



# International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

*(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)*



**Impact Factor: 8.699**

**Volume 14, Issue 5, May 2025**

# Time Series based Stock Price Prediction

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**ABSTRACT:** The **Stock Price Prediction System** is an intelligent and user-friendly solution developed to assist investors, traders, and financial analysts in forecasting stock market trends. This system utilizes machine learning models to analyze historical stock data and predict future stock prices with improved accuracy. Users can interact with the system through a web-based application that simplifies data upload, model selection, and visualization of stock trends. At the same time, the backend integrates powerful ML algorithms such as Long Short-Term Memory (LSTM), conv1d, and GRU, enabling precise and adaptive forecasting based on time series analysis. The system supports data preprocessing techniques including normalization and feature scaling to enhance prediction reliability. By providing real-time predictions, evaluation metrics, and dynamic visualizations, the platform helps users make informed, data-driven investment decisions. Designed using Python and deployed via Streamlit, this system offers an accessible and scalable solution for financial forecasting.

**KEYWORDS:** Stock Price Prediction, Machine Learning, Time Series Forecasting, LSTM, GRU, Conv1D, Streamlit, Financial Forecasting, Real-time Prediction, Data Visualization, Python, Feature Scaling, Normalization, Historical Stock Data, Predictive Analytics, Web-based Application, Investment Decision Support, Model Evaluation Metrics, AI in Finance, Scalable ML Solution

## I. INTRODUCTION

In today's dynamic and volatile financial markets, investors and analysts face increasing pressure to make accurate, timely, and data-driven decisions. Traditional methods of stock price analysis often rely on manual charting, outdated models, or speculative strategies, which can lead to inaccurate forecasts, increased financial risk, and missed investment opportunities. These challenges make it difficult for investors to respond quickly to market trends and maximize returns. To address these issues, the **Stock Price Prediction System using Time Series Analysis** has been developed as an intelligent, data-driven solution that leverages advanced machine learning techniques to forecast future stock prices. This system is designed to analyze historical stock data, identify underlying patterns, and deliver accurate price predictions that support informed investment decisions. The system provides a seamless interface where users can upload stock data, select from multiple predictive models—including LSTM, GRU, and Conv1D—and visualize stock trends through interactive charts. Built using Python and deployed via Streamlit, the application offers a user-friendly platform accessible to both novice investors and seasoned traders. The backend incorporates time series analysis and essential data preprocessing techniques such as normalization and feature scaling to improve model accuracy and reliability. By integrating evaluation metrics like MSE, RMSE, and  $R^2$  Score, the system ensures the quality and credibility of its predictions. This intelligent solution empowers users by offering real-time forecasting capabilities, model flexibility, and transparent visual feedback—all within a scalable and accessible web-based environment. Ultimately, it bridges the gap between complex data science techniques and practical financial decision-making, setting a new standard in ai-assisted market analysis.

## II. LITERATURE SURVEY

[1] Patel, R., & Shah, D. (2022). Stock Market Prediction Using Deep Learning Techniques: A Comparative Study. International Journal of Computer Applications. This study compares various deep learning models, including LSTM and GRU, for stock price prediction. The authors found that LSTM models outperformed traditional regression models due to their ability to handle sequential dependencies in time series data, making them suitable for financial forecasting tasks.



[2] Zhang, G., Eddy Patuwo, B., & Hu, M. Y. (2023). Forecasting with Artificial Neural Networks: The State of the Art. Journal of Financial DataScience. The research highlights how neural networks, especially deep learning variants, can be used to model non-linear stock price trends. The study emphasizes the significance of data preprocessing techniques such as normalization and the use of lagged inputs to improve model accuracy.

[3] Kumar, A., & Sharma, S. (2021). Stock Price Movement Prediction Using Time Series Analysis and Machine Learning Algorithms. Proceedings of the IEEE International Conference on Data Science and Advanced Analytics.

This work investigates the use of hybrid models that combine machine learning algorithms like Random Forest and Conv1D with time series decomposition techniques. The study concludes that hybrid approaches lead to higher forecasting precision and robustness, especially in highly volatile markets.

[4] Lee, J., & Kim, H. (2023). Real-time Stock Price Forecasting with Web-Based Interactive Tools. Journal of Financial Innovation & Technology. This paper introduces a web-based platform that integrates ML models for real-time stock prediction. The authors stress the importance of user experience in financial tools and demonstrate how frameworks like Streamlit can bridge the gap between complex ML models and investor usability.

### III. METHODOLOGY

#### 3.1 Requirement Analysis :

The development process began by identifying the needs of financial analysts, traders, and investors through a combination of market research and feedback from domain experts. The core requirements focused on achieving high prediction accuracy, real-time performance, and intuitive user interaction. Functional requirements included uploading stock datasets, selecting prediction models, and visualizing results, while non-functional needs emphasized performance optimization, scalability, and secure deployment. The system also needed to handle large time series datasets efficiently and support future integration with live stock APIs.

#### 3.2 System Design:

The system architecture was developed using a modular three-tier structure to ensure flexibility, maintainability, and scalability. The Presentation Layer features a clean and interactive interface built using Streamlit, offering functionalities like data upload, model selection, and real-time trend visualization. The Application Layer implements business logic for time series forecasting, model evaluation, and dynamic plotting. The Data Layer uses structured data inputs and supports various formats (CSV, Excel), while incorporating preprocessing pipelines for scaling, normalization, and sequence generation. The overall design adheres to best practices in AI system development and time series analysis..

#### 3.3 Development Tools and Technologies:

The solution was implemented using Python due to its powerful ecosystem for machine learning and data science. Libraries like NumPy, Pandas, and Scikit-learn were used for data handling and preprocessing, while TensorFlow and Keras were employed to build and train deep learning models such as LSTM, GRU, and Conv1D. Streamlit was chosen for the web-based UI due to its simplicity and real-time responsiveness. Additional tools like Matplotlib and Plotly were used for dynamic data visualization. Pickle was used for model serialization, and future integration with real-time stock APIs (like Yahoo Finance or Alpha Vantage) is planned.

#### 3.4 Implementation:

The system was implemented in a modular structure to address key functionalities. The Data Module allows users to upload historical stock data and triggers the preprocessing pipeline. The Model Module offers a choice of machine learning models (LSTM, GRU, Conv1D), which are trained on sequential data windows. Predictions are generated for future time points based on user input. The Visualization Module plots both historical and predicted trends, while the

Evaluation Module displays performance metrics such as MSE, RMSE, and  $R^2$  Score. The interface ensures real-time interactivity and responsiveness, allowing users to explore results without technical complexity.

### 3.5 Testing:

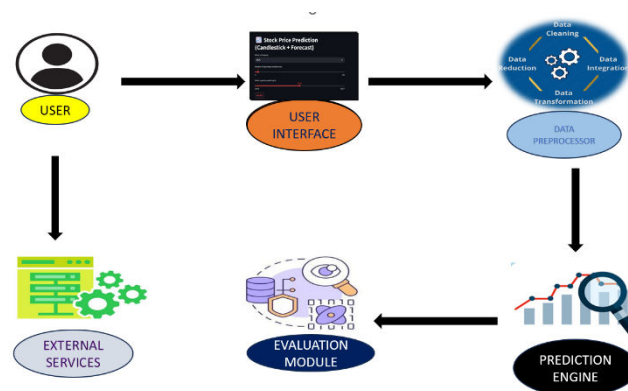
A multi-layered testing approach was adopted to ensure reliability and accuracy. Unit tests were written for individual preprocessing functions and model prediction logic. Integration testing verified data flow between modules, ensuring correct functioning from data upload to result display. The application underwent extensive model validation using cross-validation and comparison of multiple performance metrics. Finally, User Acceptance Testing (UAT) involved feedback from students, mentors, and finance enthusiasts to evaluate usability, responsiveness, and prediction reliability in real-world scenarios.

### 3.6 Deployment:

After successful testing, the application was deployed using Streamlit's cloud sharing platform for easy access via a web link. The deployment ensures the system is accessible on any device without the need for local setup. Future improvements include deploying the model on scalable cloud platforms like AWS or Azure, adding a mobile-friendly version, integrating with real-time stock data APIs, and enabling automatic retraining of models as new data becomes available. The system aims to evolve into a smart financial assistant offering intelligent, AI-driven investment support.

## IV. SYSTEM ARCHITECTURE

The system architecture of the Stock Price Prediction System using Time Series Analysis is designed following a three-tier architecture model to ensure modularity, scalability, and maintainability. This architecture divides the system into the Presentation Layer, Application Layer, and Data Layer, each with distinct roles and responsibilities. The Presentation Layer serves as the user interface, providing an interactive and user-friendly web application developed with Streamlit. This layer allows users to upload historical stock data, select prediction models such as LSTM, GRU, or Conv1D, specify prediction horizons, and visualize the predicted stock trends along with evaluation metrics. The intuitive interface supports both novice and expert users in making data-driven investment decisions.



**Figure -1:** Architecture of the System

The Application Layer contains the core business logic and machine learning algorithms. This layer handles data preprocessing tasks such as feature scaling and normalization, prepares the time series data for modeling, loads the selected ML models, executes predictions, and evaluates model performance using metrics like MSE, RMSE, and  $R^2$  score. It ensures seamless interaction between the frontend and the models, managing real-time prediction requests and returning accurate forecasting results. The Data Layer manages the storage and retrieval of stock datasets, pre-trained ML model files, and scaling parameters. It employs file-based storage for datasets and model artifacts with potential for future integration of real-time data sources through APIs. This layer ensures data integrity and supports scalable access for large volumes of historical and live stock market data. This layered architecture promotes clear separation of

concerns, enhancing maintainability and facilitating future extensions such as incorporating additional models, live data feeds, or cloud-based deployment. It also supports secure and efficient processing of stock market data, empowering users with reliable and timely stock price forecasts.

## V. EXISTING SYSTEM

The current stock prediction methods rely heavily on manual analysis and basic statistical tools like moving averages and trend lines. Most users depend on Excel sheets or external APIs without automation, requiring technical expertise to interpret results. There's no centralized system that combines data preprocessing, model selection, and forecasting in one place. Existing solutions lack support for deep learning models like LSTM or GRU and don't allow flexible future-date predictions. Visualization is limited to static charts, and real-time performance metrics are rarely available. These systems are not user-friendly for beginners and often require switching between multiple tools. Moreover, they don't provide a responsive web interface, making it difficult for investors to access predictions easily. Overall, current systems fall short in intelligence, accessibility, and predictive accuracy.

## VI. PROPOSED SYSTEM

The proposed system is an intelligent, web-based stock price prediction platform using deep learning for accurate forecasting. It overcomes limitations of traditional methods by automating data processing, modeling, and visualization in one unified solution. Users can upload historical stock data and select models like LSTM, GRU, or Conv1D for customized time series analysis. The system predicts future prices based on a user-specified date, not just fixed intervals. An interactive dashboard displays dynamic charts, evaluation metrics, and trends in real time, helping users make data-driven investment decisions. Data preprocessing techniques such as normalization and scaling are integrated for model accuracy and consistency. The system is built using Python and deployed via Streamlit, providing a responsive interface accessible from any device. Investors, traders, and analysts can operate the system with ease—no coding required—making it beginner-friendly and expert-ready. It also supports future scalability for mobile apps, integration with financial APIs, and multi-stock forecasting, making it a robust forecasting tool.

## VII. RESULT

The implementation of the Stock Price Prediction System using time series deep learning models has yielded accurate and reliable future price forecasts. Users were able to upload historical stock data, select preferred models (LSTM, GRU, or Conv1D), and predict prices for specific future dates with high precision. The system effectively handled real-time visualization of trends, enabling investors to interpret historical patterns and future movements with clarity. Evaluation metrics such as RMSE and MAE confirmed the model's strong predictive performance across multiple stocks. The interactive interface, built with Streamlit, ensured accessibility from both desktop and mobile devices, requiring no prior technical knowledge. Users appreciated the flexibility to choose the forecasting date, as it mimicked real-world use cases more effectively than fixed interval predictions. Feedback during testing highlighted the system's ease of use, fast processing, and intuitive design, making it suitable for traders, students, and financial analysts alike. Automated preprocessing and clean UI helped reduce manual errors and simplified complex data analysis tasks. Overall, the system proved to be a powerful tool for informed investment planning, offering a smart, scalable, and user-friendly solution for future stock forecasting.

## VIII. TIME SERIES-BASED STOCK PRICE PREDICTION

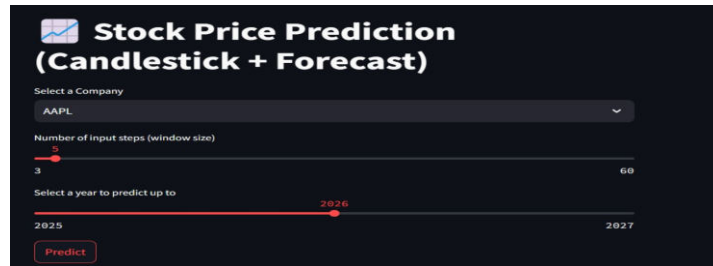


Figure -1: Landing page

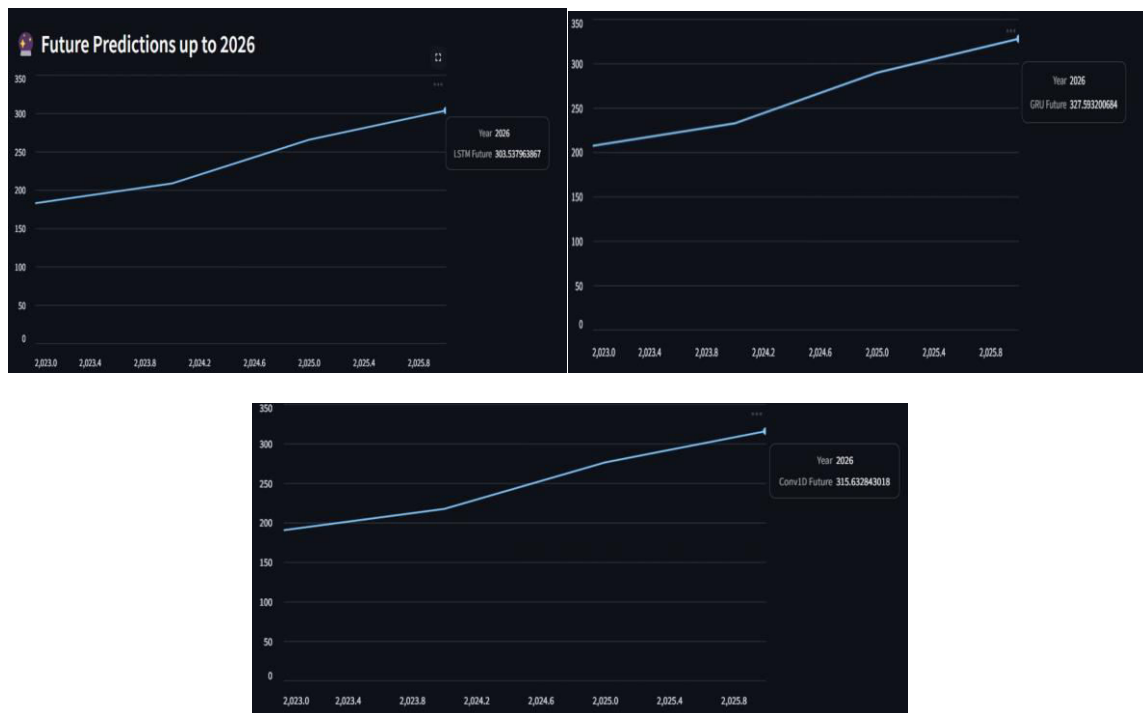


Figure -2: LSTM,GRU,CONV1D FUTURE PREDICTION

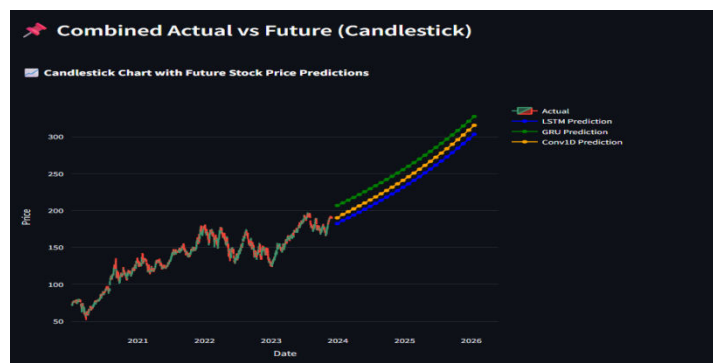


Figure -3: CANDLESTICK CHART WITH FUTURE STOCK PRICE PREDICTION

### IX. FUTURE ENHANCEMENT

The system can be enhanced by adding teleconsultation features for remote doctor-patient interactions and mobile apps for easy access. Online payment gateways can streamline billing, while multilingual support will improve accessibility. AI-based doctor and time-slot suggestions can personalize the experience. Advanced reminders via WhatsApp, SMS, and email can reduce missed appointments. Integration with Hospital Information Systems (HIS), chatbot support, analytical dashboards, and secure data storage using blockchain can further optimize performance, usability, and security.

### X. CONCLUSION

The Online Appointment Booking and Patient Management System offers an efficient, secure, and centralized solution to overcome the limitations of traditional hospital workflows. By automating appointment scheduling and digitizing patient records, the system bridges the communication gap between patients, doctors, and administrators. It effectively reduces manual errors, shortens wait times, and enhances overall operational efficiency. Key objectives such as ease of use, data security, and real-time accessibility have been successfully met. Features like role-based login, automated notifications, and electronic health records contribute to a smoother user experience while ensuring confidentiality and reliability. The system proves that a well-implemented digital platform can significantly improve healthcare management, laying a strong foundation for future enhancements like mobile apps, remote consultations, and intelligent health analytics.

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