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A Review of Stock Price Prediction Techniques using Machine Learning

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Abstract: Stock price prediction is a challenging task due to the highly volatile and nonlinear nature of financial markets. This study explores various machine learning models, including traditional approaches such as Random Forest and XGBoost, deep learning models like Long Short-Term Memory (LSTM) networks and Gated Recurrent Units (GRU), and hybrid architectures incorporating external indicators. The models are trained on historical stock price data combined with external financial indicators to improve predictive accuracy. Performance is evaluated using key metrics such as RMSE, Mean Squared Error (MSE) and R-squared scores. Results indicate that researcher work with won generated dataset and compare in different traditional ML models-Random Forest / XGBoost, Support Vector Regression (SVR), etc. Deep Learning models- LSTM (Long Short-Term Memory), GRU (Gated Recurrent Unit), CNN (Convolutional Neural Networks) for Time-Series, Transformers (e.g., Informer, Time-Series Transformer) with external indicators, outperform traditional machine learning methods in capturing market trends.
Keywords: LSTM, RMSE, MSE, GRU, CNN.

I. INTRODUCTION

The equity market holds significant can't importance in the financial market, as it helps to enhance the movement of capital, improve the distribution of assets, and encourage quicker and more effective economic growth. The varies algorithms are available In ML using which we can accommodate this task and we trying to predict stocks price as accurately as possible. A very basic thing is that if we talk about Stocks data, which is always volatile means it is variating with different numeric values or we can also conclude prices of stocks are regrating hence we need to use different regressors model to predict future price of stocks is one thing and accordingly we may classify. Classify in the sense whether investors should buy or sell or holds the stocks. As per availability of the data which may be structured or unstructured. But in this study, I am focusing on structured dataset which was gathered from yiifinace.com. There are many different machine learning models you can use for stock price prediction, each with its strengths and weaknesses. Traditional Machine Learning Models, all these models have each with its strengths and weaknesses. In this paper we tried to compare different ML model, Deep learning model for stock price prediction. We Evaluated with few parameters like RMSE (Root Mean Square Error), MSE (Mean Squared Error), R2 Square and tried to meet our intuition is that to predict future stocks price accurately as we can. In next part we visualized with the help of graphs. Comparison table of different models with evaluation parameters, finally we summarize paper with conclusion.

II. LITERATURE REVIEW

Table I. is the summary of some papers[1].

TABLE I

Refer-ence	Year	Method	Evaluati-on Metrix	Value predicted	Advantages	Challenges
[15]	2021	CEEMDAN-LSTM	RMSE,MAE, MSE,MAPE,	Stock Index	Improves the fitting and robustness of prediction model	High computational cost
[16]	2022	SVR with MEMD	RMSE, DS,MAPE	Stock Index	Effective in handling non-stationary data and capturing nonlinear relationships	Computationally intensive and requires careful parameter tuning

[17]	2023	EMD-LSTM	RMSE,MAE,MAPE	Stock Index	Combines the strengths of EMD and LSTM. providing improved prediction fit	Complexity in model implementation and high computational cost
[18]	2023	AdaBoost-AAFSA Elman with CEEMDAN	RMSE,MAE,MAPE	Stock Closing Price	Incorporates multiple models and algorithms for enhanced prediction performance	Requires extensive data preprocessing
[19]	2023	EEMD-Hurst-LSTM	RMSE,MSE,R2	Commodity futures	Improves forecasting performance by integrating ELMD and LSTM with Hurst exponent analysis	Involves complex calculations
[20]	2024	CEEMDAN-ARIMAX	RMSE,MAE	Stock Index	Provides better decomposition and noise reduction for financial market forecasting	High computational complexity and computational resources
[21]	2024	2LE-CEEMDAN	RMSE,MAE,MSE,R2	Stock Index	Offers enhanced Denoising function for more accurate time series analysts	High computational complexity and requires extensive parameter tuning

.

The paper, "prediction of stock price using machine learning techniques," explores the use of long short-term memory (LSTM) networks and random forest (RF) algorithms for prediction. the authors trained these models on historical stock price data and technical indicators. the LSTM model demonstrated superior predictive accuracy, achieving an r^2 of 0.99, MSE of 0.029, and RMSE of 0.49, compared to the RF model. while acknowledging the inherent limitations of stock price prediction due to market volatility and unforeseen events, the research suggests deep learning approaches like LSTM are promising for this complex task [2]. The model's performance is evaluated using three metrics: root mean square error (RMSE), mean absolute error (MAE), and accuracy in predicting price increases and decreases. The data used in the study from [1]
(https://www.kaggle.com/datasets/kane6543/most-watched-stocks-of-past-decade20132023) .
a robust framework for short-term stock price prediction, combining statistical, machine learning, and deep learning models. the authors use five-minute interval stock price data from Godrej Consumer Products Ltd., listed on the national stock exchange (NSE) of india, aggregated into three daily slots (morning, afternoon, evening). Sidra Mehtab, Jaydip Sen were introduced two prediction approaches are: regression (predicting the percentage change in the opening price – open_perc) and classification (classifying open_perc as positive or negative). research using 2013,2014 data for training and testing. model performance is assessed using various metrics including sensitivity, specificity, ppv, npv, classification accuracy, f1 score (for classification), and RMSE, correlation coefficient, and sign mismatch count (for regression) [1]. The results show that boosting models generally perform best in classification, while LSTM significantly outperforms other regression models. a suite of CNN models, trained on higher-granularity data (5-minute intervals), demonstrates even better accuracy than LSTM, as measured by the RMSE/mean ratio. the study highlights the potential of combining various modelling techniques to improve short-term stock price prediction. obtaining data from yahoo finance. [3]. this paper introduces a novel hybrid model, the hierarchical decomposition-based forecasting model (HDFM), for accurate stock price forecasting. the model tackles the inherent non-linearity, complexity, and volatility of stock markets by employing a hierarchical decomposition and prediction strategy. obtaining data from yahoo finance [4]. Saeede anbaee farimani, majid vafaei jahan and amin milani fard introduced abm-bcsim uses news content, sentiment from financial newsgroups, and technical indicators for price prediction with multimode. an attention mechanism learns the weights of each data mode (news, sentiment, market data) dynamically, handling multimodality. the model predicts the price change around the average price of a time window, addressing the non-stationary nature of price time series. extensive experiments across forex, cryptocurrency, and gold markets show significant improvements (up to 66.69% MAPE reduction) over various baselines [5]. the proposed model uses two channels: one for processing technical indicators via a bilstm network, and another for processing the vectorized company

descriptions via an RBM. the evaluation metrics used are mean squared error (MSE) and mean absolute error (MAE). study says for feature engineering and dimensionality reduction: the model uses a combination of technical indicators (like moving averages, RSI, Bollinger bands) and their percentage changes as features. a restricted Boltzmann machine (RBM) is employed to reduce the dimensionality of the bert-generated vectors [6]. Unfortunately, the paper does not provide the exact numerical values for the evaluation parameters (MAD, MAPE, MSE, RMSE, and the directional accuracy measures). it only presents comparative graphs showing the performance of MLP, Elman, and linear regression across different time windows (*d* days). the paper visually demonstrates that MLP had lower error metrics (MAD, MAPE, MSE) but that Elman and linear regression were better at predicting the direction of change. the study used stock market data from the Tehran Stock Exchange Corporation (TSEC) between 2000 and 2005. the model's predictive ability is limited by relying solely on historical stock value data [7]. transformer-based models used in next research, demonstrates the effectiveness of transformer-based models for asset price and direction prediction. by transforming financial time series data into 2d images and employing advanced transformer architectures, the authors achieved superior results compared to traditional methods and convolutional neural networks. the study highlights the potential of utilizing computer vision techniques for financial forecasting and provides a foundation for future research in this area.to evaluate model precision, recall, f1-score for classification used & accuracy, financial metrics: sharpe ratio: measures risk-adjusted return. Maximum drawdown: measures the largest percentage decline from a peak to a trough. cumulative return: measures the total return over the testing period [8]

III. PROPOSED SYSTEM

A. LSTM with External Indicators (Multi-Input Model)

I am trying existing models with newly generated dataset, trying to work on feature selection with the help of "LSTM with External Indicators (Multi-Input Model)". We will implement an LSTM with external indicators to improve stock price prediction. This model will use stock price, trading volume, and technical indicators like RSI (Relative Strength Index), MACD (Moving Average Convergence Divergence), and moving averages as additional features.

B. Methodology

It achieves this through a system of gates as shown in the diagram [10]:

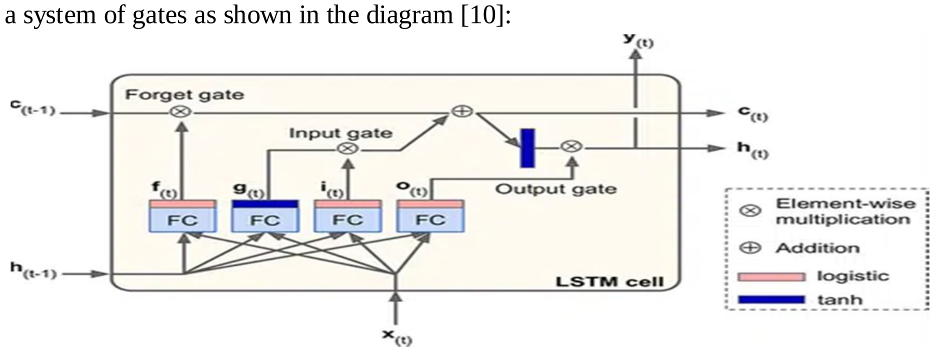

Fig. 1 working of different gates [10]

Each feature becomes part of a time-step sequence that is fed into the LSTM, allowing it to analyze the combined impact of these multiple factors [10]. A Multi-Input LSTM model combines stock price data and external indicators to improve stock price prediction. The model works by processing each input stream separately using LSTMs and then merging them before making the final prediction. Model consist of special gates (input, forget, and output gates) to control the flow of information as given in above Fig. 1

C. Use External Indicators

1) Stock prices are influenced by various external factors such as:
2) Technical Indicators: Moving averages (SMA, EMA), MACD, RSI, Bollinger Bands.
3) Macroeconomic Data: Nation, interest rates, GDP growth, unemployment rates.
4) News Sentiment: Sentiment analysis on financial news and social media.
5) Market Sentiment: VIX index, trading volume, institutional buy/sell activity.

Adding these external indicators provides more context to the LSTM model, improving prediction accuracy.

IV. CONCLUSION

The LSTM-based multi-input model enhances stock price prediction by combining historical stock prices and external indicators. This approach provides a more comprehensive view of market trends, leading to better predictive performance. As a technology in the eld of deep learning, neural network can solve non-linear problems well. LSTM neural network is optimized on traditional neural network and introduces the concept of "gate", which enhances the long-term memory ability of the model, which enhances its generalization ability. this paper constructs a stock price prediction model based on LSTM with Multi Input model and also chooses the use of single feature and multi-feature input models to seek better prediction results. Future scope will be Hyperparameter tuning, Feature selection, try (CNNLSTM) convolutional layers for better feature extraction.

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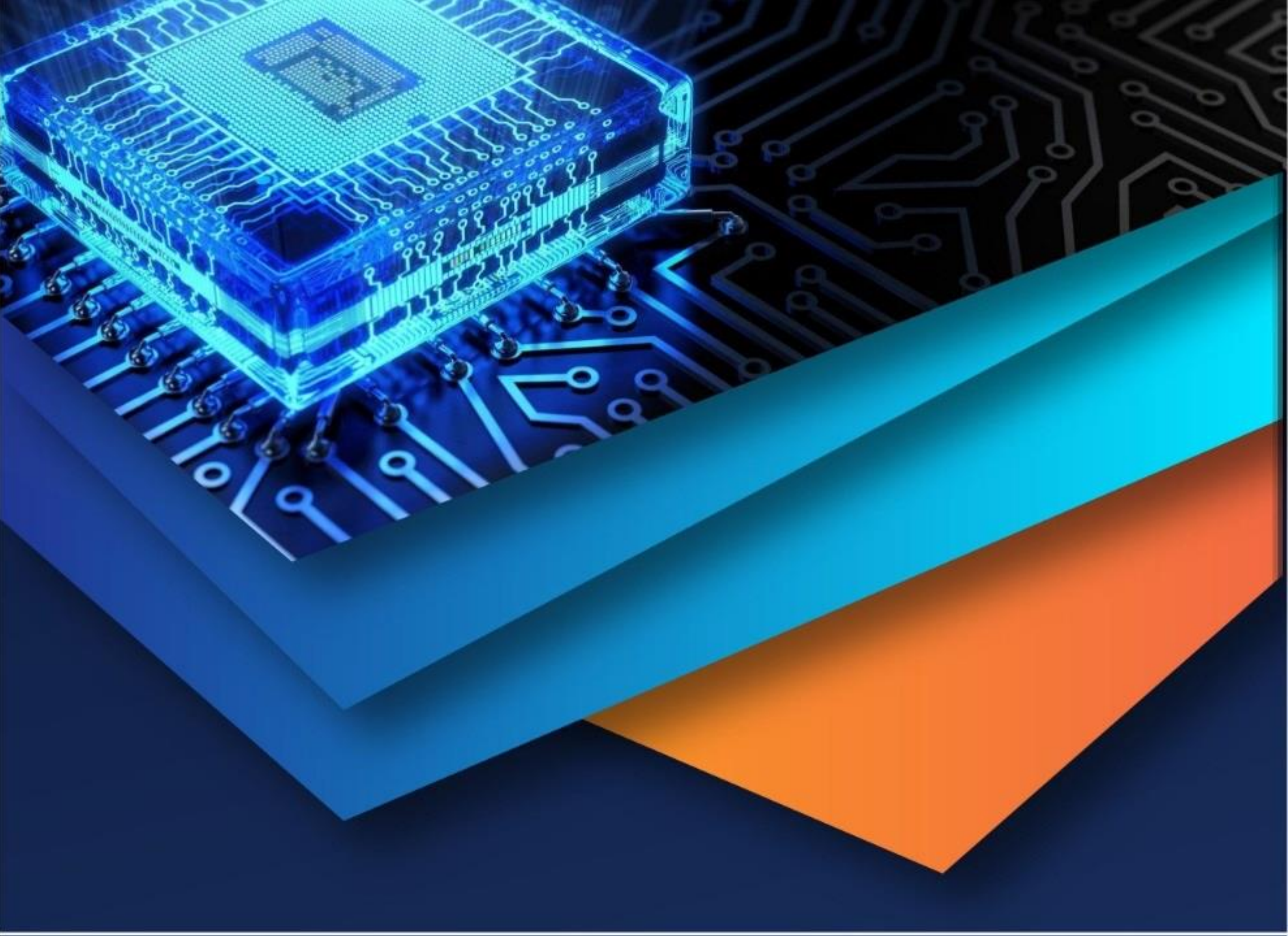

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