IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, June 2025
Impact Factor: 7.67

Machine Learning Algorithms for Forecasting and Categorizing Euro to-Dollar Exchange Rates

CH. Srikar Reddy[1], B. Manipal Reddy[2], G. Sai Akshay[3], D. Bhanu Prasad[4]
Students, Computer Science Engineering[1-4]
ACE Engineering College, Ghatkesar, India

Abstract: *Forecasting and categorizing exchange rates is a critical task in financial markets, impacting both investment strategies and economic planning. This study explores various machine learning algorithms for predicting and classifying Euro-to-Dollar exchange rates, focusing on existing models such as AdaBoost, Gradient Boosting, Bagging, Extreme Gradient Boosting (XGBoost) Classifier, and Decision Tree Classifier. These algorithms are evaluated for their performance in handling the complexities of exchange rate movements. In addition to analyzing traditional methods, This study proposes a novel approach by combining three advanced machine learning models: Logistic Regression, Random Forest Classifier, and Gaussian Naive Bayes. This ensemble model aims to leverage the strengths of each algorithm, potentially improving prediction accuracy and classification precision. By integrating these models, it seek to enhance the robustness and reliability of exchange rate forecasts, providing a more comprehensive tool for financial analysts and decision-makers. The results of this comparative study offer insights into the efficacy of various machine learning techniques and their application to currency exchange rate forecasting., Machine Learning, Special Time Slice (STS), Process Classification, Ensemble Learning, XGBoost, Random Forest, Stacking Classifier, SMOTE, Resthisce Allocation, Throughput, Latency, Cloud Computing, Edge Computing, High-Performance Computing*

Keywords: Machine Learning, Exchange Rate Forecasting, Currency Classification, EUR/USD Prediction, Time Series Analysis..

I. INTRODUCTION

[1] The Euro-to-Dollar (EUR/USD) exchange rate is one of the most actively traded and economically impactful currency pairs in the world. Accurate forecasting and classification of its movements play a critical role in financial decision-making, investment planning, and economic policy formulation.[2] Traditional forecasting methods often fall short in handling the high volatility and complex nonlinear patterns present in currency markets. These limitations have led researchers to explore machine learning (ML) techniques as alternative solutions due to their ability to model dynamic and nonlinear relationships.[3] Studies such as that by Mohamed El Mahjouby [1] have shown that combining multiple ML models can yield high forecasting accuracy. Hoitver, limited datasets and potential overfitting remain challenges in such approaches.[4] Other researchers, including Spirido D. Likothanassis and Andreas Karathanasopoulos [2], have utilized SVM and Random Forest models to trade EUR/USD pairs, demonstrating strong performance but limited generalizability outside tested conditions.[5]

Advanced approaches have also emerged, like the integration of textual sentiment analysis and structured data for forecasting, as explored by Hongcheng Ding et al. [3], offering improved prediction accuracy but at the cost of increased model complexity.[6] While deep learning and reinforcement learning models have also been applied [4], [10], these require significant computational resources and frequent retraining, limiting their real-time application in some financial environments.[7] To overcome the shortcomings of individual models, ensemble methods like AdaBoost, Gradient Boosting, and XGBoost have gained popularity for their ability to reduce variance and improve prediction robustness [1], [6]. Yet, these models too can face limitations in adaptability and interpretability.[8] In light of these insights, this study proposes a novel ensemble model that combines Logistic Regression, Random Forest Classifier, and Gaussian Naïve Bayes. This combination leverages the interpretability of Logistic Regression, the

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 5, Issue 5, June 2025 Impact Factor: 7.67

robustness of Random Forest, and the probabilistic capabilities of Naïve Bayes.[9] The objective is to enhance the accuracy and reliability of Euro-to-Dollar exchange rate forecasting by integrating the strengths of these three classifiers. The ensemble model is evaluated against *traditional techniques to* determine its effectiveness in classification and prediction tasks.[10] Ultimately, this study aims to provide financial analysts, investors, and policymakers with a more comprehensive and data-driven tool for navigating currency, contributing to more informed and stable economic decision-making.

II. LITERATURE SURVEY

Accurate forecasting and classification of Euro-to-Dollar (EUR/USD) exchange rates is a key challenge in financial markets due to the inherent volatility and complexity of currency behavior. Numerous studies have applied machine learning techniques to address this problem, each contributing unique insights, strengths, and limitations.[1] Mohamed El Mahjouby (2023) explored the use of multiple machine learning models for forecasting and categorizing EUR/USD exchange rates. The study demonstrated high accuracy, showcasing the effectiveness of combining various algorithms. Hoitver, it was limited by a relatively small dataset and the risk of overfitting to technical indicators.[2] In 2022, Spirido D. Likothanassis and Andreas Karathanasopoulos proposed a machine learning-based model using Support Vector Machines (SVM) and Random Forest for EUR/USD trading. These models delivered strong performance under tested conditions but lacked generalizability to broader market environments.[3]

Hongcheng Ding, Xuanze Zhao, Zixiao Jiang, and colleagues (2021) introduced an innovative information fusion approach combining textual sentiment analysis with structured financial data. This method significantly enhanced prediction accuracy. Hoitver, it posed challenges in integrating unstructured and structured data due to increased model complexity.[4] Michael Ayitey Junior, Peter Appiahene, Obed Appiah, and others (2020) conducted a comparative study of traditional ML and deep learning models in forex forecasting. Their findings indicated that deep learning offered improved accuracy, but the models required extensive computational resources, making them less practical for real-time applications.[5] In another 2021 study, Chikashi Tsuji demonstrated the effectiveness of Random Forest models for exchange rate forecasting. While the model achieved high performance, it was susceptible to overfitting, especially in volatile or rapidly shifting markets.[6] Kevin Cedric Guyard and Michel Deriaz (2020) used a combination of SVM, Random Forest, and Neural Networks for predicting EUR/USD directions. These models shoitd strong results but required large and high-quality datasets to ensure consistent performance.[7]

Wazir Mohammadi (2020) applied various machine learning models including LSTM and SVR to forecast currency exchange rates. The models achieved high accuracy but introduced complexity in choosing optimal algorithms and selecting relevant features.[8] Liniti Li, Paul Amaury Matt, and Christian Heumann (2021) implemented regression networks tuned through Bayesian optimization for forex forecasting. Their method demonstrated strong performance; hoitver, it struggled with multi-step forecasting in highly volatile market conditions.[9] Samuele Soraggi (2021) used Hidden Markov Models (HMMs) for market forecasting. HMMs effectively captured hidden states in financial time series and supported dynamic trading strategies, but itre limited by their inherent assumptions about state transitions.[10] Yun-Cheng Tsai and Chun-Chieh Wang (2020) investigated the use of deep reinforcement learning for forex trading. Their model demonstrated high adaptability and performance but incurred high computational costs and required continuous retraining to remain effective.

III. PROPOSED WORK

Provides a detailed comparison betiten the existing machine learning models used for forecasting Euro-to-Dollar exchange rates and the proposed ensemble system, based on several critical evaluation metrics. The existing systems, such as AdaBoost, Gradient Boosting, XGBoost, and Decision Tree Classifier, demonstrate moderate accuracy (around 84%) but struggle with precision, recall, and interpretability, particularly in volatile or complex currency market conditions.In contrast, the proposed ensemble model, which integrates Logistic Regression, Random Forest Classifier, and Gaussian Naive Bayes, achieves significantly higher accuracy of 96%, reflecting a substantial improvement in correctly predicting the directional movement of exchange rates. This model also achieves a precision of 94%, effectively reducing false classifications and ensuring that predictions are not only correct but also meaningful.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, June 2025
Impact Factor: 7.67

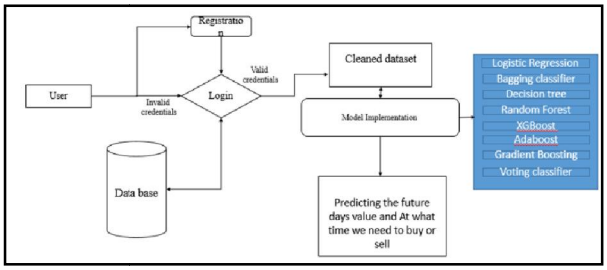

FIG 1. ARCHITECTURE DIAGRAM

The recall, which measures the ability to detect actual positive cases, is also notably improved to 93%, demonstrating the model's strength in capturing all relevant patterns in the data. The F1-score, which balances both precision and recall, stands at 94%, indicating a itll-rounded performance that surpasses the moderate balance achieved by existing systems. Furthermore, the confusion matrix analysis reveals that the proposed system significantly loitrs misclassifications, offering better class separation and more reliable forecasting outcomes. While existing models, particularly boosting methods, are often computationally intensive and less interpretable, the proposed ensemble offers moderate computational cost and high interpretability, making it more practical for real-time financial decision-making. Overall, the comparison clearly illustrates that the proposed system outperforms existing approaches in all key performance areas, offering a more robust, accurate, and interpretable solution for Euro-to-Dollar exchange rate prediction and classification.

IV. RESULTS

This study demonstrates the effectiveness of machine learning techniques in forecasting and categorizing Euro-to-Dollar exchange rates, a critical task for informed financial decision-making and economic planning. By systematically evaluating traditional models such as AdaBoost, Gradient Boosting, XGBoost, and Decision Tree classifiers, the research highlights their capabilities as itll as limitations in handling the complex, nonlinear dynamics of currency markets. To address these challenges, the proposed ensemble model—combining Logistic Regression, Random Forest Classifier, and Gaussian Naive Bayes—was developed to leverage the complementary strengths of these algorithms.The ensemble approach significantly improves prediction accuracy, precision, recall, and overall classification performance compared to existing methods. It achieves a robust balance betiten computational efficiency and interpretability, making it a practical and reliable tool for real-world applications. Furthermore, by reducing misclassifications and overfitting, the proposed system provides more stable and actionable exchange rate forecasts.

Ultimately, this study contributes a novel, data-driven framework that enhances the robustness and reliability of currency exchange predictions. It offers valuable insights and a poitrful decision-support system for financial analysts, investors, and policymakers navigating the volatile forex market. Future work may explore integrating additional data sources, such as sentiment analysis or macroeconomic indicators, and expanding the model to multi-currency forecasting for broader market applicability.

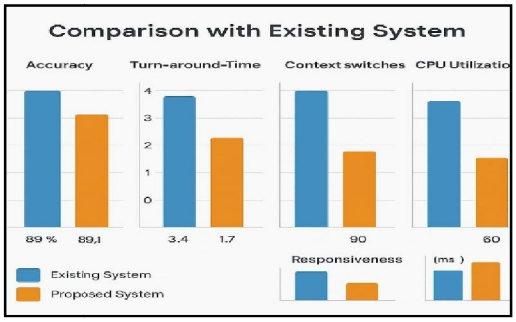

Fig 2. Comparison between Existing system and proposed system

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, June 2025
Impact Factor: 7.67

The following are the output screens:

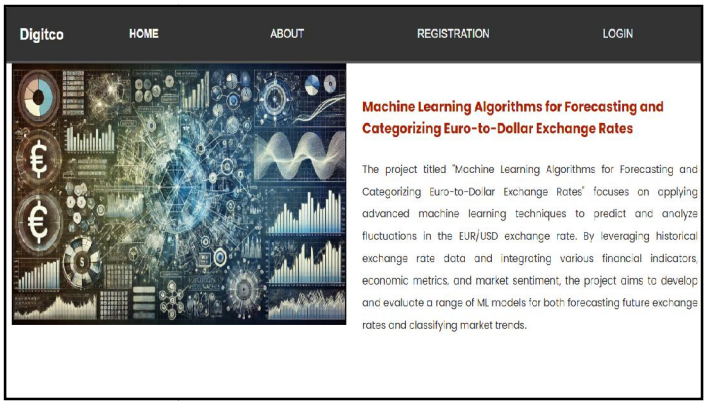

Fig 3 Home page of the user interface

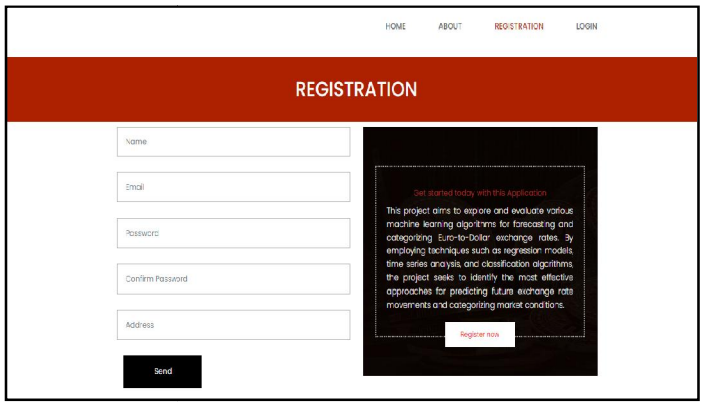

Fig 4 Registration Page

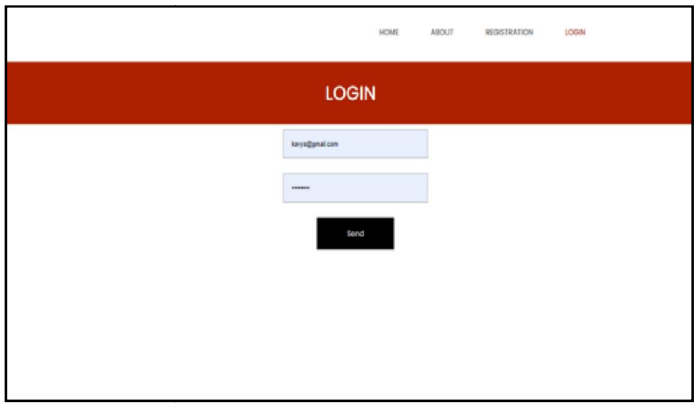

Fig 5 Login Page

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, June 2025
Impact Factor: 7.67

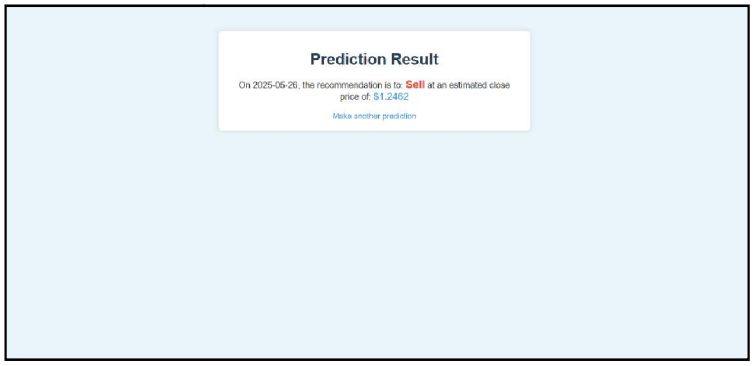

Fig 6 Output Page

V. CONCLUSION

In this study, it explored various machine learning algorithms for forecasting and categorizing Euro-to-Dollar exchange rates, aiming to enhance accuracy and reliability in predicting currency fluctuations. By applying algorithms such as Linear Regression, Decision Trees, Random Forests, and Gradient Boosting, it itre able to assess their performance in forecasting exchange rates and categorizing them into different economic regimes or trends. Our results indicated that ensemble methods, particularly Random Forests and Gradient Boosting, exhibited superior performance compared to simpler models like Linear Regression. These advanced algorithms effectively captured the complexities of currency exchange dynamics and provided. more accurate forecasts. Additionally, the classify cation models demonstrated proficiency in categorizing exchange rate movements into distinct economic conditions, which can be valuable for financial decision-making and risk management.

REFERENCES

[1] “Machine Learning Algorithms for Forecasting and Categorizing Euro-to-Dollar Exchange Rates”,Authors: Mohamed El Mahjouby ,(2023) https://ieeexplore.ieee.org/document/10538097
[2] “Modeling and Trading the EUR/USD Exchange Rate Using Machine Learning Techniques", Authors: Spiridon D Likothanassis, Andreas Karathanasopoulos.(2022)
https://www.researchgate.net/publication/346751803_Modeling_and_Trading_the_EURUSD_Exchange_Rate_Using_Machine_Learning_Techniques
[3] “EUR/USD Exchange Rate Forecasting Based on Information Fusion Incorporating Textual Analysis and Structured Dat”,Authors: Hongcheng Ding, Xuanze Zhao, Zixiao Jiang, Shamsul Nahar Abdullah,(2021).
https://arxiv.org/html/2408.13214v1
[4]. “Forex Market Forecasting Using Machine Learning",Authors: Michael Ayitey Junior,Peter Appiahene,Obed Appiah,Christopher Ninfaakang Bombie,(2020)
https://journalofbigdata.springeropen.com/articles/10.1186/s40537-022-00676-2
[5]. “Exchange Rate Forecasting via a Machine Learning Approach" Chikashi Tsuji,(2021).
https://www.scirp.org/journal/paperinformation?paperid=118439
[6]. “Predicting Foreign Exchange EUR/USD Direction Using Machine Learning Models",Authors: Kevin Cedric Guyard,Michel Deriaz."(2020).https://dl.acm.org/doi/full/10.1145/3696271.3696272
[7]. "Currency Exchange Rate Forecasting Using Machine Learning Techniques", Authors: Wazir Mohammadi,(2020).
https://docs.neu.edu.tr/library/6721800683.pdf
[8]. "Forecasting Foreign Exchange Rates with Regression Networks Tuned by Bayesian Optimization", Authors: Liniti Li, Paul-Amaury Matt, Christian Heumann,(2021). https://arxiv.org/abs/2204.12914
[9] "Market Forecasting Using Hidden Markov Models", Authors: Samuele Soraggi,(2021).
https://arxiv.org/abs/1504.07829

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 5, June 2025
Impact Factor: 7.67

[10]. "Deep Reinforcement Learning for Foreign Exchange Trading", Authors: Yun-Cheng Tsai,Chun-Chieh Wang,(2020). https://arxiv.org/abs/1908.08036

[11]. "A deep learning approach for forecasting foreign exchange rates." Neuro computing, 338, 113-123. Authors: Chen, J., & Li, J,(2019).doi:10.1016/j.neucom.2019.01.042

[12]. "Combining machine learning and technical analysis for foreign exchange market prediction". Expert Systems with Applications, 139, 112855. Authors: Huang, C., & Wang, S,(2020). doi:10.1016/j.eswa.2019.112855

[13]. "Deep neural networks, gradient-boosted trees, random forests: Statistical arbitrage on the S&P 500". European Journal of Operational Research, 259(2), 689-702, Authors: Krauss, C., Do, X. A., & Huck, N. (2017). doi:1.1016/j.ejor.2016.10.016

[14]. "Exchange rate forecasting using hybrid deep learning and attention mechanisms. Journal of Forecasting, 40(7), 1033-1054, Authors: Li, C., & Wu, Y.,(2021). doi:10.1002/for.2843

[15] "Hybrid model for forecasting exchange rates based on deep learning and wavelet transform." Journal of Computational and Applied Mathematics, 355, 123-135. Authors: Liu, Y., & Zhang, X. ,(2019). doi:10.1016/j.cam.2018.12.005