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A Predictive Machine Learning Approach for Digital Payment Platform Adoption Among Retail Vendors

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***Abstract* – The rapid advancement of digital technologies has significantly transformed the retail sector by accelerating the adoption of digital payment platforms. Digital payment solutions provide enhanced transaction speed, improved security, operational efficiency, and greater convenience for both merchants and consumers. Despite these advantages, the adoption of digital payment platforms among small and medium-sized retail vendors remains inconsistent due to several technological, organizational, and behavioral factors. Understanding these influencing factors is essential for financial institutions, payment service providers, policymakers, and retailers seeking to promote a cashless economy. Recent developments in Machine Learning (ML) have enabled more effective analysis of complex adoption patterns by identifying hidden relationships within large datasets and generating reliable predictive models.. The predictive performance of the proposed framework is evaluated using Accuracy, Precision, Recall, and F1-Score metrics. Experimental analysis demonstrates that the Support Vector Machine achieves an overall accuracy of 56.67%, precision of 59.38%, recall of 66.67%, and an F1-score of 66.25%, indicating moderate predictive capability for digital payment adoption. The findings further reveal that perceived usefulness, social influence, and compatibility are the most significant factors encouraging adoption, whereas perceived ease of use and technical support exhibit relatively lower influence. The proposed framework provides valuable insights for improving digital payment adoption strategies and supports policymakers, financial institutions, and platform providers in developing more effective initiatives that encourage wider acceptance of digital payment technologies among retail vendors.**

Keywords - **Machine Learning, Digital Payment Adoption, Retail Vendors, Predictive Analytics, FinTech, Consumer Behavior Analysis**

I. INTRODUCTION

The rapid digital transformation of financial services has significantly changed the way commercial transactions are performed across the retail industry. The widespread availability of smartphones, affordable internet connectivity, and secure payment infrastructures has accelerated the transition from traditional cash-based transactions to digital payment platforms. Solutions such as mobile wallets, Unified Payments Interface (UPI), QR code payments, and online banking applications have enabled retailers to process transactions more efficiently while offering customers faster, safer, and more convenient payment experiences. Consequently, digital payment technologies have become an essential component of modern retail operations, supporting financial inclusion and promoting a cashless economy.

Despite the increasing popularity of digital payment systems, their adoption among small and medium-sized retail vendors remains uneven. While many merchants have successfully integrated digital payment platforms into their daily business activities, others continue to rely primarily on conventional cash transactions. The adoption process is influenced by multiple technological, organizational, and behavioral factors that vary across businesses and market environments. Retail vendors often evaluate aspects such as operational benefits, ease of implementation, transaction security, compatibility with existing business processes, customer demand, and peer recommendations before deciding whether to adopt a digital payment solution. Understanding these factors is essential for improving adoption strategies and supporting sustainable digital transformation within the retail sector.

Traditional statistical techniques have been extensively employed to investigate technology adoption behavior and identify the factors influencing digital payment acceptance. Although methods such as regression analysis and factor analysis provide valuable insights into the relationships between individual variables, they may not adequately capture the complex interactions that exist among multiple behavioral and business-related attributes. With the increasing availability of retail transaction data and computational resources, Machine Learning (ML) has emerged as an effective alternative for analyzing multidimensional datasets and generating predictive models capable of supporting intelligent decision-making. By learning hidden patterns directly from historical data, machine learning algorithms can improve prediction accuracy and provide more reliable estimates of technology adoption behavior.

Among various machine learning techniques, Support Vector Machine (SVM) has demonstrated considerable effectiveness in solving classification problems involving high-dimensional datasets. SVM constructs optimal

decision boundaries that distinguish between different adoption outcomes based on multiple influencing factors. When combined with conventional statistical methods such as Exploratory Factor Analysis (EFA) and Multiple Regression Analysis, machine learning provides a comprehensive analytical framework that not only identifies the key determinants of digital payment adoption but also predicts the likelihood of future adoption among retail vendors. Furthermore, integrating forecasting models such as AutoRegressive Integrated Moving Average (ARIMA) enables researchers to estimate future trends in digital payment usage using historical search and transaction data.

This study proposes an intelligent machine learning framework for predicting digital payment platform adoption among retail vendors operating in Bangalore. The research utilizes survey responses collected from 270 merchants across 10 major retail markets, representing both organized and unorganized business sectors. The proposed framework employs Exploratory Factor Analysis to identify the principal adoption factors, Multiple Regression Analysis to examine relationships among business variables, is also analyzed. The outcomes of this study provide practical insights for payment service providers, financial institutions, policymakers, and retail businesses seeking to improve digital payment adoption and strengthen the digital economy.

II. LITERATURE SURVEY

The rapid growth of digital financial technologies has encouraged researchers to investigate the factors that influence the adoption of digital payment platforms among retailers and consumers. As digital transactions become an integral part of modern commerce, numerous studies have explored the technological, behavioral, and organizational aspects that determine users' willingness to adopt electronic payment systems. Earlier research primarily focused on technology acceptance theories, while recent investigations have increasingly integrated machine learning techniques to improve the prediction of adoption behavior and support data-driven decision-making.

Several studies have applied the Technology Acceptance Model (TAM) to explain users' acceptance of digital payment technologies. According to this framework, perceived usefulness and perceived ease of use are among the most influential determinants affecting technology adoption. Research consistently indicates that merchants are more inclined to adopt digital payment platforms when they believe that these systems improve transaction efficiency, enhance customer service, reduce operational complexity, and contribute to overall business performance. Although ease of use remains an important consideration, many investigations report that practical business benefits often exert a stronger influence on adoption decisions than system simplicity alone.

Subsequent research expanded traditional technology acceptance theories by incorporating additional behavioral and environmental demonstrate that recommendations from customers, peers, and business communities significantly influence merchants' decisions to implement digital payment solutions. Similarly, compatibility with existing business operations has been identified as an important requirement, as retailers generally prefer payment platforms that integrate seamlessly with their current workflows without requiring substantial operational changes. Security and trust have also received considerable attention in digital payment research because financial transactions involve sensitive customer information. Numerous studies report that confidence in transaction security, privacy protection, fraud prevention mechanisms, and platform reliability positively affects merchants' willingness to adopt digital payment technologies. As digital payment providers continue strengthening security infrastructures and regulatory compliance, retailers have gradually developed greater confidence in electronic payment systems. Nevertheless, maintaining strong security measures remains essential for sustaining long-term adoption and increasing user trust across diverse business environments.

technology adoption behavior beyond conventional statistical approaches. Unlike traditional regression models that primarily evaluate linear relationships among variables, machine learning algorithms can identify complex nonlinear interactions within multidimensional datasets. Classification techniques such as Support Vector Machine (SVM) have demonstrated promising capability in predicting technology adoption by learning hidden behavioral patterns from historical data. The integration of machine learning with statistical methods enables researchers to improve prediction accuracy while providing more comprehensive insights into the factors influencing digital payment acceptance. Furthermore, time-series forecasting techniques such as AutoRegressive Integrated Moving Average (ARIMA) have been widely adopted to estimate future trends in digital payment usage by analyzing historical search behavior and transaction patterns.

Although previous investigations have significantly advanced the understanding of digital payment adoption, several research gaps remain. Many existing studies focus primarily on identifying influential factors without combining behavioral analysis, predictive modeling, customer satisfaction assessment, and future trend forecasting within a unified analytical framework. In addition, limited research has examined adoption behavior among small and medium-sized retail vendors operating in metropolitan markets using both statistical analysis and machine learning techniques. The present study addresses these limitations by integrating Exploratory Factor Analysis (EFA), Multiple Regression Analysis, Support Vector Machine (SVM), customer satisfaction evaluation, and ARIMA-based forecasting to develop a

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comprehensive framework for predicting digital payment platform adoption among retail vendors. This integrated approach provides deeper insights into merchant behavior while supporting strategic planning for digital payment providers, policymakers, and financial institutions.

III. PROPOSED METHODOLOGY

The proposed framework presents an intelligent Machine Learning-based Digital Payment Adoption Prediction System designed to estimate the likelihood of retail vendors adopting digital payment platforms. The framework combines conventional statistical analysis with machine learning techniques to identify the major determinants influencing adoption behavior while generating predictive insights that support strategic decision-making. Unlike traditional approaches that focus solely on descriptive analysis, the proposed system integrates Exploratory Factor Analysis (EFA), Multiple Regression Analysis, Support Vector Machine (SVM) classification, customer satisfaction analysis, and ARIMA-based trend forecasting into a comprehensive predictive framework. This integrated methodology enables both factor identification and future adoption prediction, providing valuable information for payment service providers, policymakers, and retail businesses.

A structured questionnaire is employed to collect information related to business profile, digital payment usage, transaction behavior, customer preferences, and factors influencing digital payment adoption. Prior to analysis, all collected responses are validated and organized into a structured dataset suitable for statistical and machine learning processing.

Following data collection, the dataset undergoes data preprocessing to improve quality and analytical consistency. Missing values, inconsistent responses, and incomplete records are identified and appropriately handled to ensure reliable model development. The cleaned dataset is subsequently prepared for statistical analysis by organizing the variables into meaningful categories representing technological, behavioral, and organizational factors affecting digital payment adoption.
To identify the major determinants influencing adoption, Exploratory Factor Analysis (EFA) is applied to evaluate relationships among variables including perceived usefulness, perceived ease of use, social influence, facilitating conditions, perceived security, technical support, and compatibility. EFA groups related variables into underlying factors that explain merchants' adoption behavior. Subsequently, Multiple Regression Analysis is performed to examine the influence of digital payment usage characteristics, transaction frequency, and business attributes on adoption decisions, providing statistical evidence regarding the significance of individual variables. After identifying the influential factors, the processed dataset performance and reliability.

In addition to adoption prediction, the proposed framework performs customer satisfaction analysis to compare user experiences across multiple digital payment platforms. The comparative evaluation helps identify the platforms receiving higher satisfaction levels among retail vendors. Furthermore, future adoption patterns are estimated using the AutoRegressive Integrated Moving Average (ARIMA) forecasting model applied to historical Google Trends data. This forecasting component provides valuable insights into the expected growth of digital payment technologies over time and supports strategic planning for financial institutions and payment service providers.

Overall, the proposed framework combines statistical modeling, machine learning classification, customer satisfaction evaluation, and time-series forecasting into a unified analytical system for predicting digital payment platform adoption. By integrating multiple analytical techniques, the framework provides a comprehensive understanding of merchant behavior while supporting evidence-based decision-making aimed at accelerating digital payment adoption within the retail sector.

Fig. 1. System Architecture of the Proposed Machine Learning Framework for Predicting Digital Payment Platform Adoption Among Retail Vendors.

IV. METHODOLOGY

The proposed methodology employs a systematic framework that integrates statistical analysis, machine learning, and time-series forecasting to predict the adoption of digital payment platforms among retail vendors. The methodology consists of six major phases: data collection, data preprocessing, exploratory data analysis, factor identification, machine learning-based prediction, and future trend forecasting. This comprehensive approach enables the identification of influential adoption factors while generating reliable predictions regarding digital payment acceptance among retailers.

The first phase involves collecting primary data from 270 retail vendors operating across ensure broad representation of business categories. Data are gathered through a structured questionnaire containing questions related to business characteristics, digital payment usage, transaction behavior, customer interactions, and various technological and behavioral factors affecting digital payment adoption. Prior to participation, informed consent is obtained from all respondents, and the collected information is anonymized to maintain confidentiality and comply with ethical research standards.

Following data acquisition, the collected responses undergo data preprocessing to improve dataset quality before statistical and machine learning analysis. Missing values, incomplete responses, and inconsistencies are identified and appropriately handled to ensure reliable model development. The cleaned dataset is organized into structured variables representing merchant demographics, business characteristics, transaction information, and behavioral attributes associated with digital payment adoption. This preprocessing stage minimizes data irregularities and prepares the dataset for subsequent analytical procedures.

To understand the characteristics of the collected data, descriptive statistical analysis is initially performed by calculating measures such as mean, standard deviation, median, minimum, and maximum values for important demographic variables including age, gender, business type, and years of business experience. The descriptive analysis provides an overall understanding of the retailer population and highlights the diversity of merchants participating in the study.

The methodology then applies group them into meaningful latent factors. Subsequently, Multiple Regression Analysis is performed to investigate the relationship between digital payment usage characteristics and business attributes, enabling statistical evaluation of the factors affecting adoption behavior.

After identifying the influential factors, a, allowing objective assessment of predictive capability and classification reliability.

In addition to machine learning prediction, the methodology incorporates customer satisfaction analysis to compare merchants' experiences across different digital payment platforms. Finally, historical Google Trends data are analyzed using the AutoRegressive Integrated Moving Average (ARIMA) model to forecast future digital payment adoption patterns. The forecasting results provide valuable insights into long-term market trends and support strategic planning for financial institutions, payment platform providers, and policymakers.

Overall, the proposed methodology integrates statistical modeling, machine learning classification, customer satisfaction evaluation, and time-series forecasting into a unified analytical framework capable of identifying key adoption factors, predicting merchant behavior, and estimating future digital payment adoption trends with improved analytical reliability.

V. EXPERIMENTAL RESULTS AND DISCUSSION

The proposed framework is experimentally evaluated using data collected from 270 retail vendors across 10 major retail markets in Bangalore. The experimental analysis investigates the effectiveness of combining statistica and medium-sized retail businesses. The study integrates Exploratory Factor Analysis (EFA), Multiple Regression Analysis, Support Vector Machine (SVM) classification, customer satisfaction analysis, and ARIMA forecasting to provide a comprehensive evaluation of merchant adoption behavior.

Initially, descriptive statistical analysis is performed to summarize experience. The statistical observations indicate that the collected dataset represents a diverse group of retailers operating in different business environments, thereby providing a reliable foundation for subsequent predictive analysis.

The regression model produces a relatively low coefficient of determination, indicating that these transaction-related variables alone are insufficient for explaining variations in business classification. These findings suggest that merchant adoption decisions are influenced more strongly by behavioral and organizational factors than by transaction volume alone.

predictive capability and is able to identify adoption patterns by learning relationships among multiple behavioral and business-related factors. Although prediction performance can be further improved using more advanced machine learning algorithms or larger datasets, the obtained results confirm the suitability of SVM for modeling digital payment adoption behavior.

Customer satisfaction analysis further compares merchant experiences across various digital payment platforms. The results indicate that certain payment platforms achieve higher satisfaction ratings than others, suggesting differences in usability, service quality, and overall merchant experience. Additionally, future adoption patterns are estimated using the ARIMA forecasting model applied to historical Google Trends data. The forecasting analysis indicates continued interest in digital payment technologies over the coming years while highlighting increasing uncertainty in long-term trend projections.

Overall, the experimental findings demonstrate that integrating statistical analysis, machine learning classification, customer satisfaction evaluation, and time-series forecasting provides a comprehensive framework for understanding digital payment adoption among retail vendors. The proposed system successfully identifies the key behavioral factors influencing adoption, predicts merchant acceptance with moderate accuracy, and offers valuable insights for improving digital payment strategies, enhancing customer experience, and supporting evidence-based decision-making within the digital financial ecosystem.

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VI. FUTURE ENHANCEMENT

Although the proposed framework demonstrates the capability of combining statistical analysis and machine learning to predict digital payment platform adoption among retail vendors, several opportunities remain for enhancing its performance and practical applicability. Future research may focus on collecting larger and more diverse datasets from multiple cities, states, and rural regions to improve the generalization capability of the predictive models. Including vendors from different business sectors such as supermarkets, pharmacies, restaurants, apparel stores, and service industries would enable the framework to capture a broader range of adoption behaviors and increase prediction reliability across diverse retail environments.

Support Vector Machines. Comparative evaluation of these models could identify more robust prediction techniques for digital payment adoption.

Future studies may also integrate real-time transaction data, customer purchasing behavior, merchant sales records, and mobile payment usage statistics with survey-based information to construct richer predictive datasets. The incorporation of financial transaction histories, seasonal purchasing patterns, customer demographics, and economic indicators may significantly improve prediction performance while enabling personalized adoption recommendations for individual retail businesses.

The proposed framework can further be extended by incorporating Explainable Artificial Intelligence (XAI) techniques that provide transparent explanations for machine learning predictions. Explainable models would help merchants, financial institutions, and policymakers better understand the factors influencing adoption decisions and increase confidence in automated decision-support systems. Additionally, cloud-based deployment and integration with digital banking platforms could facilitate real-time prediction services capable of continuously monitoring adoption trends and providing timely recommendations.

Furthermore, future research may investigate the influence of emerging technologies such as blockchain-based payment systems, Central Bank Digital Currencies (CBDCs), contactless payment technologies, and Artificial Intelligence-powered financial services on digital payment adoption. Evaluating these evolving technologies alongside consumer behavior and regulatory developments would contribute to a more comprehensive understanding of the future digital payment ecosystem. Overall, these enhancements have the potential to improve prediction accuracy, support intelligent financial decision-making, and accelerate the adoption of secure and efficient digital payment platforms across the retail industry.

VII. CONCLUSION

This study presented an integrated Machine Learning-based Digital Payment Platform Adoption Prediction Framework for analyzing and predicting the adoption behavior of retail vendors. By combining Exploratory Factor Analysis (EFA), Multiple Regression Analysis, Support Vector Machine (SVM) classification, customer satisfaction evaluation, and ARIMA-based forecasting, the proposed framework provides a comprehensive approach for identifying the factors that influence digital payment adoption while estimating future adoption trends. The analysis was conducted using data collected from 270 retail vendors across representing both organized and unorganized retail sectors.

The experimental findings indicate that demonstrating moderate predictive capability for identifying digital payment adoption patterns. Customer satisfaction analysis further highlighted differences in merchant experiences across various payment platforms, while ARIMA forecasting provided valuable insights into future trends of digital payment adoption.

The proposed framework offers practical benefits for financial institutions, payment service providers, policymakers, and retail businesses by supporting evidence-based strategies that encourage wider adoption of digital payment technologies. Understanding the key behavioral and technological factors influencing merchant decisions enables stakeholders to design more effective awareness programs, improve payment platform features, strengthen customer support services, and develop policies that facilitate digital financial inclusion.

In conclusion, the integration of statistical analysis, machine learning, customer satisfaction assessment, and time-series forecasting establishes a robust analytical framework for digital payment adoption prediction. The study demonstrates that intelligent predictive techniques can effectively support strategic planning within the digital financial ecosystem and provides a strong foundation for future research involving advanced machine learning models, real-time financial analytics, and intelligent decision-support systems that promote sustainable growth in digital payment technologies.

REFERENCES

1. F. Liébana-Cabanillas, A. F. Villarejo-Ramos, and J. Lara-Rubio, “Explanatory and predictive model of the adoption of P2P payment systems,” Behaviour & Information Technology, vol. 40, no. 6, pp. 528–541, 2021.
2. S. Moghavvemi, T. X. Mei, S. W. Phoong, and S. Y. Phoong, “Drivers and barriers of mobile payment adoption: Malaysian merchants’ perspective,” Journal of Retailing and Consumer Services, vol. 59, p. 102364, 2021.

3. K. Khando, M. S. Islam, and S. Gao, "The emerging technologies of digital payments and associated challenges: A systematic literature review," Future Internet, vol. 15, no. 1, 2023.
4. R. Seethamraju and K. S. Diatha, "Adoption of digital payments by small retail stores," in Proc. 29th Australasian Conference on Information Systems (ACIS), 2018, pp. 1–11.
5. M. A. Botta, "A study on the adoption of digital payment mechanism by small retail stores," Journal of Positive School Psychology, vol. 6, no. 10, pp. 61–66, 2022.
6. B. O. Antonio, L. R. Juan, I. D. Ana, and F. L. Cabanillas, "Examining user behavior with machine learning for effective mobile peer-to-peer payment adoption," Financial Innovation, vol. 10, no. 1, 2024.
7. K. Kajol, R. Singh, and J. Paul, "Adoption of digital financial transactions: A review of literature and future research agenda," Technological Forecasting and Social Change, vol. 184, p. 121991, 2022.
8. T. Ravikumar and N. Prakash, "Determinants of adoption of digital payment services among small fixed retail stores in Bangalore, India," International Journal of Business Innovation and Research, vol. 28, no. 3, pp. 319–346, 2022.
9. V. Chang, L. M. T. Doan, A. Di Stefano, Z. Sun, and G. Fortino, "Digital payment fraud detection methods in digital ages and Industry 4.0," Computers & Electrical Engineering, vol. 100, 2022.
10. F. D. Davis, "Perceived usefulness, perceived ease of use, and user acceptance of information technology," MIS Quarterly, vol. 13, no. 3, pp. 319–340, 1989.
11. V. Venkatesh and F. D. Davis, "A theoretical extension of the technology acceptance model: Four longitudinal field studies," Management Science, vol. 46, no. 2, pp. 186–204, 2000.
12. V. Venkatesh, M. G. Morris, G. B. Davis, and F. D. Davis, "User acceptance of information technology: Toward a unified view," MIS Quarterly, vol. 27, no. 3, pp. 425–478, 2003.
13. C. M. Bishop, Pattern Recognition and Machine Learning. New York, NY, USA: Springer, 2006.
14. V. Vapnik, The Nature of Statistical Learning Theory. New York, NY, USA: Springer, 1995.
15. C. Cortes and V. Vapnik, "Support-vector networks," Machine Learning, vol. 20, no. 3, pp. 273–297, 1995.
16. F. Pedregosa et al., "Scikit-learn: Machine learning in Python," Journal of Machine Learning Research, vol. 12, pp. 2825–2830, 2011.
17. R. J. Hyndman and G. Athanasopoulos, Forecasting: Principles and Practice, 3rd ed. Melbourne, Australia: OTexts, 2021.
18. G. E. P. Box, G. M. Jenkins, G. C. Reinsel, and G. M. Ljung, Time Series Analysis: Forecasting and Control, 5th ed. Hoboken, NJ, USA: Wiley, 2015.
19. J. D. Hamilton, Time Series Analysis. Princeton, NJ, USA: Princeton University Press, 1994.
20. L. Breiman, "Random forests," Machine Learning, vol. 45, no. 1, pp. 5–32, 2001.
21. T. M. Taye, "Understanding machine learning with deep learning: Architectures, workflow, applications and future directions," Computers, vol. 12, no. 5, 2023.
22. M. T. Ballestar, P. Grau-Carles, and J. Sainz, "Predicting customer quality in e-commerce social networks: A machine learning approach," Review of Managerial Science, vol. 13, no. 3, pp. 589–603, 2019.
23. D. P. Ramesh Babu and P. Krishna Rao, "Artificial intelligence-driven financial analytics using machine learning for digital payment ecosystems," International Journal of Intelligent Systems and Applications in Engineering, vol. 12, no. 5, pp. 2478–2490, 2024.