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**Research Article**

# FinAI: Gamified Finance Learning Platform

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**ABSTRACT**

Financial illiteracy in India is pervasive, leading to detrimental financial decisions and outcomes. In response, we developed FinAI, a software platform designed to simplify complex financial concepts through gamification. By offering accessible courses and clear explanations, FinAI empowers users, particularly beginners, to make informed financial decisions and capitalize on market opportunities. Our study addresses a pressing need for accessible and engaging financial education, aiming to mitigate the negative effects of financial illiteracy. Through FinAI's gamified approach, users can navigate courses and grasp complex financial terms, promoting financial literacy and enabling users to navigate the market effectively. Utilizing React.js and Node.js for frontend and backend development, Neon DB for database management, and hosting on Vercel, FinAI incorporates a chatbot named "Finbot" powered by Bard API (Application Programming Interface) and Finhub, providing comprehensive responses to user queries. A stock pre- diction model leveraging LSTM (Long Short-Term Memory) and ARIMA (Auto-Regressive Integrated Moving Average) machine learning models, along with the yfinance live data, offers insights into future stock prices. The platform also includes a news feed feature to enhance users' understanding of financial news and events. Through the implementation of energy points and experience points, users progress through course levels, with the option to purchase additional energy points contributing to the platform's revenue stream. Our study revealed significant interest among young students in learning financial concepts through FinAI, with ARIMA demonstrating superior accuracy in stock prediction. FinAI represents a crucial step towards addressing financial illiteracy in India, offering an accessible, engaging, and effective means of financial education.

**Keywords:** Gamification, Financial literacy, Chatbot, Stock Prediction, ARIMA, LSTM, Web Application, FinAI.

## I. INTRODUCTION

In today's rapidly evolving financial landscape, the acquisi- tion of sound financial literacy skills has become increasingly essential for individuals to navigate the complexities of per- sonal finance and investment decisions effectively. Traditional methods of financial education often struggle to engage and empower learners, particularly when faced with the daunting task of simplifying intricate financial concepts. In response to this challenge, innovative solutions leveraging technology and pedagogical advancements have emerged, seeking to revolutionize financial education and empower individuals to make informed financial decisions confidently [12]. One such pioneering initiative is the "FinAI: Gamified Finance Learn- ing Platform," which combines gamification techniques and artificial intelligence (AI) to simplify the teaching of complex financial concepts. By integrating elements of gamification, such as interactive quizzes and level-based progression, with AI-driven features like a financial chatbot and stock price prediction model, FinAI aims to create an immersive and engaging learning environment that fosters comprehension and skill development [14]. The primary objective of this research is to comprehensively evaluate the effectiveness of FinAI in enhancing financial literacy and empowering users to make informed financial decisions. Through a rigorous analysis of user engagement, learning outcomes, and the impact of FinAI's various features, this study seeks to elucidate the platform's potential to revolutionize financial education. Key areas of investigation include the efficacy of FinAI's gamified user interface in simplifying complex financial concepts, the accuracy and utility of its financial chatbot in addressing user queries and improving understanding,

and the effectiveness of its stock price prediction model in guiding investment decisions. The study aims to assess the role of real-time news updates in keeping users informed about market devel- opments and to evaluate the platform's accessibility and user- friendliness across web and mobile platforms.

## II. LITERATURE SURVEY

In two distinct papers, the application of gamification in various educational contexts is explored. "Gamification Ap- plications in E-learning: A Literature Review" delves into the integration of gamification elements within online learning environments, recognizing its potential to elevate motivation, user interaction, and overall social impact. Employing a qual- itative approach and focusing on the keyword "gamification," the paper identifies grades, leaderboards, and levels as pivotal gamified elements in online education. The findings under- score the increasing acknowledgment of play as a potent tool for crafting engaging educational experiences and emphasize the significance of integrating gamification strategies within online learning platforms [1]. "Can gamification improve financial behaviour? The moderating role of app expertise" delves into the realm of financial behaviour and explores the influence of gamification on financial well-being and savings motivation. By conducting surveys among college students and Mechanical Turk participants, the study reveals nuanced preferences for gamified features based on users' prior experience with financial applications. While seasoned users seek a balance between social and economic features, novices prioritize financial functionalities. These insights not only inform game designers and financial services marketers about consumer preferences but also emphasize the potential of gamification to improve financial literacy and behaviour among diverse user groups. Together, these studies contribute to a deeper understanding of the multifaceted impact of gam- ification in education and finance, calling for further research to explore its full potential in enhancing learning outcomes and promoting financial well-being [2].

The impact of gamification on student engagement and involvement with e-learning systems is explored in an empir- ical study. Despite debates over its effectiveness in enhancing student engagement and learning outcomes, gamification is investigated as a potential tool for promoting continuous learning. The study incorporates a question board within an e-learning portal, allowing students and teachers to interact and confirm correct answers. Data collected over 10 months reveal that gamification can indeed attract users to educational systems and increase their interaction and involvement [4]. In another study, the use of gamification to teach and as- sess financial education among self-directed bank investors is examined. The research assesses the understanding of complex financial products and portfolio management among adult investors, highlighting areas where they exhibit low- level skills, particularly in comprehending complex financial product issues. Through an online multiple-choice quiz, the study evaluates participants' financial literacy and suggests that while general financial knowledge is satisfactory, there is room for improvement in understanding high-risk finan- cial products. These findings contribute valuable insights to ongoing research on distance learning through gamification, addressing the growing importance of financial education in contemporary society [5].

The study conducts a comparative analysis of ARIMA and LSTM models for predicting daily or monthly average prices of companies listed on the NASDAQ stock exchange, high- lighting ARIMA's consistent outperformance across various time periods. ARIMA demonstrates superior accuracy com- pared to LSTM, particularly for longer-term forecasts, with approximately 3.4 times better accuracy for 30-day forecasts and about 1.8 times better accuracy for averaged 3-month periods. ARIMA exhibits dominance over LSTM in terms of mean absolute percentage error (MAPE) across different prediction horizons, achieving approximately 1.6 times better accuracy for averaged 1-month predictions and around 2.1 times better accuracy for averaged 9-month periods. Con- versely, LSTM excels in short-term predictions, showcasing approximately 1.12 times better accuracy for 1-day forecasts. The paper also explores various aspects such as error metrics selection, parameter optimization, and the impact of input window sizes on LSTM performance [6]. In a separate inves- tigation, the paper evaluates the efficacy of ARIMA, neural network (NN), and long short-term memory network (LSTM) models in predicting Bursa Malaysia's closing prices during the pandemic period. The study identifies the LSTM model with three hidden layers as the most effective in forecasting Bursa Malaysia stock prices, leveraging root mean square error (RMSE) and mean absolute percentage error (MAPE) metrics for evaluation. Ultimately, these findings underscore ARIMA's robustness for longer-term predictions and LSTM's efficacy for short-term forecasts, providing valuable insights for stock price prediction models [7].

The increasing complexity of financial markets globally necessitates a concerted effort to enhance financial literacy among individuals. As financial landscapes evolve with the rise of microfinance and other services, individuals bear greater responsibility for their financial decisions. Financial illiteracy can lead to adverse outcomes such as debt, damaged credit records, and inadequate investment strategies, particularly im- pacting vulnerable low-income families. Promoting financial education becomes imperative to empower individuals and bolster their financial decision-making capabilities. Financial literacy encompasses understanding financial products, making informed choices, and managing risks, enabling individuals to navigate financial challenges more effectively. Moreover, financially literate consumers contribute to market stability and economic growth by driving demand for financial services [8]. In parallel, the relationship between attitudinal factors, financial literacy, and stock market participation is scrutinized, revealing their significant influence on individuals' decisions to engage in the stock market. Attitudinal factors like risk tolerance and confidence, coupled with financial literacy, shape stock market participation. Despite progressive regulations, emerging markets like India exhibit below-standard levels of equity product penetration, underscoring the need to un- derstand financial literacy's impact on investment intentions and perceptions of regulators. A theoretical model, draw- ing from the Theory of Planned Behaviour and Consumer Socialization Theory, elucidates this complex relationship. The section delves into the demographic characteristics of experts and the surveyed sample, shedding light on reasons for non-participation in stock markets and measurement models utilized for assessment. Overall, the discussion provides com- prehensive insights into the multifaceted dynamics influencing stock market participation in emerging economies [9].

## III. METHODOLOGY

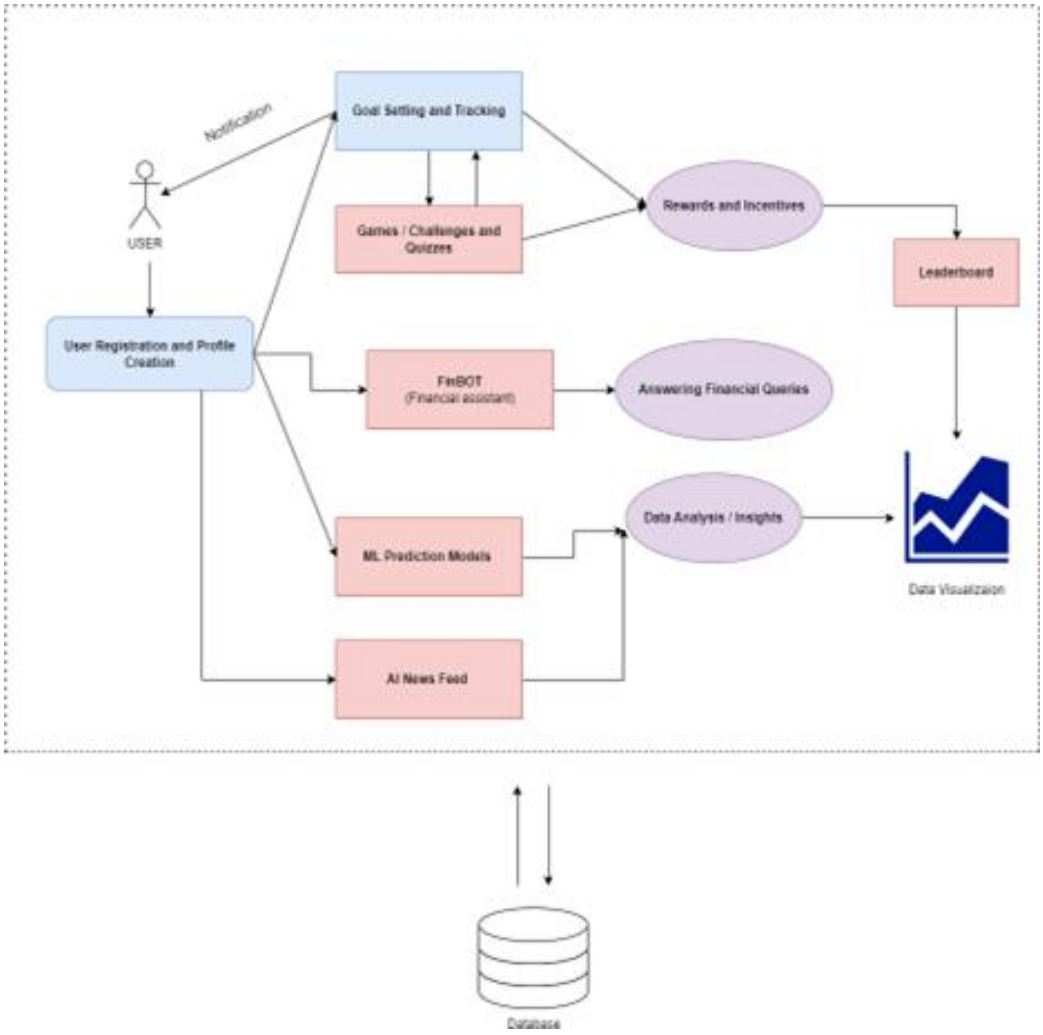


Fig. 1. Flow Diagram

The depicted Fig. 1 illustrates the comprehensive work- flow of our project, delineating the seamless journey users undertake from initial login to course completion and logout. This diagram serves as a visual guide, elucidating the intricate pathways and interactions within our application. This diagram not only provides clarity on the application's functionality but also underscores its efficiency in facilitating user engagement and task completion.

### *A. User Login and Authentication*

The User login and Authentication encompasses the initial interaction point for users accessing the "FinAI: Gamified Finance Learning Platform." Upon visiting the website via URL, users are directed to the login page, where they are prompted to either register or sign in to proceed further.

The FinAI application offers two distinct methods for user authentication:

- Google Single-sign in: This method enables users to uti- lize their existing Google accounts for seamless authentication. Leveraging the Google OAuth 2.0 API, the appli- cation facilitates the authentication process by verifying the user's Google account credentials. Upon successful authentication, the API returns an access token containing basic user information, which is stored securely within the Neon database for tracking user progress.
- Login Form: Alternatively, users can opt to log in using a traditional login form. This method allows users to create their own login credentials, such as a username and password, within the application. To ensure the security of user inputs and data, the application implements robust security measures, including input validation and sanita- tion. These measures safeguard against potential vulnera- bilities and unauthorized access, thereby maintaining the integrity and confidentiality of user information.

### *B. Course Selection*

The "Course Selection" feature allows users to browse through various financial courses offered by the "FinAI: Gam- ified Finance Learning Platform" post-login as shown in Fig.
2. Available courses cover diverse topics like: Share Market, Mutual Funds, Bonds, Life Insurance, Health Insurance. Each structured into three levels with specific modules. Users have the freedom to select courses aligning with their interests and learning goals, and the platform tracks the number of courses chosen by each user for further analysis. The "Learning Path" presents users with a structured journey upon selecting a course. For instance, selecting the Share Markets course unveils a learning path comprising five chapters: Chapter 1: Basics of Stock Market, Chapter 2: Investment Metrics, Chap- ter 3: Types of Stocks, Chapter 4: Market Conditions, Chapter 5: Trading Strategies. This pathway comprises comprehensive exploration of financial topics organized into chapters and units. Users progress by expending Energy Points, completing levels to earn XP. Accumulated XP allows users to complete quests and ascend the leaderboard, fostering engagement and competition among users.

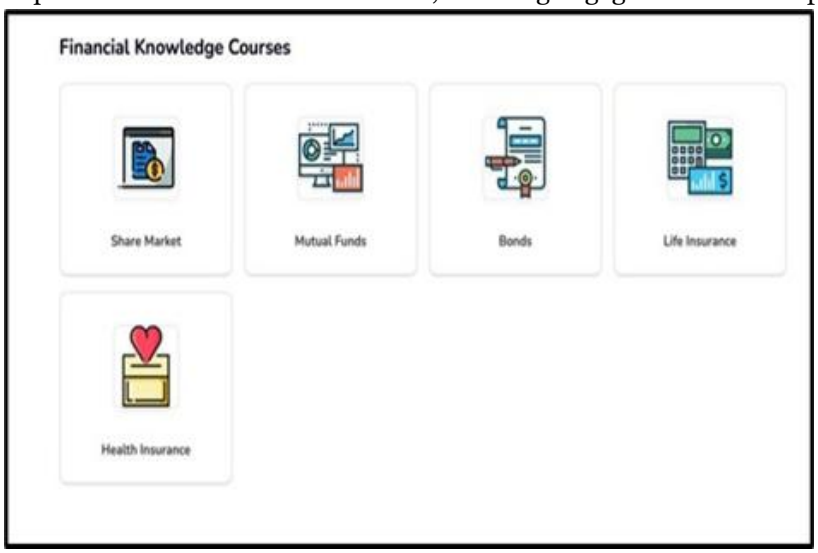


Fig. 2. Courses

### C. Algorithm

The Following are the Algorithms that were used while developing the stock Prediction model for our platform. They were compared with each other to select the most accurate model for our platform.

*1) LSTM (Long Short-Term Memory):* Leveraging LSTM (Long Short-Term Memory) modelling techniques, we devel- oped a stock price predictor to assist users in tracking prices of their preferred stocks and making informed investment deci- sions. The LSTM model, along with the Yahoo Finance library dataset, was fine-tuned to meet the application's requirements [11].

- We scale the input data for uniformity and define the length of input sequences for the model.
- We created a Sequential model in Keras, starting with an LSTM layer to capture temporal patterns. Dropout regularization is applied to prevent overfitting. The out- put layer predicts the next closing price. Added the initial LSTM layer with 50 units to capture temporal dependencies in the input sequence data. Configure it to return sequences since multiple LSTM layers are stacked. Incorporate dropout regularization with a rate of 0.2 after each LSTM layer to mitigate overfitting. Conclude the architecture with a Dense layer having 1 unit for output, as the objective is to predict a single continuous value (the next closing price).
- We first Prepare input data for prediction by scaling it using the same MinMaxScaler employed during training. Generate input sequences (x_test) from the test data and utilize the trained model to predict stock prices. The model is trained using prepared data, adjusting weights to minimize loss over epochs.
- Input data is scaled, sequences are generated, and the model predicts stock prices, and We assess the model's performance using metrics like (Mean Square Error) MSE, RMSE, and MAE (Mean Absolute Error).
- The model's performance is visualized by plotting actual versus predicted prices and we predict the next day's stock price and evaluate the model's short-term predictive ability.

*2) ARIMA (Autoregressive Integrated Moving Average):* We incorporated ARIMA (Autoregressive Integrated Moving Average) modelling techniques into our stock price predictor. After thorough comparison and evaluation of both LSTM and ARIMA models, the ARIMA model emerged as the preferred choice due to its accuracy in predicting stock prices [10].

- Visualized the historical stock prices and returns the historical stock prices and returns to visually inspect their behaviour. Analysed the autocorrelation function (ACF) and partial autocorrelation function (PACF) of the return's series. These plots help in determining the order of differencing (d) and the autoregressive (p) and moving average (q) terms for the ARIMA model.
- Utilized automated model selection techniques like (auto_arima) or manual inspection of ACF and PACF plots to identify the optimal parameters (p, d, q) for the ARIMA model.
- Fitted the ARIMA model to the historical stock prices using the selected parameters. Tools like the statsmodels library in Python assisted in this step.
- Generated Predictions for the next day's stock price based on the ARIMA forecast. Assess the reliability of the predictions by comparing them to actual observed values, if available. Evaluation metrics such as mean absolute error (MAE), mean squared error (MSE), and root mean squared error (RMSE) can provide insights into prediction accuracy.

### D. News Feed

Incorporated within our platform, the "News Feed" feature offers users a convenient way to access live updates on trending news headlines relevant to their investments as shown in Fig. 3. Utilizing the News API, our platform aggregates news articles, eliminating the need for users to manually search the web for information. With this tool, users can effortlessly stay informed about market developments and news impacting their investments.

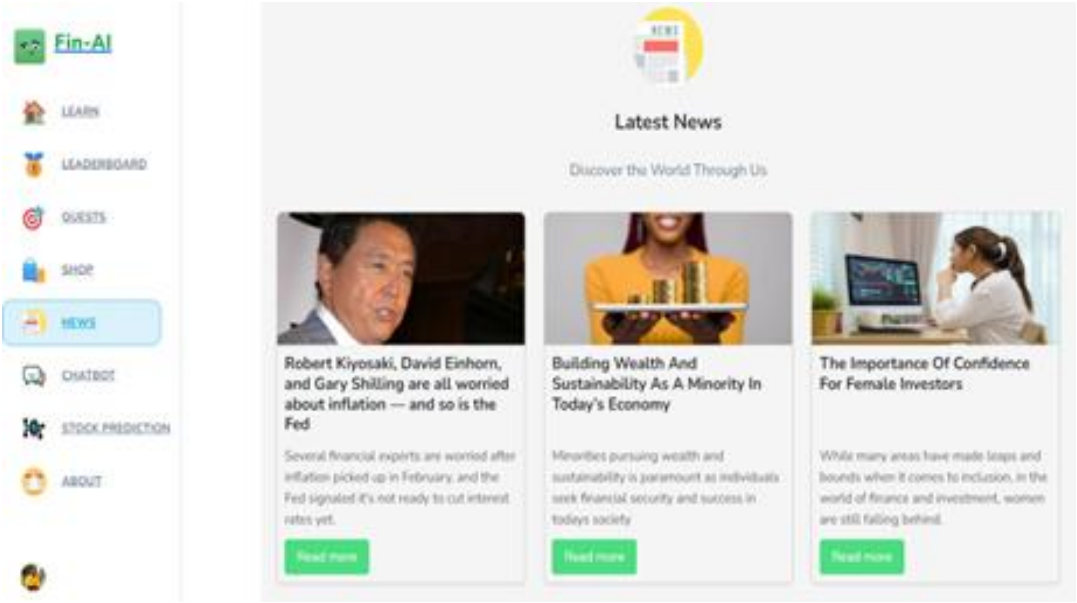


Fig. 3. News Feed

Our platform includes filtering options for articles which as follows :

- By Keywords: Our platform includes a powerful filtering option that allows users to specify keywords of interest. By entering a specific keyword as a query, users can customize their news feed to display headlines related to their chosen topic. This feature ensures that users receive news updates tailored to their investment preferences and areas of interest.
- By Number of Articles: Users have the flexibility to filter the news feed based on the number of articles they wish to view. Whether users prefer a concise overview or a more comprehensive selection of news articles, they can adjust the filtering options to meet their preferences and information needs.

To ensure accessibility and convenience, the platform was developed to be seamlessly accessible on both web and mobile platforms. The website using NERN stack provided easy access from desktops, while the mobile interface, developed using Android Studio, enabled users to engage with the platform anytime and anywhere.

## IV. RESULTS

This section presents a comprehensive overview of the FinAI platform, detailing the user interface (UI) for vari- ous pages. It showcases the implementation figures of key components, including the AI-driven chatbot and the stock prediction model. Also, includes two tables comparing the results of LSTM and ARIMA models for predicted stock prices of TESLA. Through this analysis, the effectiveness and performance of the platform's features and models are evaluated, providing valuable insights into their impact on user engagement and predictive accuracy.

The user interface (UI) of the FinAI application illustrated in Fig. 4, resembles the layout of the Duolingo mobile appli- cation's home page. The Learning Path comprises multiple Chapters, each subdivided into 4 to 6 lessons. Six lessons are combined to form a Chapter, with each lesson containing various multiple-choice questions (MCQs) as detailed in the methodology.

Upon completing each Lesson within a chapter, users are rewarded with XP points and provided feedback on their completion time and overall accuracy. This real-time feed- back mechanism enhances user engagement and motivation, encouraging active participation and learning.

The leader board feature of the platform as showcased in Fig. 5, presents users with the opportunity to compete within various leagues, Users vie for top positions within these leader boards, with promotions to higher ranks contingent on achieving certain XP thresholds. By clicking on individual user profiles, users can compare their performance metrics and achievements with those of their peers, fostering a sense of community and healthy

competition.

The outcomes produced by the stock price predictor that was integrated into the platform are displayed in Fig. 6. The predictor predicts the future price of a chosen stock by using

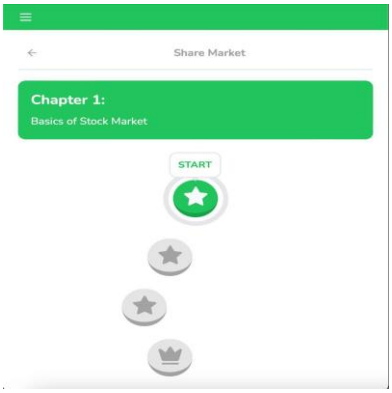


Fig. 4. Learning Path.

machine learning algorithms and data that is taken from Yahoo Finance. The selected stock's closing prices are shown on the graph, together with its 100- and 200-day moving averages, which give users insightful information about possible market trends and investment possibilities.

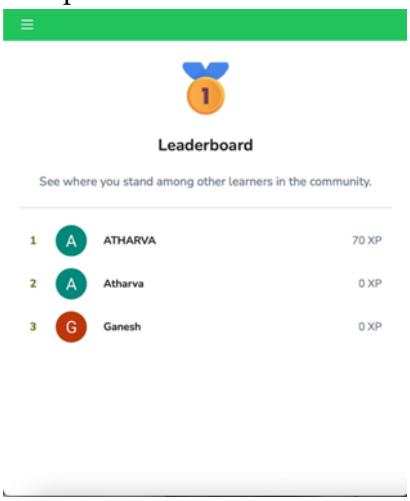


Fig. 5. Leaderboard.


Fig. 6. Stock Prediction UI

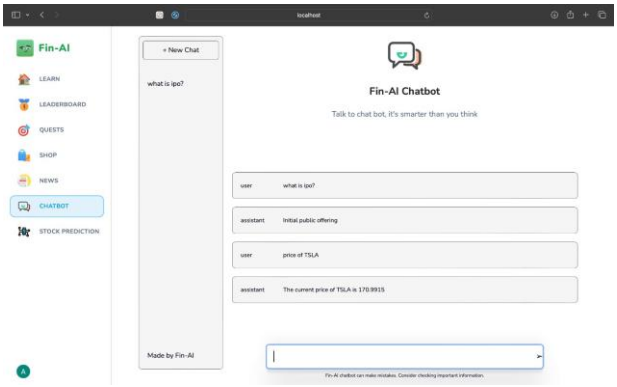


Fig. 7. FinBot.

The Fig. 7 depicts the user interface (UI) of Finbot, the chatbot integrated within our FinAI application, designed to address user queries related to finance. Utilizing the Google Bard API from the Makersuite, Finbot leverages its services to provide responses to user inquiries. However, during our analysis, we observed discrepancies in the accuracy of stock prices when queried by users. To address this issue, we developed an API using Rule-based Information Extraction Technique that fetches live data on stock prices from Finhub by trimming the user prompt. This API dynamically trims user queries to extract the relevant stock symbol, ensuring accurate and precise responses regarding stock prices for users.

LSTM stands for Long Short-Term Memory. This means the cell actually has a memory and is therefore much better at remembering patterns and making predictions based on patterns. This was the best performing model I have built in this project. It is interesting how the 30 day window was the best model by far as shown in Fig. 8.

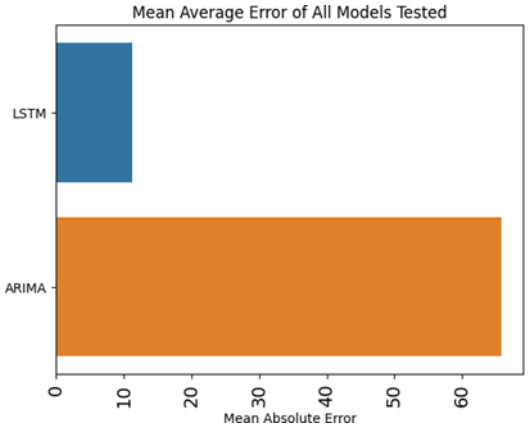


Fig. 8. Mean Average Error of the Models Tested

In essence, Figure 9 encapsulates the graph which provides a visual representation of the performance of the predictive model in forecasting TSLA (Tesla) stock prices. The actual share prices are depicted in black, while the predicted prices are represented in green. By comparing the two lines, users can assess the accuracy of the model's predictions over the specified time period. Key evaluation metrics such as Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and Mean Absolute Error (MAE) are calculated and displayed, offering insights into the model's predictive performance.

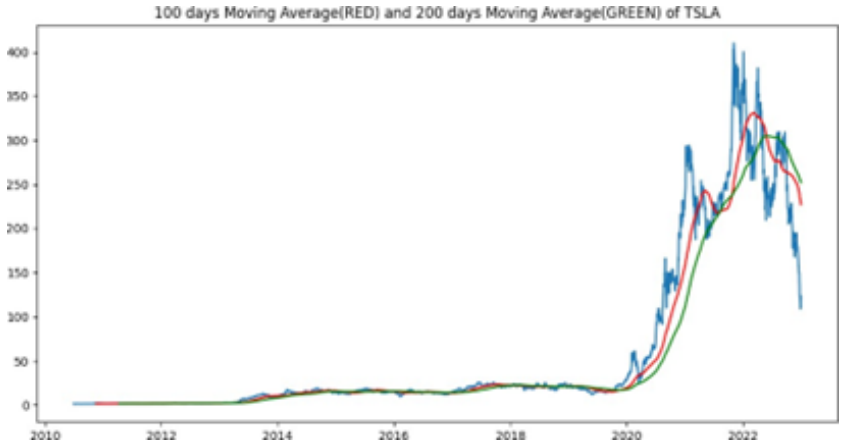


Fig. 9. 100 Days and 200 Days Moving Average of TESLA.

In the pursuit of enhancing stock price prediction accuracy, our research evaluated the performance of both Long Short- Term Memory (LSTM) and Autoregressive Integrated Moving Average (ARIMA) models. As depicted in Tab.1, which compares the predicted and actual stock prices of TESLA using LSTM, our findings indicate a relatively lower Mean Squared Error (MSE) for the LSTM model compared to the ARIMA model. However, upon further scrutiny and real-time application, Tab.2 showcases those predictions generated by the ARIMA model demonstrated superior accuracy compared to LSTM. Despite the initial advantage of LSTM in terms of MSE, the ARIMA model exhibited more reliable predictions when tested against real-time data . This observation suggests that while LSTM may excel in certain metrics during model evaluation, ARIMA's performance in practical scenarios, particularly in real-time prediction tasks, proves to be more robust and accurate. These contrasting outcomes underscore the importance of considering both model performance metrics and real-world applicability when selecting an appropriate forecasting model for stock price prediction task.

TABLE I
STOCK ANALYSIS USING LSTM

| ***Dates*** | ***Predicted Stock Price*** | ***Actual Stock Price*** |
|---|---|---|
| 1/3/2024 | 176.5817 | 175.12 |
| 2/3/2024 | 175.9074 | 166.63 |
| 3/3/2024 | 182.6486 | 168.39 |
| 4/3/2024 | 175.8591 | 171.21 |
| 5/3/2024 | 180.9935 | 164.90 |

[a]All prices are in dollars.

The line plot in Fig. 10 compares the predicted and actual stock prices of TESLA over a specific period, using both LSTM and ARIMA models for forecasting. The solid lines represent the predicted stock prices generated by the LSTM and ARIMA models, while the dashed lines depict the actual stock prices observed on those dates. The graph provides a visual comparison between the predicted and actual prices, allowing for an assessment of the models' accuracy in

TABLE II
STOCK ANALYSIS USING ARIMA

| ***Dates*** | ***Predicted Stock Price*** | ***Actual Stock Price*** |
|---|---|---|
| 1/3/2024 | 176.7660 | 175.12 |
| 2/3/2024 | 175.0759 | 166.63 |
| 3/3/2024 | 167.8176 | 168.39 |
| 4/3/2024 | 173.7208 | 171.21 |
| 5/3/2024 | 172.5032 | 164.90 |

[a]All prices are in dollars.

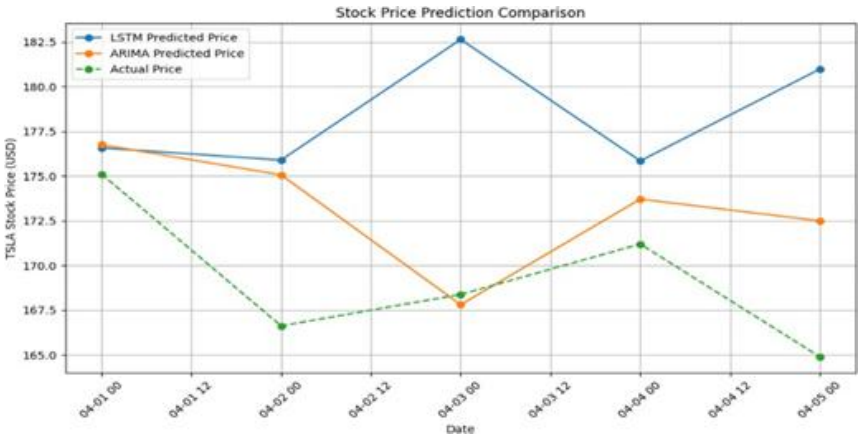


Fig. 10. 1LSTM vs ARIMA vs Actual price.

Forecasting TESLA stock prices. It illustrates how closely the predicted prices align with the actual prices, offering insights into the performance of the LSTM and ARIMA models in capturing the underlying patterns and trends in the stock price data.

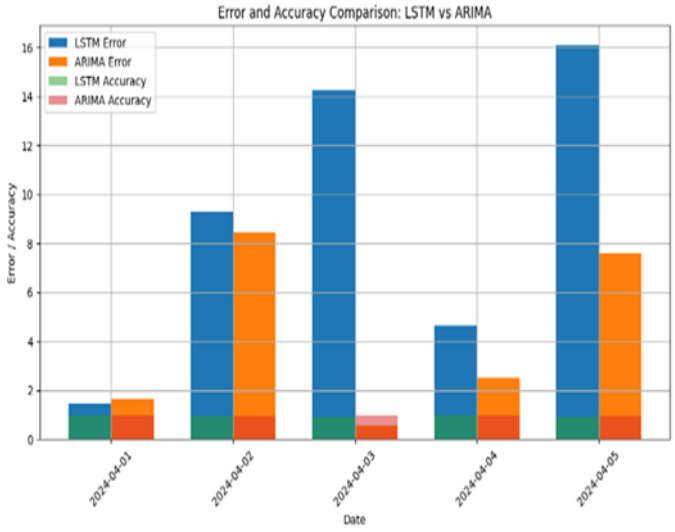


Fig. 11. Error and Accuracy Comparison: LSTM vs ARIMA.

The bar plot as shown in Fig.11 compares the error and accuracy between LSTM and ARIMA models for predicting stock prices of TESLA over a specific period. The error bars represent the absolute difference between the predicted and actual stock prices, while the coloured bars depict the accuracy, calculated as 1 minus the error divided by the actual price. From the graph, it's evident that ARIMA consistently

exhibits lower error and higher accuracy compared to LSTM for the given dataset. In terms of percentage accuracy, ARIMA outperforms LSTM by approximately (10%) on average across the observed dates, indicating its superior predictive capability for this particular task.

## V. CONCLUSION

The research on the "FinAI: Gamified Finance Learning Platform" underscores its transformative potential in enhanc- ing financial literacy and empowering users. Through meticu- lous evaluation, including gamified interface, AI-driven chat- bot, stock prediction model, and real-time updates, FinAI sim- plifies complex concepts, fosters engagement, and improves learning outcomes. Its accuracy in stock prediction, accessibil- ity, and motivational elements drive continuous improvement. Real-time updates enrich the learning experience. Synthesizing empirical analysis and user feedback, this study provides insights for FinAI's development. By addressing optimization areas, FinAI evolves as a dynamic tool for financial education, fostering confidence and competence in navigating personal finance.

## VI. FUTURE SCOPE

FinAI highlights its potential to transform financial literacy through gamification and AI driven features. It simplifies complex concepts, enhances user engagement, and fosters confidence in financial decision-making. Findings confirm its effectiveness in maximizing comprehension and providing valuable insights. Recommendations for optimization aim to further empower users in navigating personal finance con- fidently, positioning FinAI as a crucial tool for advancing financial literacy in the digital era. This innovative method not only makes learning about money fun but also has the potential to empower people and organizations to make more informed financial decisions.

In a world where financial management can be complex, this platform serves as a user-friendly and adaptable solution. As it continues to develop, incorporating real-life market simulations and expanding to cover emerging financial trends, it equips users with practical knowledge and skills essential for navigating today's financial world. Whether for individuals looking to secure their financial future or companies seeking to enhance their employees' financial literacy, the gamified Personal Finance Learning Platform is poised to revolutionize financial education and management, fostering a society that is more financially confident and capable.

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