Technical Indicator and Industrial Specific Information”, Information, Volume 12, ResearchGate, (2021).
11. Lokesh Chouhan, Navanshu Agarwal - "Stock market prediction using machine learning", Springer,

(2018).
12. Mingze Shi, Qiangfu Zhao – "Stock market trend prediction and investment strategy by Deep Neural Networks", IEEE, (2021).
13. Priya Singh, Manoj Jha, Mohamed Sharaf," Harnessing a Hybrid CNNLSTM Model for Portfolio Performance: A Case Study on Stock Selection and Optimization", IEEE, (2022).
14. Pushpendra Singh Sisodia, Anish Gupta, Gaurav Kumar Ameta," Stock Market Analysis and Prediction for Nifty50 using LSTM Deep Learning Approach", IEEE, (2022).Ritika singh, shasi srivastava – "Stock prediction using deep learning".
15. Ritika singh, shasi srivastava – "Stock prediction using deep learning", Multimedia Tools and Application, volume / 6, Springer (2016).
16. Aharon, D.Y.; Gavious, I.; Yosef, R. Stock market bubble effects on mergers and acquisitions. Q. Rev. Econ. Financ. 2010, 50, 456–470. [CrossRef].
17. BM. Henrique, VA. Sobreiro, H. Kimura, Stock price prediction using support vector regression on daily and up to the minute prices, J. Financ. Data Sci. 4 (3) (2018) 183–201, Available from: https://doi.org/10.1016/j.jfds.2018.04.003 [Internet] Elsevier Ltd.
18. Ashish Sharma, Dinesh Bhuriya, Upendra Singh. "Survey of Stock Market Prediction Using Machine Learning Approach", ICECA 2017.
19. SS. Patil, K. Patidar, M. Jain, Stock market trend prediction using support vector machine, Int.J. Curr. Trends Eng. Technology.2(1)(2016) 18–25, Available http://casopisi.junis.ni.ac.rs/index.php/FUAutCont Rob/article/view/ 585 [Internet].
20. A. Kshirsagar, Bio-remediation: Use of nature in a technical way to fight pollution in the long run, ResearchGate [Internet] (2018) Available from: http://dx.doi.org/10.13140/RG.2.2.26906.70088.
21. Xi Zhang, Siyu Qu, Jieyun Huang, Binxing Fang, Philip Yu, "Stock Market Prediction via Multi-Source Multiple Instance Learning." IEEE2018.
22. P. Dhenuvakonda, R. Anandan, N. Kumar, Stock price prediction using artificial neural networks, J. Crit. Rev. 7 (11) (2020) 846–850.
23. Fama, Eugene F., 1995. Random walks in stock market prices. Financ. Anal. J. 51 (1), 75–80.
24. Jason Brownlee, A gentle introduction to long short-term memory networks by the experts [internet],2017,Available from: https://machinelearningmastery.com/gentle- introduction-long-short-term-memory-networks- experts/ [cited 2021 Jun 25].
25. Ali Khan, J., 2016. Predicting Trend in Stock Market Exchange Using Machine Learning Classifiers. Sci. Int. 28, 1363–1367.
26. P. Solanki, D. Baldaniya, D. Jogani, B. Chaudhary, M. Shah, A. Kshirsagar, Artificial intelligence: new age of transformation in petroleum upstream, Pet. Res. (2021) Elsevier.
27. Raut Sushrut Deepak, Shinde Isha Uday, Dr. Malathi, "Machine Learning Approach In Stock market.
28. Tejvan Pettinger, How does the stock market affect the economy?- economics help[internet],2020,Available from: https://www.economicshelp.org/blog/221/stock- market/how-does-the-stock-market-effect-the- economy-2/ [cited 2021 Jun 25].
29. Gupta, R.; Garg, N.; Singh, S. Stock Market Prediction Accuracy Analysis Using Kappa Measure. In Proceedings of the 2013 International Conference on Communication Systems and Network Technologies, Gwalior, India, 6–8 April 2013; pp. 635–639.
30. Ashish Sharma, Dinesh Bhuriya, Upendra Singh. "Survey of Stock Market Prediction Using Machine Learning Approach", ICECA 2017.
31. Arikaran N, Sathishkumar R, Balaji S, Ashwin G, Mohamed Salman M. "Quick Response Codes for Bone Fracture Diagnosis Based on Deep Learning", 2023 International Conference on System, Computation, Automation and Networking (ICSCAN), 2023.
32. Parshv Chaajer, Manan Shah, Ameya Kshirsagar. "The applications of artificial neural networks, support vector machines, and long-short term memory for stock market prediction", Decision Analytics Journal, 2021.
33. Xiang Ma, Tianlong Zhao, Qiang Guo, Xuemei Li, Caiming Zhang. "Fuzzy Hypergraph Network for Recommending Top-K Profitable Stocks", Information Sciences, 2022.
34. Shamali Mawande, Rohan Kulkarni, Suhas Kakade, Ranjit Sadakale. "Estimation of Solar PV Plant Output using LSTM-CNN Algorithm", 2023 International Conference on Digital Applications,Transformation & Economy (ICDATE), 2023
35. Mohammad Shariful Islam, Mohammad Abu Tareq Rony. "Navigating the global stock market: correlation, prediction, and the influence of external factors", Iran Journal of Computer Science, 2024