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Abstract

This project proposes an intelligent e-commerce platform that leverages AI-driven recommendations, 3D product visualization, and an interactive shopping experience. The system will collect and analyze user data, including profile details, browsing history, and preferences, to generate highly personalized product suggestions. This ensures that users receive recommendations tailored to their interests, enhancing the relevance and efficiency of the shopping experience.

A key feature of this platform is the integration of 3D product visualization, allowing users to virtually try on clothing items such as shirts and pants. By utilizing 3D motion technology, users can see how these products fit and look on them in real-time before making a purchase, providing a more immersive and confident shopping experience.

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1. Introduction

The rise of e-commerce has transformed the retail industry, making online shopping more convenient. However, generic recommendations and lack of user interaction often result in poor user experience. Customers seek a more personalized and immersive shopping journey.

This project aims to solve these issues by integrating AI-powered recommendations and dynamic pricing analysis into an e-commerce store. The intelligent system will analyze user behavior, interests, and interactions to suggest products tailored to their needs. Additionally, 3D product visualization will allow users to interact with products in an engaging way.[1]

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2. Problem Statement

Traditional e-commerce platforms face several issues:

- **Lack of Personalization**: Generic recommendations lead to low customer engagement.
- **Limited Product Interaction**: Static images do not provide a detailed view of the product.
- **Inefficient Pricing Suggestions**: Users often have difficulty finding products within budget range.

To overcome these limitations, an AI-driven e-commerce store is required that provides tailored recommendations and immersive product interactions.

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3. Problem Solution for Proposed System

Our intelligent e-commerce platform will address these issues through:

AI-Powered Recommendations: Suggesting products based on user interests and browsing patterns.

3D Product Visualization: Allowing users to view products from multiple angles.

Dynamic Pricing Analysis: Tracking user preferences to suggest affordable options.

By integrating advanced AI models and interactive UI features, our system aims to provide a seamless and intelligent shopping experience.

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4. Related System Analysis/Literature Review

E-commerce platforms like Amazon, Shopify, Flipkart, eBay, and Alibaba face unique challenges that can be addressed through advanced solutions.

Amazon's generic recommendations often lack deep personalization, limiting product discovery. Implementing AI-driven recommendation systems analyzing user profiles and browsing history can enhance relevance and engagement.

Shopify lacks integrated 3D product visualization, reducing user interaction. Incorporating 3D product features can allow virtual try-ons, enhancing the shopping experience and reducing return rates.[5]

Flipkart struggles with real-time pricing insights. Dynamic price analysis based on user behavior can optimize pricing strategies and promote competitive offers.

eBay and Alibaba also face limitations in personalized recommendations and dynamic pricing strategies. Integrating AI and market trend analysis can significantly improve user engagement and satisfaction.

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5. Advantages/Benefits of Proposed System

Personalized Shopping – AI-based recommendations enhance user experience.

Immersive Product Viewing – 3D models allow users to see products from different angles.

Efficient Price Tracking – AI suggests products within users' budget ranges.

Improved Engagement – Like-based product ranking increases interaction.

Better Marketing Strategy – User segmentation enhances targeted promotions.

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6. Scope

The proposed e-commerce system will enhance online shopping through AI-driven recommendations and 3D product visualization. It will include secure user authentication, ensuring safe login and account access. The platform will provide interest-based product suggestions, leveraging AI to analyze user preferences. Users can interact with 3D product models, allowing them to virtually try on clothing items.

A dynamic product ranking system will sort items based on likes and sales trends, while AI- powered notifications will alert users about relevant offers and updates. The system will not include physical store integration or third-party vendor management, focusing solely on an interactive, AI-enhanced online shopping experience.

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7. Modules

- **Functional Requirements**

  The system will support multiple actors, including Admin, Seller, and Customer, each with specific functionalities:

  - **Admin**:
    - Manage users (approve/reject sellers, suspend accounts)
    - Oversee product listings and remove inappropriate content
    - Monitor sales, orders, and platform analytics
    - Manage pricing strategies and promotions
  - **Seller**:
    - Register and manage their storefront
    - Upload and manage product listings (images, descriptions, pricing)
    - Track sales and manage customer orders
    - Respond to customer inquiries and reviews
  - **Customer:**
    - Create and manage their profile
    - Browse and search for products
    - Add items to cart and complete purchases
    - Leave reviews and ratings

- **User Management**

  This module handles user authentication, including login, sign-up, and profile management. Users can update their profiles with personal preferences, which will be used for product recommendations. It ensures secure access and data privacy.[2] Role-based authentication will be implemented to distinguish between customers and administrators. Users will also be able to manage their purchase history and saved items.

- **Order Management**

Order Management handles all aspects of order processing, tracking, and fulfillment. It ensures smooth transactions between sellers and customers, covering:

- **Order Placement:** Customers can place orders and receive confirmation.
- **Order Status Tracking:** Real-time updates on order status (Processing, Shipped, Delivered, Canceled, Refunded).
- **Returns & Refunds:** Users can request order cancellations, returns, or refunds based on predefined policies.
- **Order History Management:** Customers can view their past orders, invoices, and transaction details.

- **Payment Processing**

Payment Processing ensures secure and efficient handling of digital transactions. Key features include[4]:

- **Supported Payment Gateways:** Integration with Stripe, PayPal, and other providers.
- **Secure Transactions:** Implementation of PCI DSS compliance and encryption. **Automatic Refunds & Disputes:** Handling of refunds and chargebacks efficiently.
- **Subscription & Installment Payments:** Support for recurring payments if needed.

- **Notification & Alerts**

This module enhances communication between users and the platform through automated notifications.

- **Order Notifications:** Customers receive updates about order status via email/SMS.
- **Promotional Alerts:** Personalized discount notifications based on user preferences.
- **Admin Alerts:** Alerts for policy violations, low stock warnings, or security threats.
- **Push Notifications:** Mobile and web push notifications for engagement.

- **Product Recommendation**

This module leverages AI to analyze user behavior, browsing history, and preferences to suggest relevant products. The recommendation engine will continuously refine suggestions based on user interactions. It enhances personalization by adapting to customer interests over time. The system aims to increase user engagement by displaying highly relevant items.

- **3D Product Viewer**

This module integrates WebGL technology to enable interactive 3D visualization of products. Users can rotate, zoom, and examine items such as clothing in a virtual environment. It allows customers to virtually try on apparel, improving their confidence in purchase decisions. [3]This feature enhances the shopping experience by bridging the gap between online and in-store shopping.

- **Product Ranking:**

This module dynamically sorts products based on user engagement metrics, such as likes, views, and purchase frequency. AI-driven algorithms will highlight trending and highly rated products. It ensures that popular and well-reviewed items are more accessible to users. This ranking system improves discoverability and enhances product visibility.

- **Wish-list & Save-for-Later**

Allows customers to save items for future purchases.

- **Wish-list Feature:** Users can add products to a wishlist without adding them to the cart.
- **Save-for-Later:** Customers can move items from the cart to a saved list.
- **Personalized Reminders:** Automated reminders for items left in the wishlist.

- **Admin Dashboard**

The admin module provides a centralized interface for managing products, users, and analytics. Administrators can add, update, or remove products, track user activity, and analyze sales performance. AI-powered insights will help optimize product recommendations and pricing strategies. This dashboard streamlines platform management, ensuring smooth operation.

- **Non-Functional Requirements**

These requirements define system performance, usability, and security:

- **Scalability:** The platform should handle an increasing number of users and product listings without performance degradation.
- **Security:** Implement authentication (OAuth 2.0) and encryption to protect user data.
- **Usability:** The UI should be intuitive and responsive for a seamless shopping experience.
- **Performance:** The system should process recommendations and product searches efficiently, ensuring low latency.
- **Reliability:** The system should maintain up-time of at least 99.9% to ensure availability.

- **Domain Requirements**

This project falls within the E-Commerce and AI-Based Recommendation Systems domain. The primary focus is on:

- **AI-Powered Personalization:** The system will use AI algorithms to suggest relevant products based on user behavior.
- **3D Product Visualization**: WebGL will be used to enable interactive 3D viewing of products.

- **Dynamic Pricing & Ranking:** AI-based analytics will adjust pricing and highlight trending products.
- **User & Role Management**: The system will support different roles (Admin, Seller, Customer) with distinct functionalities.

- **Inverse Requirements**

These specify what the system will not include:

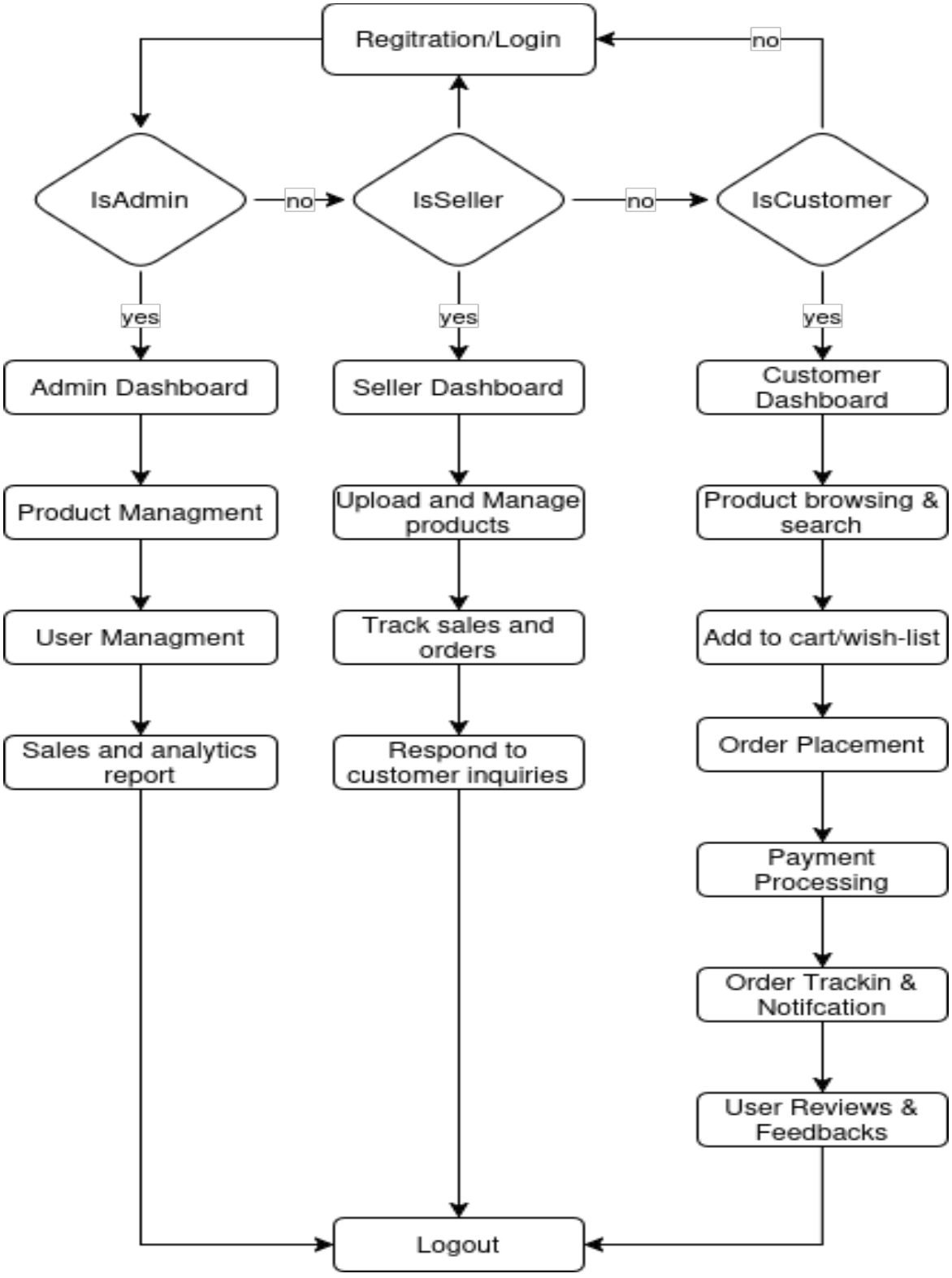
- **No Physical Store Integration:** The platform will focus solely on online shopping and will not connect with physical stores.
- **No Third-Party Vendor Management:** Sellers must directly list and manage their own products; external vendor systems will not be integrated.
- **No Manual Product Recommendation:** All product recommendations will be AI- driven, without manual curation.
- **No Cash on Delivery (COD)**: All payments will be processed through digital transactions only.

- **Admin Analytics & Reports**

A comprehensive reporting module for admins to monitor platform performance.

- **Sales Reports:** View total revenue, sales trends, and peak shopping periods.
- **User Behavior Analytics:** Analyze customer engagement, browsing patterns, and abandoned carts.
- **Product Performance Metrics:** Track best-selling products and low-performing items.
- **Seller Performance Dashboard:** Monitor top sellers, fulfillment rates, and user ratings.

- **Flow chart diagram**



8. System Limitations/Constraints

- AI model training may require large datasets.
- High-quality 3D models might increase load times.
- Internet dependency for real-time recommendations.

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9. Software Process Methodology

The project will follow the Agile methodology, which enables iterative development, continuous feedback, and flexibility in adapting to user needs. Agile allows us to develop the system in multiple phases, ensuring that new features can be tested and improved based on user input. This methodology is well-suited for our AI-driven e-commerce platform, as it supports incremental enhancements in product recommendations and 3D visualization. Additionally, Agile aligns with our expertise in modern web development, making it an ideal choice for building a dynamic and user-centric application.

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10. Tools and Technologies

Table 1: Software Tools

Tools and Technologies	Version	Rationale
Visual Studio Code	Latest	IDE for front-end and back-end development
Postman	Latest	API testing and development
Git & GitHub	Latest	Version control and project collaboration

Table 2: Technology Stack

Technology	Version	Rationale
React.js	Latest	Front-end framework for building dynamic UI
Django (Python)	Latest	Back-end framework for handling business logic
MongoDB	Latest	NoSQL database for flexible and scalable data storage
TensorFlow/Scikit-learn	Latest	AI model development for recommendations
Three.js/WebGL	Latest	3D rendering for product visualization
OAuth 2.0	Latest	Secure authentication mechanism

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11. Project Stakeholders and Roles

The key stakeholders in this project are:

- **Students:** Azeem Amjad & Moazzam Tanveer - Responsible for development and implementation.
- **Supervisor:** Kalim Sattar- Provides guidance and feedback.
- **Final Year Project Committee:** Evaluates the project outcomes and performance.

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12. Team Members' Work Division

Team Member	Role & Responsibilities
Azeem Amjad	AI-based recommendations, product ranking, back-end development
Moazzam Tanveer	3D product visualization, front-end development, database management

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13. Data Gathering Approach

The following methods will be used to gather data:

- **User Surveys:** To understand shopping preferences.
- **Market Research:** Analysis of existing e-commerce trends.
- **Competitor Analysis:** Reviewing features of similar platforms.

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14. Concepts

This project will incorporate the following key concepts:

- **AI-Based Recommendations** - Machine learning models to personalize product suggestions.
- **3D Product Visualization** - Implementing WebGL-based product viewing.
- **User Behavior Tracking** - Analyzing interactions to refine recommendations.
- **Dynamic Pricing Analysis** - Suggesting relevant products based on budget preferences.

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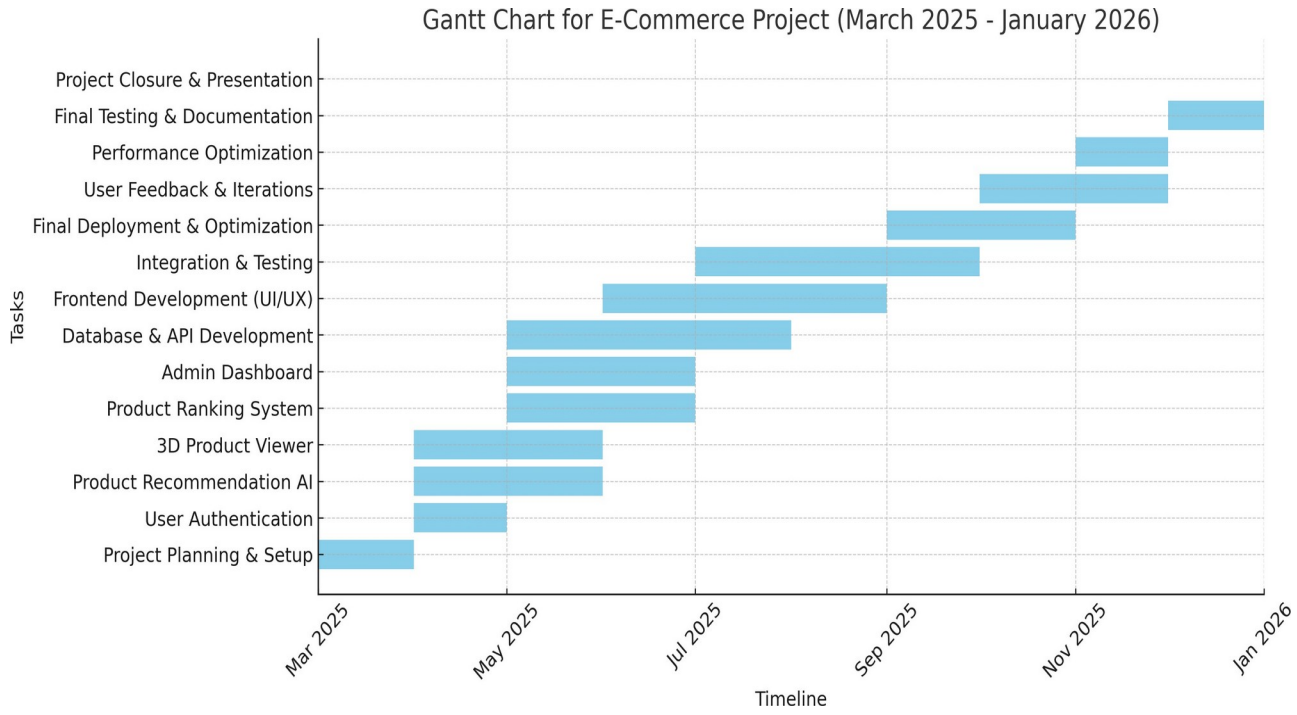
15. Gantt Chart



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16. Conclusion

This project aims to develop an AI-powered e-commerce platform that revolutionizes the online shopping experience by enhancing customer engagement, improving product discovery, and increasing user satisfaction. By integrating advanced AI algorithms for personalized recommendations and immersive 3D product visualization, the platform will offer a tailored and interactive shopping journey. This approach not only ensures that users receive product suggestions aligned with their preferences but also enables them to visualize products more effectively, leading to more informed purchasing decisions and a higher level of customer satisfaction.

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17. References

1. Smith, J. (2023). "AI in E-commerce: Personalized Recommendations." *Journal of Digital Commerce*, 12(3), 45-60.
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5. Chen, L. (2022). "Advancements in Virtual Shopping Experiences." *Global E-Commerce Journal*, 7(4), 200-215.