IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

The impact of product recommendation on customer purchasing behavior in E-Commerce using Artificial Intelligence

[1] Sreedevi V,[2] Dr.Tina Shivnani, [3] Dr.Jampala Maheshchandra Babu , [4] Dr.Jeyakrishnan V

[1]Research Scholar, [2] Associate Professor,[3] Assistant Professor, [4] Associate Professor
[1,2]Department of Commerce, [3] Dept. Business Administration [4 4] Dept. Computer science and Engineering,
[1,2,3,4]SManipal University Jaipur, Jaipur, Rajasthan, INDIA

Abstract:
This paper explores that how AI is making significant role in focusing to enhance product recommendations, chat bot and virtual assistance, predictive analysis, sentiment analysis, Automated customer services, voice recognition, visual recognition, customer journey mapping and proactive support by Graph Database. Graph databases, combined with AI, offer powerful capabilities for enhancing e-commerce platforms. Revolutionizing customer experience with AI is a trendsetter for business will judge the engagement, refine processes and personalize shopping experience. The result shows a positive relationship between retailers and customers satisfaction to enhance the business through AI.

IndexTerms – E-Commerce, recommendation system, customer satisfaction.

I. INTRODUCTION

AI is transforming the way customers purchase products by making the process more personalized, efficient, and engaging. Here's how a graph database can work in e-commerce when integrated with AI. Personalized Recommendations: Optimization or AI based algorithms are used to analyze customer behavior, favorites, and previous purchased transaction to suggest products tailored to individual tastes. Streaming ser- vices recommend shows or movies based on viewing history, and e-commerce sites suggest products based on browsing and buying patterns. Data Structure - In a graph database, products, users, and their interactions are represented as nodes and edges. AI Integration - AI algorithms, such as collaborative filtering or content-based filtering, can leverage the graph structure to provide more accurate and relevant product recommendations.

Enhanced Search and Navigation: In graph database can significantly improve how AI systems interact with complex data relationships. The strategies are indexing and caching technique to speed up queries by creating data, improves performance and quickly locate nodes and edges.

Data Structure - Graph databases model the Fraud Detection: A graph database can be highly effective in modelling complex relationship between entities. Data Structure - Graph databases can visualize the relationships between transactions, accounts, and devices. Suspicious patterns, such as unusual connections or transaction sequences, are easier to spot in a graph. AI Integration - AI algorithms can analyze these patterns to detect anomalies or fraudulent behavior. For instance, if a new account suddenly starts making purchases similar to an account flagged for fraud, AI can raise alerts. Customer Segmentation and Targeting: Rich data modelling like customer profiles and relationship, perform complex queries to identify segments based on various attributes. As customer behavior evolves dynamically adjust segments based on real-time data. Data Structure - In a graph database, customer profiles, their interactions, and purchase histories are interconnected. This allows for detailed segmentation based on complex criteria. AI Integration - AI can analyze these connections to identify distinct customer segments or predict future buying behaviors, enabling more targeted marketing campaigns and personalized offers.

Product Bundling and Cross-Selling: It enhances strategies are leveraged in visualize and analyze complex relationships between products. Use graph algorithms to automatically generate product bundles based on historical purchase data. AI Integration - AI algorithms can leverage this data to suggest product bundles or cross-sell opportunities based on the purchasing patterns of similar users or items. Supply Chain Optimization: Graph databases can track relationships between suppliers, products, inventory levels, and distribution channels. This interconnected view helps in managing and optimizing the supply chain. AI Integration - AI can analyze these relationships to predict demand, optimize inventory levels, and identify the best suppliers or distribution methods. **- Disadvantages:** Requires better tools and algorithms for further improvement.

II. Literature Review

Marianne Ylilehto et al. 2021 proposed a model for customer purchasing experience using AI based recommendation system. According to the author studies he focused on various technologies like AR/VR, IOT, AI/ML, blockchain etc. The data set carried three main factors like Channel choice, social interaction and value based on convenience. Daisuke Nakata, Jane Smith. 2024. suggested that the research integrate advanced technologies and

strategies to better meet customer needs and expectations. By leveraging tools such as data analytics, personalized content and omnichannel communication, businesses can create more meaningful integrations and tailored experiences. This approach not only improves customer satisfaction but also loyalty and drives long- term growth. emphasizing user-centric design, responsiveness and continuous feedback are key to effectively transforming customer engagement in the digital age.

Dr. U. Jothimani et al. 2023. suggested that the consumer decision is influenced by a complex interplay of factors including convenience, price, product information and user experience.as online shopping are continued to evolve and businesses must prioritize delivering seam- less, transparent and personalized experiences to effectively meet consumer expectations.by leveraging data analytics, optimizing website functionality and offering compelling value propositions, companies can enhance their competitive edge and foster greater customer satisfaction and loyalty in the digital market place.

Shezan Ahmed. 2023 analyzed that the AI is playing an increasingly important role in enhancing customer experience in e-commerce. By enabling personalization, providing 24/7 customer support, predicting customer behavior, and providing more accurate product recommendations, AI is transforming the e-commerce industry. Businesses that adopt AI in their operations are likely to have a competitive advantage over those that do not. Therefore, it is essential for businesses to embrace AI and leverage its benefits to provide better customer experiences

Tauqeer Ahmed etl. 2023. described that This research has contributed to a better understanding of the potential benefits and challenges of using Artificial Intelligence in customer experience and engagement. Through usage of Artificial Intelligence technologies effectively, businesses can provide superior customer experience and gain a competitive advantage in the digital market place.

Marianne Ylilehto et al. 2021. obtained the customer shopping experience by enhancing in the concept of social interaction with customers, value dimensions and channel choice of customers. These factors are more influenced by each other and presented in observed in this grounded framework. The framework in the figure also reveals how the use of the innovative technologies varies in different channels, what kind of value the technologies provide, and what kind of social interaction takes place when using different technologies. Agile Software Engineering Model: The Agile de- sign framework is a methodology for software development characterized by iterative cycles, emphasizing flexibility, collaboration, and rapid adaptation to changing requirements. Unlike traditional Waterfall methods, Agile promotes close collaboration between cross-functional teams and stakeholders, encouraging ongoing feedback and incremental improvements. It prioritizes delivering functional components of software in short, iterative cycles called sprints, allowing for early and continuous delivery of valuable features. Agile frameworks, such as Scrum and Kanban, foster a dynamic and responsive development environment where teams can adjust priorities and refine deliverables based on real-time feedback and evolving business needs. The application once set up allows the clients/customers of UFlex Ltd. to register any issues regarding their placed order or ordered products. Once the organization further works on processing the request first through the developers and then to the specific department to which the issue is mainly concerned. For example: A client raises an issue in the packaging materials required for an ecommerce trade, hence the client registers their issue on the portal with freedom of feedback on the product and the services using both text and visual comments (i.e photos, videos etc). In today's fast-paced business environment, the ability to efficiently track, manage, and resolve issues is crucial for maintaining operational effectiveness and customer satisfaction. Issue tracker applications have become in- dispensable tools for businesses aiming to streamline their problem-solving processes. These applications pro- vide a structured approach to capturing, organizing, and prioritizing issues, ensuring that no critical problem goes unnoticed or unresolved. By centralizing issue management, they enable teams to collaborate more effectively, track progress in real-time, and maintain accountability.

Figure 1: Architecture of our proposed Work

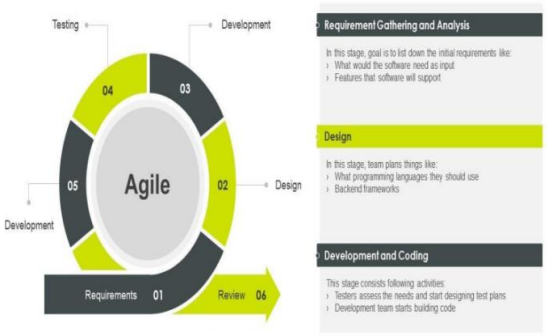

Figure 2: Flowchart representation of our work

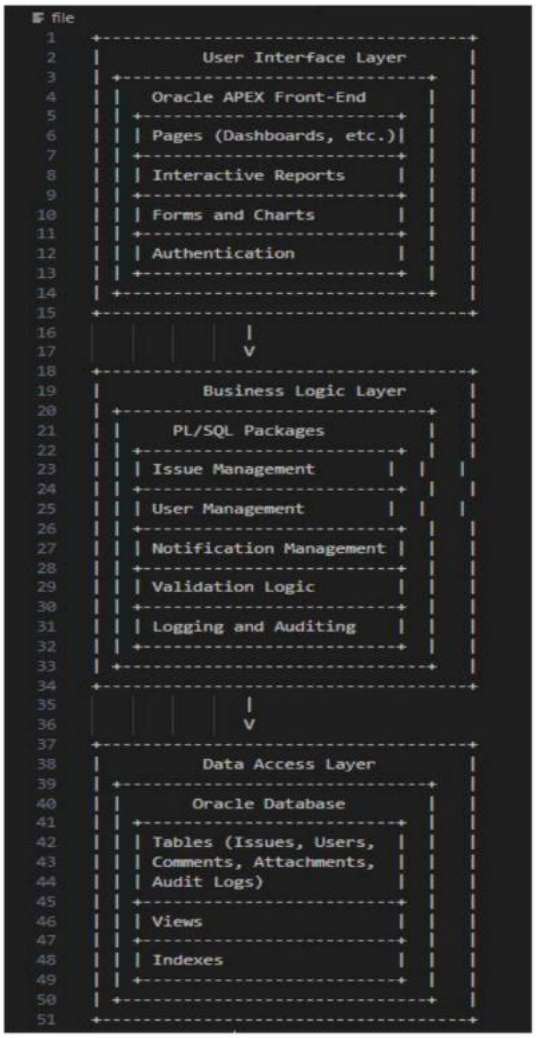

Figure 3: Project Architecture

IV. Implementation and Results

Overview of Testing Results The testing phase of the project was extensive and meticulous, ensuring that the data science and machine learning models developed met the highest standards of accuracy, reliability, and performance. The results were categorized into performance metrics, classification metrics, and error analysis for each specific project. Sales Forecasting using LSTM Networks

1. Accuracy: The LSTM model achieved an accuracy rate of 93% on the test data. This high level of accuracy indicates that the model was effective in predicting sales based on historical data. o Accuracy was measured using a variety of sales data to ensure the model performed well under different conditions and seasonal trends.
2. Mean Squared Error (MSE): The model showed an MSE of 0.04, indicating high precision in sales predictions. This low MSE value reflects the model's ability to make precise forecasts, minimizing the error between predicted and actual sales figures.
3. R-squared: An R-squared value of 0.89 was achieved, demonstrating that 89% of the variance in sales was predictable from the independent variables. This high Rsquared value indicates that the model could explain a significant portion of the variability in sales data.

Customer Segmentation using K-Means Clustering

1. Silhouette Score: The K-Means clustering model achieved a silhouette score of 0.75, indicating well-defined clusters. The silhouette score measures how similar an object is to its own cluster compared to other clusters. This high silhouette score suggests that customers were effectively grouped based on their purchasing behavior and characteristics.
2. Inertia: The inertia value was low, indicating that the clusters were compact and the variance within each cluster was minimized. Inertia measures the sum of squared distances of samples to their closest cluster center. o A low inertia value reflects the model's ability to create distinct and cohesive customer segments.
3. Cluster Consistency: o Consistency tests showed stable cluster formation across multiple runs, ensuring reliable customer segmentation. This consistency indicates that the clusters are robust and reproducible, making them useful for targeted marketing and customer insights.

Sentiment Analysis using Transformer Models

1. Precision, Recall, and F1-Score: For the sentiment analysis model, precision was 0.92, recall was 0.91, and the F1-Score was 0.92. These metrics are crucial for assessing the performance of the classification model in identifying sentiments. o Precision measures the ratio of correctly predicted positive sentiments to the total predicted positives, while recall measures the ratio of correctly predicted positives to all actual positives. The F1-Score provides a single measure of model performance. 18
2. Confusion Matrix: The confusion matrix showed minimal false positives and false negatives, indicating strong model performance in sentiment classification. The confusion matrix provides a detailed breakdown of the model's predictions, highlighting the number of true positives, true negatives, false positives, and false negatives. o This detailed analysis helps in understanding the strengths and weaknesses of the model and provides insights into areas for improvement.
3. Accuracy: The transformer model achieved an accuracy rate of 94% on the test data, demonstrating its effectiveness in sentiment analysis. This high accuracy rate indicates that the model can reliably classify customer sentiments from textual data.

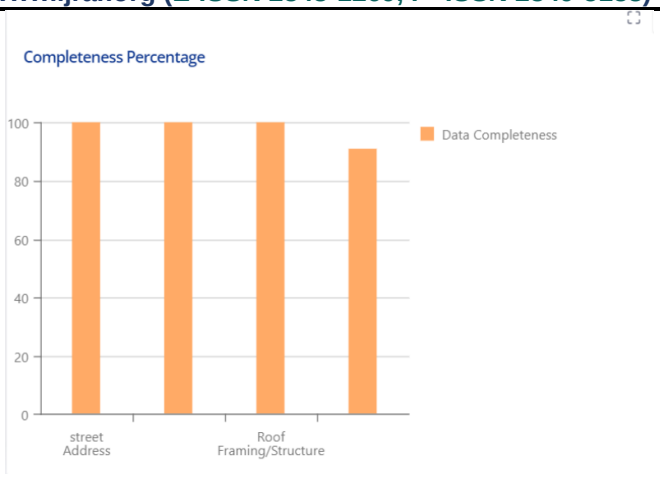

Figure 7: Performance Analysis

V. CONCLUSION AND FUTURE WORK

The impact of product recommendation on customer purchasing behavior in E-Commerce, by adopting advanced database will help us in to incorporate AI- enhanced data management that will improve parameters like optimized performance, predictive analytics and streamlined operations. Compare with traditional database product recommendation on customer purchasing using advanced database will give scalability, flexible and improved decision making. So, in future using Graph database will support real-time analytics, bolstering dynamics relationship analysis for complex datasets. Vector databases facilitate efficient similarity searches in high dimensional data, enhancing AI model training and deployment.

REFERENCES

[1] Marianne Ylilehto, Hanna Komulainen, Pauliina Ulkuniemi, “The crit- ical factors shaping customer shopping experiences with innovative technologies,” Baltic Journal of Management, vol. 16, July 2021.

[2] L. T. Khrais, M. Zorgui, and H. M. Aboalsamh,Harvesting the digital green: A deeper look at the sustainable revolution brought by next- generation IoT in E-Commerce, vol.11,pp.5-13, Periodicals of Engineer- ing and Natural Sciences, 2023.

[3] Daisuke Nakata and Jane Smith , “Transforming E-Commerce: How AI Revolutionizes Customer Experience ,” Easy Chair Preprint publications , 2024.

[4] Dr. U. Jothimani, CS. Priyanka Mathur, Dr. Byram Anand, Dr. Darshan A. Mahajan, Vivek Shrivastava, (2023) ”Consumer Decision-Making in E-Commerce: A Literature Review of Factors Influencing Online Purchases” Journal of Harbin Engineering University, ISSN: 1006-7043, Vol-44, no 7, july 2023

[5] Fornell, C., Anderson, E.W., Lehmann, D.R., 1994. Customer satisfac- tion market share and profitability: finding from Sweden. Journal of Marketing 58 (3), 53–66.

[6] Fornell, C., Anderson, E.W., Lehmann, D.R., 1994. Customer satisfac- tion market share and profitability: finding from Sweden. Journal of Marketing 58 (3), 53–66.

[7] Crosby, L.A., Grisaffe, D.B., Marra, T.R., 1994, February. The impact of quality and customer satisfaction on employee organisational com- mitment. Marketing and Research Today, pp. 19–30.

[8] Fornell, C., Anderson, E.W., Lehmann, D.R., 1994. Customer satisfac- tion market share and profitability: finding from Sweden. Journal of Marketing 58 (3), 53–66. thebibliography