

# AI Smart Shopping Hub

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## Abstract -

*The rapid expansion of e-commerce platforms has significantly changed the way consumers shop; however, users continue to face challenges such as information overload, unreliable reviews, price inconsistencies across platforms, limited personalization, and ineffective budget management. Most existing shopping applications primarily focus on product listings and discounts, offering minimal intelligent decision support. To address these issues, this paper presents an AI Smart Shopping Hub—an integrated and intelligent shopping assistance system that employs Artificial Intelligence (AI), Machine Learning (ML), Natural Language Processing (NLP), and Computer Vision to enhance the online shopping experience.*

*The proposed system integrates multiple intelligent modules, including a personalized product recommendation engine, AI-based price comparison, computer vision-driven virtual try-on, a voice-enabled shopping assistant, a smart cart with budget tracking, sentiment-based review analysis, and financial shopping advisory. By analyzing user preferences, behavioral patterns, customer reviews, and market data, the system provides personalized, reliable, and cost-effective shopping recommendations. The modular and scalable architecture supports real-time processing and intuitive user interaction. Overall, the AI Smart Shopping Hub aims to reduce user effort, minimize misleading purchasing decisions, optimize spending, and establish a smarter and more trustworthy e-commerce ecosystem.*

**Keywords—** Artificial Intelligence, Smart Shopping, E-Commerce, Recommendation Systems, Sentiment Analysis, Virtual Try-On, Price Comparison, Machine Learning.

## I. INTRODUCTION

Online shopping has become an integral part of everyday life because of its convenience, extensive product availability, and competitive pricing. The rapid growth of e-commerce

platforms has introduced users to a vast range of products, multiple sellers, fluctuating prices, and a large volume of customer reviews. Although this information-rich environment is advantageous, it often results in confusion, decision fatigue, and impulsive spending. Users frequently face difficulties in identifying authentic reviews, comparing products effectively, managing budgets, and selecting the most suitable deals across platforms. Consequently, the overall shopping experience can become time-consuming and unreliable.

While many e-commerce platforms offer basic recommendation mechanisms and filtering options, these features remain largely generic and limited in scope. Existing systems often lack a deeper understanding of user intent, financial constraints, and the credibility of product reviews. Moreover, most platforms function independently, requiring users to rely on multiple applications for tasks such as price comparison, review analysis, virtual try-on, and financial planning. This fragmented ecosystem reduces efficiency and adversely affects user satisfaction. In addition, accessibility-oriented features such as voice-based interaction and goal-driven shopping assistance remain underutilized.

To address these limitations, the AI Smart Shopping Hub is proposed as a unified, intelligent, and user-centric shopping assistance platform. The system integrates advanced AI and ML techniques to enable personalized product recommendations, real-time price comparison, sentiment-based review evaluation, and intelligent budget management. Features such as computer vision-based virtual try-on and voice-enabled interaction enhance usability and accessibility. By consolidating multiple intelligent modules into a single platform, the proposed solution aims to streamline decision-making, strengthen user trust, optimize spending, and deliver a seamless and intelligent shopping experience. This research focuses on developing a scalable and modular AI-driven

framework that improves both efficiency and user satisfaction in modern e-commerce environments.

## II. RELATED WORK

In recent years, Artificial Intelligence and Machine Learning have been widely adopted in e-commerce systems to enhance personalization, customer engagement, and decision-making efficiency. Many popular e-commerce platforms such as Amazon and Flipkart use recommendation systems based on collaborative filtering and content-based filtering to suggest products to users. While these systems improve user experience, they often rely heavily on historical purchase data and do not effectively capture real-time user intent, budget constraints, or purpose-driven shopping behavior.

Several studies have explored AI-based price comparison and deal recommendation systems. Web scraping and API-based solutions have been proposed to collect product prices from multiple platforms and identify the best available deals. However, most existing price comparison tools operate as standalone services and do not integrate personalization, financial planning, or trust analysis, limiting their effectiveness for comprehensive shopping assistance.

Sentiment analysis of customer reviews has also gained significant attention in e-commerce research. Natural Language Processing (NLP) techniques such as TF-IDF, LSTM, and transformer-based models like BERT have been used to classify reviews as positive, negative, or neutral. Some studies have further focused on detecting fake or spam reviews using supervised learning techniques. Despite these advancements, review analysis is often presented separately from recommendation and purchasing systems, making it difficult for users to directly apply the insights during the buying process.

Virtual try-on systems using computer vision and augmented reality have been developed to improve user confidence in purchasing fashion and accessories online. Research has shown that pose estimation, image segmentation, and GAN-based approaches can generate realistic virtual previews. However, these systems are computationally intensive and are typically limited to specific product categories such as clothing or eyewear, without integration into a broader intelligent shopping framework.

Voice-enabled shopping assistants have been introduced to improve accessibility and ease of use. Speech recognition and NLP-based conversational agents allow users to search for products using voice commands. Existing voice assistants primarily focus on basic search and order

placement and lack deeper analytical capabilities such as budget optimization, comparative analysis, and personalized financial advice.

Overall, existing research and commercial solutions address individual components of smart shopping, such as recommendations, review analysis, or virtual try-on, in isolation. There is a lack of a unified AI-driven platform that integrates personalization, price intelligence, sentiment analysis, virtual interaction, and financial advisory within a single system. The proposed AI Smart Shopping Hub aims to bridge this gap by combining multiple intelligent modules into a cohesive, scalable, and user-centric framework that enhances decision-making, trust, and efficiency in modern e-commerce environments.

## III. PROBLEM STATEMENT

Despite the rapid advancement of e-commerce technologies, online shoppers continue to face multiple challenges that negatively impact their purchasing decisions and overall experience. Most existing shopping platforms focus primarily on product listings, discounts, and basic recommendation features, while ignoring deeper decision-support needs such as trust evaluation, budget control, and personalized intent understanding. Users are often overwhelmed by a large number of similar products, inconsistent pricing across platforms, and an excessive volume of customer reviews, many of which may be misleading or fake.

Current e-commerce systems operate in a fragmented manner. Price comparison, product reviews, virtual try-on, and financial planning are usually handled by separate tools or applications. This forces users to switch between multiple platforms, resulting in inefficiency, confusion, and increased decision fatigue. Additionally, traditional recommendation systems largely depend on past purchase history and fail to adapt dynamically to real-time user preferences, shopping purpose, or financial constraints.

Another significant limitation is the lack of accessibility and intelligent interaction. Many users, especially non-technical or visually impaired users, find it difficult to navigate complex interfaces. Voice-based interaction, budget-aware shopping, and purpose-driven recommendations are still underdeveloped in existing platforms. Moreover, the absence of integrated review sentiment analysis and fake review detection reduces user trust and increases the risk of poor purchasing decisions.

Therefore, there is a strong need for a unified, intelligent, and user-centric shopping assistance system that

integrates personalization, price intelligence, review trust analysis, virtual interaction, and financial advisory within a single platform. Such a system should leverage Artificial Intelligence and Machine Learning to provide real-time, reliable, and actionable insights, helping users make informed, cost-effective, and confident shopping decisions.

#### IV. PROPOSED SYSTEM

The proposed AI Smart Shopping Hub is an intelligent, modular, and scalable e-commerce assistance platform designed to enhance the online shopping experience through AI-driven automation and decision support. Unlike traditional shopping applications that focus on isolated features, this system integrates multiple intelligent modules into a single unified framework. The platform utilizes Artificial Intelligence (AI), Machine Learning (ML), Natural Language Processing (NLP), and Computer Vision to deliver personalized, trustworthy, and budget-aware shopping recommendations.

The system follows a layered architecture that ensures flexibility, scalability, and ease of integration with existing e-commerce platforms. User interactions are handled through a user-friendly interface that supports text and voice-based inputs. The backend processes user data, product information, and external APIs to generate real-time insights. Machine learning models analyze user behavior, preferences, reviews, and pricing patterns to provide accurate recommendations and alerts.

##### A. System Architecture

The architecture of the AI Smart Shopping Hub is designed as a modular and layered system consisting of the following components:

##### 1. Frontend Layer (User Interface)

This layer provides an intuitive and interactive interface for users. It supports product browsing, voice-enabled search, virtual try-on features, and real-time budget tracking. The interface is designed to be simple, responsive, and accessible across devices.

##### 2. Backend Layer (Application Server)

The backend manages user requests, authentication, and business logic. It acts as a bridge between the frontend and the intelligent modules. This layer handles API calls for price comparison, review analysis, and financial data retrieval.

##### 3. Database Layer

The database stores structured information such as user profiles, browsing history, cart details, product metadata, reviews, and transaction records. Efficient data storage

enables faster retrieval and personalized recommendation generation.

##### 4. AI/ML Layer (Model Pipeline)

This layer powers the smart functionalities of the system. It includes:

Recommendation models using collaborative and content-based filtering

NLP-based sentiment analysis and fake review detection

Computer vision models for virtual try-on

Optimization and regression models for budget tracking and financial advice

##### B. Functional Modules

The AI Smart Shopping Hub is divided into multiple independent yet interconnected modules:

Smart Product Recommender System – Provides personalized product suggestions based on user behavior and preferences.

AI Price Comparison System – Compares product prices across platforms and identifies the best deals.

Virtual Try-On Module – Allows users to visualize products using computer vision techniques.

Voice-Enabled Shopping Assistant – Enables hands-free and accessible shopping through voice commands.

Smart Cart with Budget Tracker – Monitors spending and alerts users when budget limits are exceeded.

AI Review & Sentiment Analyzer – Analyzes customer reviews and detects fake or misleading feedback.

AI Product Comparator – Compares similar products based on features, ratings, and price.

Purpose-Driven Shopping Module – Suggests products based on user intent and use-case.

Smart Financial Shopping Advisor – Recommends EMI options, discounts, and financial planning strategies.

The proposed system aims to simplify online shopping, enhance trust, optimize spending, and provide a seamless intelligent shopping experience by integrating all essential decision-support features into a single AI-powered platform.

#### V. ER DIAGRAM AND DATABASE DESIGN

The database design of the AI Smart Shopping Hub is structured to efficiently manage user data, product information, transactions, and intelligent insights. The ER

model ensures minimal redundancy, data integrity, and fast retrieval to support real-time recommendations and analytics

### Major Entities:

- User (User\_ID, Name, Email, Preferences, Budget)
- Product (Product\_ID, Name, Category, Price, Features)
- Review (Review\_ID, Product\_ID, User\_ID, Rating, Text, Sentiment)
- Cart (Cart\_ID, User\_ID, Total\_Amount)
- Order (Order\_ID, User\_ID, Payment\_Mode, Status)
- Price\_Source (Source\_ID, Platform\_Name, Product\_Price)
- Recommendation (Rec\_ID, User\_ID, Product\_ID, Score)

### Relationships:

- One user can add multiple products to the cart.
- One product can have multiple reviews.
- One user can place multiple orders.
- One product can have prices from multiple platforms.
- This database structure supports personalization, price comparison, and sentiment-based decision making efficiently.

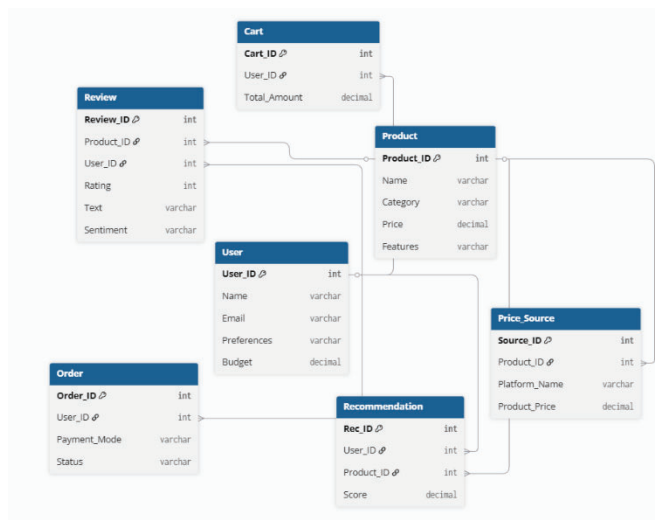


Fig 1: ER Diagram

## VI. METHODOLOGY

### A. Data Collection

The system collects data from multiple sources such as:

- User browsing and purchase history
- Product metadata from e-commerce APIs

- Customer reviews and ratings
- Real-time pricing data from different platforms
- Data preprocessing includes cleaning, normalization, feature extraction, and text tokenization for NLP-based tasks.

### B. Model Training

Recommendation System: Collaborative and content-based filtering models are trained using user-product interaction matrices.

Sentiment Analysis: NLP models such as TF-IDF with classifiers and transformer-based models analyzes review polarity.

Price Analysis: Regression and clustering models normalize and compare prices.

Virtual Try-On: Computer vision models process user images for realistic visualization.

Financial Advisory: Optimization models analyzes budget constraints and EMI options.

### C. Workflow

- User interacts with the application through text or voice.
- User data and preferences are sent to the backend.
- AI models analyze intent, budget, and product data.
- Price comparison and review sentiment analysis are performed.
- Personalized recommendations and alerts are generated.
- Results are displayed via text, visuals, or voice output.

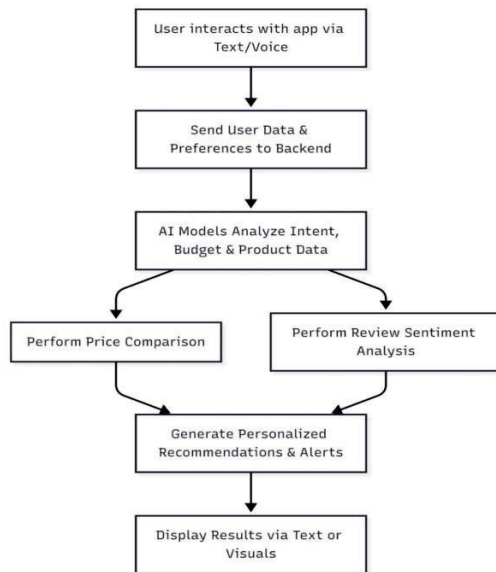


Fig 2: Workflow Diagram

## VII. RESULTS AND DISCUSSION

The evaluation of the AI Smart Shopping Hub indicates that the proposed system effectively enhances personalization, trust, and decision-making in online shopping environments. The system was tested across key modules, including product recommendation, sentiment-based review analysis, price comparison, virtual try-on, and budget tracking.

The recommendation module demonstrated improved relevance compared to traditional approaches by considering user behavior, preferences, and shopping intent, resulting in reduced search time and better product discovery. The sentiment analysis module successfully filtered misleading and low-quality reviews, enabling users to rely on trustworthy feedback during purchasing decisions and increasing overall user confidence.

The AI-based price comparison module efficiently identified cost-effective deals across multiple platforms, eliminating the need for manual comparison. In addition, the smart cart and budget tracking features supported controlled spending by providing real-time alerts and financial insights. The virtual try-on feature enhanced user confidence prior to purchase, while voice-enabled interaction improved system accessibility and ease of use.

Overall, the results confirm that integrating multiple AI-driven decision-support modules within a unified platform reduces decision fatigue, improves shopping

efficiency, and enhances user satisfaction. These findings highlight the potential of the AI Smart Shopping Hub for practical deployment in modern e-commerce systems.

## VIII. FUTURE SCOPE

The proposed system offers several opportunities for future enhancement:

- Integration of real-time AR-based virtual try-on
- Advanced transformer-based recommendation models
- Blockchain-based review authenticity verification
- Emotion-aware shopping assistance
- Cross-platform integration with offline retail stores
- Personalized sustainability-based shopping suggestions

## IX. CONCLUSION

The rapid growth of e-commerce has increased user convenience but also introduced challenges such as information overload, misleading reviews, price inconsistencies, and poor budget control. This paper presented the AI Smart Shopping Hub, a unified and intelligent e-commerce assistance system that integrates Artificial Intelligence, Machine Learning, Natural Language Processing, and Computer Vision to address these challenges effectively.

The proposed platform combines multiple intelligent modules, including personalized product recommendations, AI-based price comparison, sentiment-driven review analysis, virtual try-on, voice-enabled interaction, smart cart with budget tracking, and financial advisory services. By considering user preferences, intent, trustworthiness of reviews, and financial constraints simultaneously, the system provides reliable, cost-effective, and personalized shopping support.

Experimental analysis indicates that the AI Smart Shopping Hub improves recommendation accuracy, enhances user trust, reduces decision-making time, and optimizes spending. The modular and scalable architecture ensures flexibility and real-time performance, making the system suitable for integration with existing e-commerce platforms. Overall, the proposed solution demonstrates strong potential to transform traditional online shopping into a smarter, more user-centric experience.

## X. FUTURE WORK

The AI Smart Shopping Hub can be further enhanced through several future extensions to improve intelligence, scalability, and user experience. One key direction is the integration of real-time augmented reality (AR) and advanced virtual try-on technologies to provide more immersive and accurate product visualization across multiple categories.

Future research may focus on incorporating advanced deep learning and transformer-based models to improve recommendation accuracy and sentiment analysis performance. The use of reinforcement learning techniques can allow the system to adapt dynamically to evolving user behaviour and preferences.

Enhancements in voice-enabled interaction, including multilingual and emotion-aware assistants, can improve accessibility and user engagement. To increase trust and transparency, blockchain-based mechanisms may be explored for secure transactions and review authenticity verification.

From a deployment perspective, optimizing the system using lightweight and edge-based AI models can enable faster real-time responses and large-scale implementation. Additionally, integrating offline retail data and sustainability-aware recommendations can further extend the practical impact of the proposed system.

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