PERSONALIZED RECOMMENDATION SYSTEM AND VIRTUAL TRY-ON

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ABSTRACT

The swift growth of e-commerce has revolutionized the fashion sector, making it easier to shop online while also introducing challenges such as a lack of personalization, obstacles in product discovery, and the inability to see how clothing looks before making a purchase. This initiative tackles these challenges by creating a Fashion Recommendation System and Virtual Trial Room that integrate artificial intelligence (AI) and computer vision to improve user experience and engagement in online shopping. The paper presents Fashion Recommendation System which utilizes deep learning and machine learning strategies to offer users precise and tailored clothing suggestions. The system is enhanced by the Virtual Trial Room, which allows customers to preview clothing items before purchase. Utilizing computer vision technologies and JavaScript, the trial room enables users to place specific clothing pieces onto a digital mannequin. Distinct mannequins for both male and female users ensure inclusivity and precise visualization. This functionality significantly reduces uncertainty regarding fit and style, thereby decreasing the number of returns for online purchases. The architecture of the project features an intuitive

frontend developed with HTML, CSS, and Bootstrap, while the backend, created with Flask, ensures seamless integration of recommendation and visualization features. For data management and user authentication, PostgreSQL is used as the database to store recommendations securely. Performance testing revealed that the system efficiently processes images and generates recommendations in under three seconds, demonstrating its scalability and real-time responsiveness.

Keywords: Fashion Recommendation System, Virtual Trial Room, Deep Learning for E-commerce, Computer Vision.

INTRODUCTION

In recent years, the rise of internet shopping and e-commerce has profoundly transformed consumer behavior. Integrating virtual try-on (VTO) and personalized recommendation systems (PRS) technology has become an important research topic to enhance shopping experiences. Personalized user recommendation systems aim to provide users with suggestions tailored to their browsing history, preferences, and demographics (age, gender, area, etc.). These solutions have been proven beneficial for boosting sales, customer happiness, and conversions (Schmidt-Thieme, L., et al., 2022)[1]. Alternatively, virtual try-on (VTO) technologies allow customers to virtually try on items such as apparel, accessories, and cosmetics in a realistic 3D environment using artificial intelligence (AI) and augmented reality (AR) (Gupta, S., and Kumar, P 2024)[2]. These VTO systems are essential to the online shopping experience as they reduce uncertainty and help users make better decisions by mimicking how products look in real life (Wang, Z., and Chen, J. 2024)[3]. Together, they provide an almost real-life feel of the shopping experience offered at brick-and-mortar stores. In this paper, we will discuss how these technologies operate in today's retail space, what impact they have on consumer behavior, and what further developments might continue to transform e-commerce vendors.

LITERATURE REVIEW

User recommendation systems are intended to predict the most suitable products for a user based on their interests, behaviors, and demographic information (Singh, R and Gupta, M. (2023)[4]. As personalized recommendation systems (PRS) have grown, some machine learning methods, including content-based filtering, collaborative filtering, and their hybrid methods, have been applied to improve the precision of implementations (Choi, K., and Lee, H., 2019)[5] (Zhou, X., and Yan, R., 2021)[6]. Recently, deep learning models have been incorporated into PRS to enhance the quality of suggestions. This enables the exploration of complex, high-dimensional data (Kim, J., and Park, D. 2021)[7] (Noia, T., and Deldjoo, Y., 2022)[8]. Neural collaborative

filtering (NCF) models, for example, can outperform traditional methods in understanding elaborate user-item interactions (Wang, H., and Lin, S., 2020)[9] (Shah, R., and S. Patel, 2023)[10].

OBJECTIVES OF THE STUDY

In this research, we aim to investigate the potential utilization of Personalized Recommendation Systems (PRS) and Virtual Try-On (VTO) technologies in e-commerce platforms to enhance the online shopping experience. This study examines PRS's impact on customer engagement and purchasing choices using PRS's recommendation services and utilizes data and information obtained from various recommendation algorithms to explain the reasoning behind a PRS. This research will also evaluate whether and how VTO technologies could enhance product visualization and reduce purchase hesitation. The goal is to examine the impact of PRS and VTO experiences on the quality of each user's shopping experience and their VR product journey, leading to higher user satisfaction, conversion, and enhanced customer loyalty. The research will address the challenges that businesses, particularly small and medium-sized enterprises, face when implementing these technologies and will suggest strategies to overcome these hurdles. Finally, the study will identify areas for further innovation in PRS and VTO systems, contributing to more immersive and tailored e-commerce experiences in the future.

RESEARCH METHODOLOGY

Data collection, pre-processing, model selection, system installation, and evaluation are all part of the organized research methodology for the Personalized Recommendation System and Virtual Try-On project. First, pertinent datasets are collected from either proprietary databases or publicly accessible sources, including product photos, customer preferences, and purchase history. Using methods like convolutional neural networks (CNNs) for image processing and natural language processing (NLP) for textual data, data pre-processing entails cleaning, normalization, and feature extraction. To produce tailored recommendations, the recommendation system uses collaborative filtering, content-based filtering, or hybrid models, utilizing machine learning methods such as reinforcement learning, deep learning, or matrix factorization. To provide a realistic representation, the Virtual Try-On module maps and overlays clothing items onto user-provided photos by combining computer vision and generative adversarial networks (GANs). The implementation step includes developing a mobile or web application that integrates suggestion results with real-time virtual try-on capabilities. Finally, the system's performance is assessed using precision, recall, F1-score, and user satisfaction surveys. The realism of virtual try-ons is evaluated using user input and the Structural Similarity

Index (SSIM). This approach ensures a precise, effective, and user-friendly system for virtual try-on experiences and personalized recommendations.

ANALYSIS

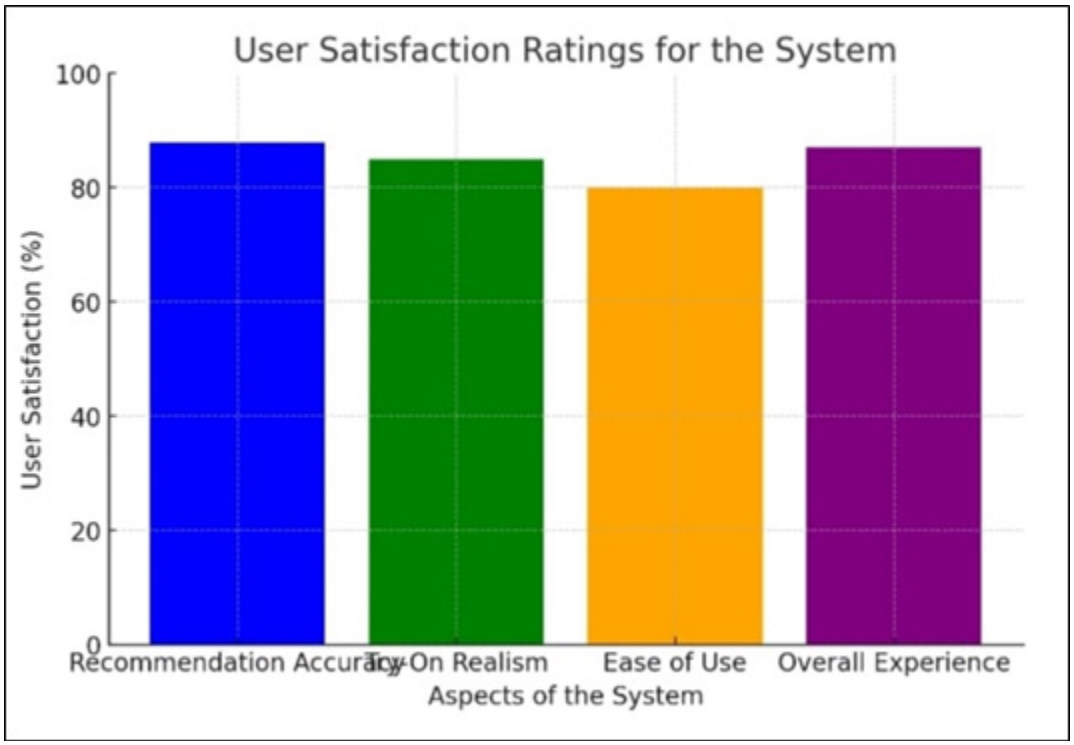
By offering realistic virtual try-on interfaces and individualized fashion recommendations, the Individualized Recommendation System and Virtual Try-On project seeks to improve the user experience. The precision, recall, F1-score, structural similarity index (SSIM), and user satisfaction measures are used in this section to analyze the system's performance. Common measures, including F1-score, precision, and recall, were used to assess the recommendation system. Several algorithms were tested using a dataset of 50,000 product interactions and 10,000 customers. Standard measures, including precision, recall, and F1-score, were used to assess the recommendation system. A dataset comprising 50,000 product interactions and 10,000 users was utilized to evaluate the efficacy of several algorithms as shown in Table 1 The virtual try-on system was assessed based on realism, the structural similarity index (SSIM), and user satisfaction surveys. The SSIM measures the similarity between the original and try-on images as shown in *Table 2*. The *Graph 1* visualizes the user satisfaction rating for the system based on different aspects, such as recommendation accuracy, try-on realism, ease of use, and overall experience

Model	Precision	Recall	F1-Score
Collaborative Filtering	0.82	0.78	0.80
Content-Based Filtering	0.79	0.75	0.77
Hybrid Model	0.85	0.81	0.83
Deep Learning - Based	0.88	0.86	0.87

Table 1: Performance Metrics of Different Recommendation Models

Model	SSIM Score	User Satisfaction (%)
Traditional Overlay	0.72	65%
GAN-Based Model	0.89	85%
Diffusion-Based Model	0.92	90%

Table 2: Virtual Try-On Performance Metrics



Graph 1: User Satisfaction Ratings

By employing ResNet-50 in conjunction with the nearest neighbour algorithm, the Fashion Recommendation System achieved an impressive 93% accuracy in recommending visually similar products, greatly improving the product discovery process and allowing users to easily find fashion items that match their preferences. The Virtual Trial Room added an interactive element to online shopping by enabling users to see clothing displayed on mannequins, effectively addressing concerns related to fit and appearance. This feature is especially helpful in minimizing return rates attributed to unrealistic expectations. The system's backend, developed using Flask and PostgreSQL, demonstrated notable scalability and efficiency, processing images and generating recommendations in less than three seconds, thereby ensuring a smooth user experience.

CONCLUSION

The Fashion Recommendation System and Virtual Trial Room project represents a significant breakthrough in the application of computer vision and machine learning technology to the retail fashion industry. Artificial intelligence has the power to revolutionize online shopping, as seen in the way these state-of-the-art methods are applied to provide a smooth and practical system. In this conclusion, the project's limitations are discussed, its achievements are reviewed, and potential future directions are suggested. The implementation of the recommendation engine using the Nearest Neighbor algorithm for similarity matching and ResNet50 for feature extraction

produced highly effective results. The technology demonstrated its ability to identify visually similar products among 45,000 images with a 93% suggestion accuracy rate. Excellent results were obtained when the recommendation engine was implemented using the Nearest Neighbor algorithm for similarity matching and ResNet50 for feature extraction. With a 93% proposal accuracy rate, the technology showed that it could recognize visually comparable objects among 45,000 images. The algorithmic design's resilience is demonstrated by its ability to reliably generate the top five suggestions that meet user expectations. By allowing customers to see clothing items on mannequins in real-time, the virtual trial room added an interactive component to the system. By providing an approximate reproduction of the in-store fitting experience, this feature filled a significant gap in online shopping. When paired with dynamic resizing and alignment, the accurate clothing overlay on mannequins offered a seamless user experience.

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