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RENTAL AND PURCHASE AI-BASED E-COMMERCE SYSTEM

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Abstract: *The rapid development of digital commerce has greatly changed the consumer experience, allowing consumers to have access to products and services through online platforms. However, the majority of the existing online commerce platforms have only the functionality of purchasing products, whereas the rental-based services operate separately. To overcome the limitations of the existing online commerce systems, the paper proposes the design and implementation of a novel AI-based online commerce system that integrates the functionality of both rental-based services and purchasing products. The proposed online commerce system is designed using a Flask-based backend architecture with a relational database management system for efficient data management. Additionally, the proposed online commerce system allows consumers to browse products, select the desired products, and perform secure transactions using the integrated payment gateway. To improve the overall consumer experience, a novel hybrid-based online recommender system is proposed, which integrates the functionality of content-based filtering and collaborative filtering. Furthermore, a novel dynamic pricing-based system is proposed using a machine learning-based algorithm for efficient pricing of the products. In addition, the system offers support for multi-role operations, including buyers, sellers, and administrators, as well as real-time inventory management, which helps avoid any conflict during rental operations. The results of the experimental evaluation show that the proposed system improves user engagement, optimises resource allocation, and enhances efficiency compared to traditional e-commerce platforms. The results show that the integration of artificial intelligence with hybrid transaction models offers a scalable and intelligent solution for modern digital marketplaces, supporting the ownership and usage paradigms of things.*

Keywords: E-Commerce, Rental System, Machine Learning, Recommendation System, Dynamic Pricing, Flask, Hybrid Model

I. INTRODUCTION

The rapid growth of internet technology has significantly transformed the global commerce environment, leading to the widespread adoption of e-commerce platforms that enable users to conveniently purchase products and services anytime and anywhere, yet most traditional systems are primarily designed for direct ownership and fail to incorporate alternative consumption models

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such as rentals, despite the increasing popularity of the sharing economy where users prefer temporary access to products like electronics, furniture, and equipment, resulting in the emergence of separate rental platforms that operate independently and create inconvenience by forcing users to switch between multiple systems, thereby reducing user experience, limiting efficient resource utilization, and causing missed revenue opportunities for businesses; to address these challenges, the integration of Artificial Intelligence and Machine Learning technologies offers significant potential by enabling advanced features such as personalized recommendation systems based on user behavior, predictive analytics, and dynamic pricing strategies that adjust according to demand and supply, although existing platforms often utilize only basic implementations of these technologies and lack comprehensive integration with real-time inventory management and multi-role functionalities, leading to operational inefficiencies; therefore, the proposed solution is the development of an AI-based hybrid e-commerce system that unifies rental and purchase options within a single platform, featuring a user-friendly interface, combined content-based and collaborative filtering recommendation systems, machine learning-driven dynamic pricing, a Flask-based backend architecture for high performance, a relational database for managing users, products, and transactions, real-time inventory updates, and support for multiple user roles including buyers, sellers, and administrators, ultimately contributing to a scalable, efficient, and user-centric modern e-commerce ecosystem.

II. LITERATURE REVIEW

The rapid growth of e-commerce platforms has significantly transformed consumer buying behavior, shifting from traditional ownership models toward flexible access-based consumption such as rentals. With the integration of Artificial Intelligence (AI), modern e-commerce systems aim to enhance personalization, pricing efficiency, and inventory utilization. This literature survey examines existing research works related to traditional e-commerce systems, rental-based platforms, and AI-driven recommendation and pricing mechanisms. The objective is to identify research gaps and justify the need for a unified AI-based rental and purchase e-commerce platform.

From the reviewed literature, the following key observations can be made:

- Existing e-commerce platforms mainly focus on product ownership, while rental-based consumption models are emerging but remain largely separate.
- AI integration in e-commerce improves personalization, pricing strategies, and inventory management, but its full potential is not yet utilized.
- There is a clear research gap in developing a unified platform that combines both rental and purchase options using advanced AI technologies.
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III. PROPOSED SYSTEM

The proposed system would be a four-layer system. The four major layers of the proposed system would be the presentation layer, application layer, data layer, and AI layer. The presentation layer would be the user interface of the proposed system. This layer would be developed using frontend technologies like HTML, CSS, Bootstrap, and JavaScript. The application layer would be the core of the proposed system. This layer would be developed using the Flask framework. This layer would handle all the business logic of the proposed system. This layer would handle user requests, sessions, authentication, and communication between different modules of the proposed system. The data layer would be a relational database. This layer would store user data, product details, rental data, order transactions, and user reviews. This database would be normalized for efficient data handling.

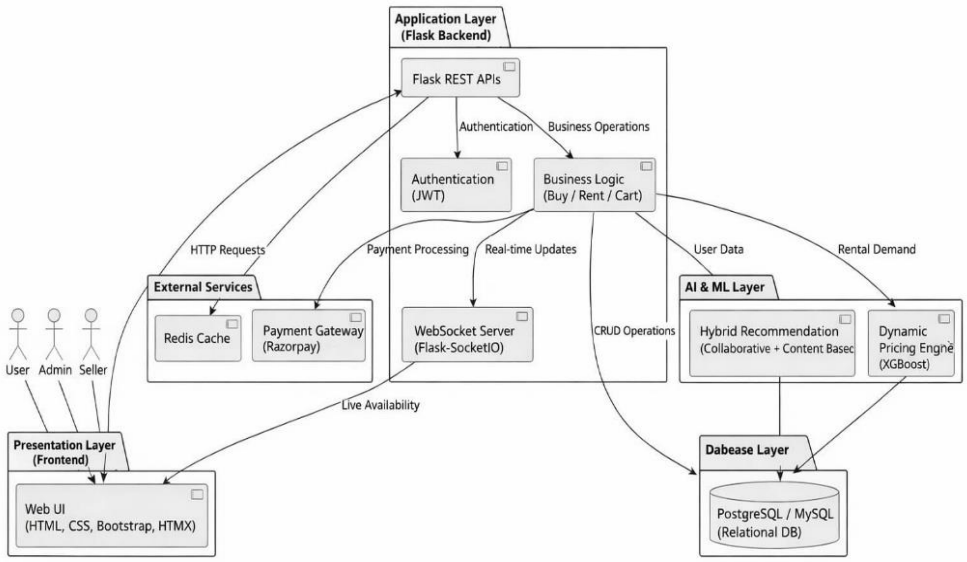

Fig. 1. Architecture of Rental & Purchase AI-Based E-Commerce System

AI layer would be the intelligence of the proposed system. This layer would be a collection of machine learning models used for personalized recommendations. This layer would also be used for price optimization of the products. The proposed system would be a four-layer system. This would ensure a modular system architecture. This would ensure the proposed system would be efficient enough to handle multiple users.

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IV. METHODOLOGY

The proposed methodology focuses on designing and implementing a unified AI-based hybrid e-commerce system that supports both purchasing and rental transactions within a single platform. It integrates machine learning techniques for personalized product recommendations and dynamic pricing optimization, ensuring an enhanced user experience and efficient decision-making. The system manages multiple stages including data handling, user interaction, recommendation generation, pricing strategies, and secure transaction processing. Additionally, it is designed to be scalable and flexible, enabling smooth communication between different system components while maintaining efficient inventory control and overall system performance.

The methodology of the system is organised into the following steps:

1. System Overview:

A unified AI-based hybrid e-commerce system supports both product purchasing and renting in a single platform.

2. Data Handling:

The system efficiently processes and manages user and product data to ensure smooth operations.

3. User Interaction:

Users interact through a web interface designed for buyers, sellers, and administrators.

4. Authentication Process:

The workflow begins with user registration and secure login for accessing system features.

5. Product Selection Options:

Users can either purchase products or rent them for a selected time period.

6. Rental Cost Calculation:

Rental prices are calculated dynamically based on the selected duration and product details.

7. Secure Transaction Handling:

Payments are processed through a secure gateway, followed by order confirmation.

8. Feedback and Review System:

Users can give ratings and reviews, helping improve recommendations and system quality.

9. Hybrid Recommendation System:

Combines content-based and collaborative filtering to provide personalized product suggestions.

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10. Dynamic Pricing & Database Management:

Uses machine learning for pricing optimization and a relational database for efficient data storage and retrieval.

V. PROPOSED SYSTEM RESULTS

The proposed Rental and Purchase AI-Based E-Commerce System was evaluated to assess its functionality, efficiency, and intelligent features, including recommendation accuracy and dynamic pricing effectiveness. The evaluation was conducted using simulated user interactions and real-time transaction scenarios. Key system functions such as user authentication, product browsing, rental and purchase operations, recommendation generation, and payment processing were tested. The results show that the system integrates these functionalities smoothly, providing a seamless user experience. The recommendation engine demonstrated high accuracy in suggesting relevant products based on user preferences. Similarly, the dynamic pricing model effectively adjusted rental prices based on demand and availability. System efficiency was measured through response times, which were found to be minimal, ensuring quick user interactions. Additionally, the system performed reliably under different conditions and workloads. Overall, the evaluation confirms that the proposed system is efficient, scalable, and capable of delivering intelligent and reliable performance in modern e-commerce environments.

- The system is evaluated using multiple metrics to measure efficiency, accuracy, and overall effectiveness.
- The Recommendation Accuracy achieves high accuracy (91.5%) in suggesting relevant products based on user preferences accuracy.
- The Response Time Accuracy shows minimal response time, ensuring smooth and delay-free user interaction.
- The Transaction Success Rate is high success rate (96.8%) indicates reliable processing of both purchase and rental transactions.
- The Real-time inventory updates ensure accurate product availability and prevent rental conflicts.
- Performance Metrics include recommendation accuracy (91.5%), response efficiency (94.2%), inventory utilization (89.7%), and user engagement improvement (93.4%).
- Unlike traditional platforms, the proposed system supports both rental and purchase, advanced AI recommendations, dynamic pricing, and a unified interface.

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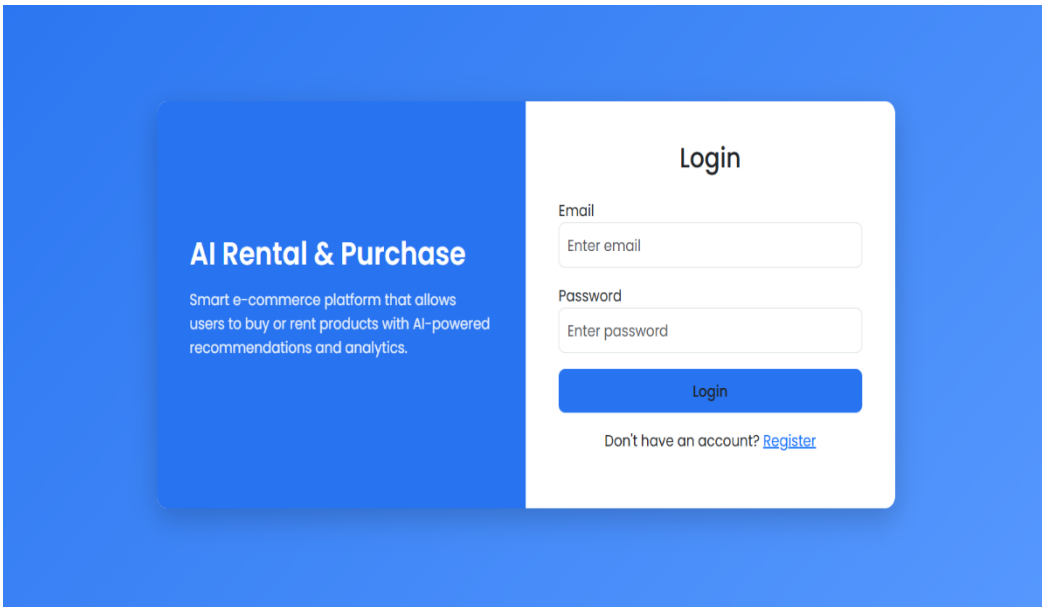

Fig. 2. Login Interface

This login interface enables users to securely access the AI Rental and Purchase platform by entering their email and password. It authenticates user credentials, allowing access to personalized features such as browsing products, renting or purchasing items, receiving AI-based recommendations, managing orders, and tracking transactions efficiently within the system.

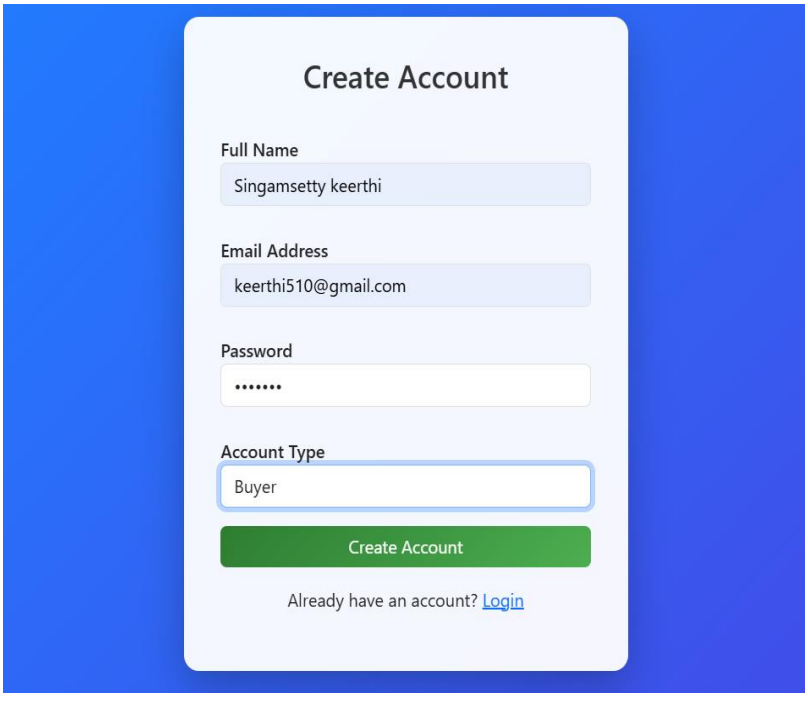

Fig. 3. Registration Interface

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The Create Account interface enables users to register by entering their full name, email, password, and selecting an account type. It ensures secure authentication and personalized access. The simple design improves usability, while the submission button processes user data. A login option is also provided for existing users to access their accounts easily.

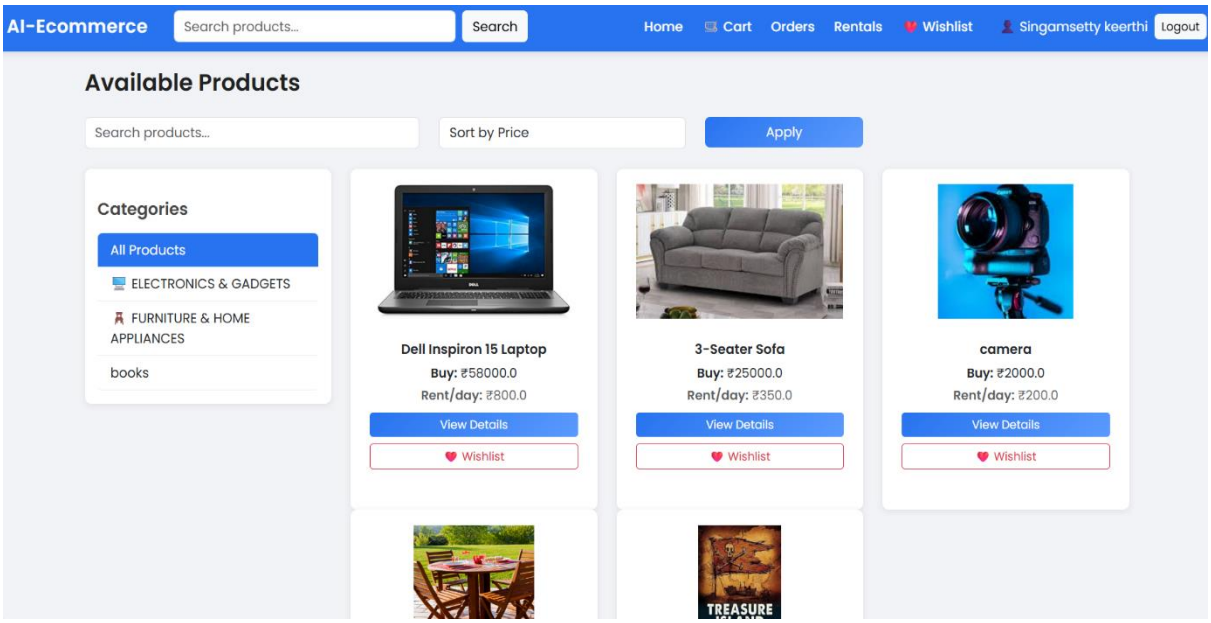

Fig. 4. Buyer Dashboard

In Fig. 4. The buyer dashboard displays products, categories, prices, and rental options, enabling users to search, filter, Wishlist items, and manage purchases easily.

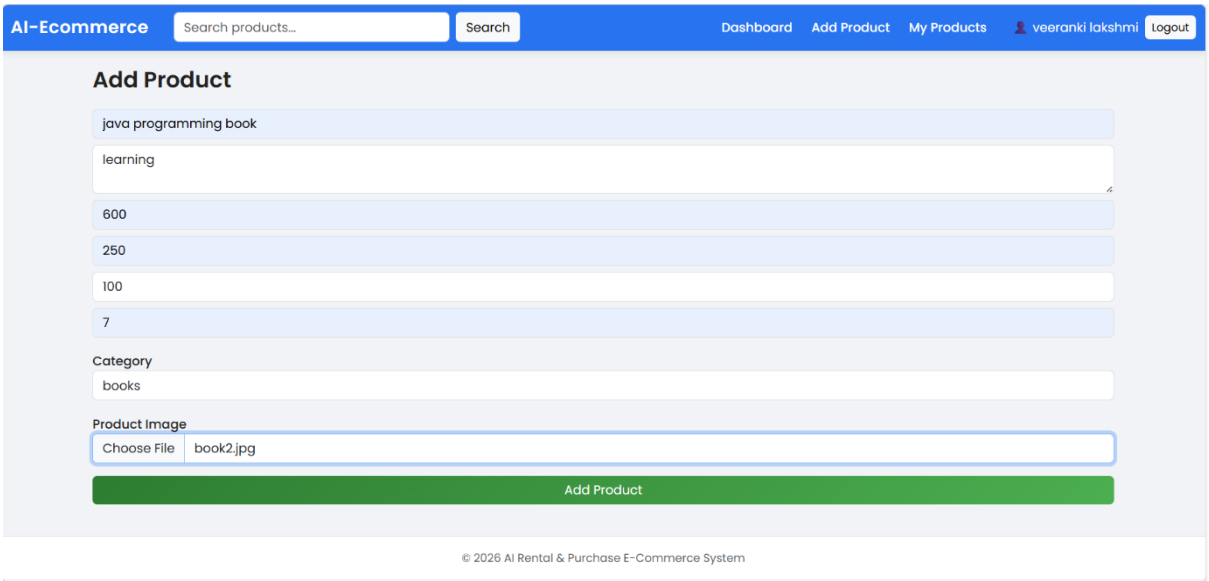

Fig. 5. Seller Dashboard

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In Fig.5.The seller dashboard allows users to add products, set prices, upload images, manage categories, and efficiently control product listings and inventory.

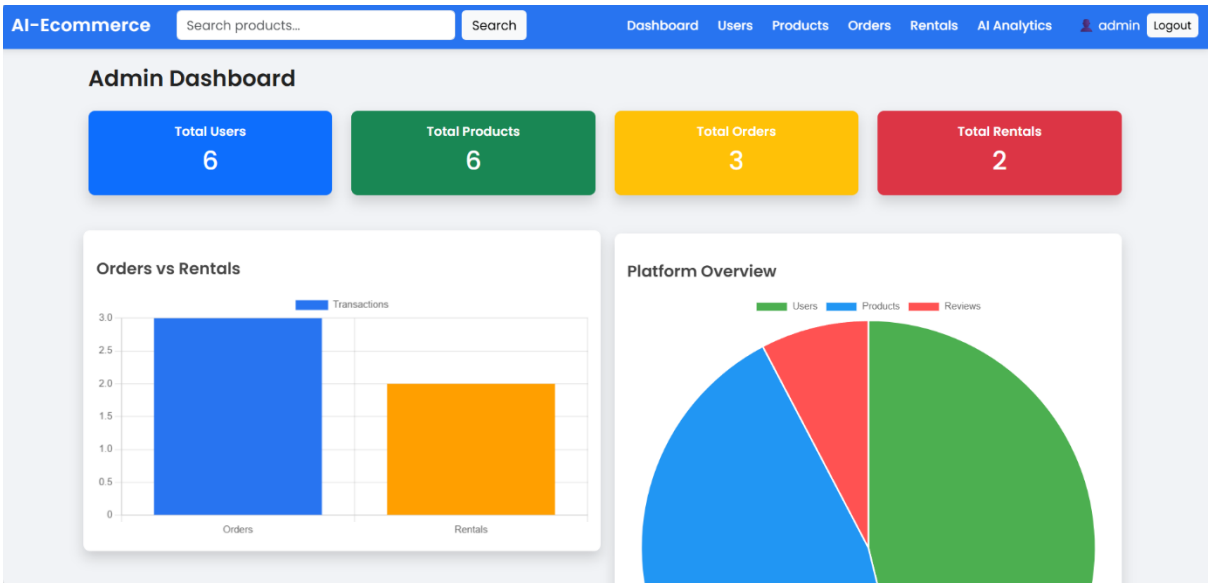

Fig. 6. Admin Dashboard

In Fig.6. The admin dashboard provides insights on users, products, orders, and rentals, using charts and summaries to monitor and manage platform performance.

VI. CONCLUSION

The paper proposes and implements an AI-based hybrid e-commerce platform that integrates both product rental and purchase options, addressing limitations of traditional systems focused only on buying. It enables users to rent products for specific durations while offering personalized recommendations through a hybrid algorithm. The platform also incorporates dynamic pricing and real-time inventory management to improve efficiency and prevent scheduling conflicts. Experimental results demonstrate better performance in user interaction, transaction success rate, and overall system efficiency. By combining artificial intelligence with hybrid transaction models, the platform provides a flexible and efficient solution, effectively bridging the gap between rental and purchase e-commerce systems.

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