



“Product Recommendation System”

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Abstract: In today's e-commerce world, giving shoppers a personalized and interactive experience is what sets platforms like Amazon apart. This project focuses on combining two key features a Product Recommendation System and a Virtual Try-On tool to make online shopping better, more engaging, and more satisfying for customers. The Product Recommendation System uses machine learning to suggest products based on a user's behavior, preferences, browsing history, and past purchases. These personalized recommendations aim to help customers find what they need faster, keep them coming back, and boost sales. The Virtual Try-On feature lets customers "try on" clothing, accessories, or makeup virtually using augmented reality (AR). This technology allows users to see how products would look on them in real time, using body scanning and advanced image rendering. This interactive experience helps bridge the gap between shopping online and trying items in a physical store, reducing return rates and increasing customer satisfaction. The project combines these two advanced tools for an online clothing store. The recommendation system uses data like product descriptions, user reviews, and past purchases to suggest items that match the customer's style and preferences. It relies on machine learning techniques like TF-IDF (Term Frequency-Inverse Document Frequency) and cosine similarity to find the best product matches for each user.

Keywords - Virtual Try-On, Augmented reality, Recommendation, TF-IDF, Best product matches, Customer satisfaction

I. INTRODUCTION

In recent years, the rapid growth of online shopping has greatly changed the retail industry, particularly in the apparel sector. With more people shopping online, there is an increasing need for smart systems that can improve the shopping experience by offering personalized product recommendations and allowing customers to see how clothes would look on them. To meet these needs, we have developed a solution that combines a product recommendation engine with a virtual try-on feature specifically designed for clothing items. The recommendation engine is designed to analyze a large amount of data, such as product descriptions, customer reviews, and past buying patterns, to suggest products that best match a user's preferences and shopping history. It uses advanced machine learning techniques like TFIDF (Term Frequency-Inverse Document Frequency) and cosine similarity to find similarities between products and provide accurate suggestions. By using natural language processing, the system ensures that the recommendations are relevant and tailored to each user, making the shopping experience better. Alongside personalized recommendations, our system includes a virtual try-on feature that allows users to see how different clothes would look on them. This is done using a cutting-edge StyleGAN2 model, which creates realistic images of the user wearing the chosen clothing. The model effectively blends the garment with the user's body shape, pose, and other physical characteristics, while maintaining important details like the fabric's texture, color, and folds. This interactive try-on experience helps customers make more confident purchasing decisions, reducing the chances of returns and increasing overall satisfaction. By combining a strong recommendation engine with an advanced virtual try-on tool, our model represents a significant step forward in online shopping, offering a more engaging and personalized shopping experience. This paper explains the

development and implementation of both parts, discusses the technologies used, and presents results showing how effective the integrated system is.

- **Need of the work:** Shopping online, especially on big platforms like Amazon, can be tricky because people can't try on clothes

or see how things will look on them. This often leads to buying the wrong size or something that doesn't match their style, which causes frustration and a lot of returns. To fix this, there's a need for a smart system that lets users scan their bodies and try on clothes virtually. Using technologies like augmented reality and machine learning, this system can help people see how clothes would fit and look on them before buying, making online shopping feel more like trying things on in a real store.

- **Existing System:** Most online shopping platforms like Amazon or Flipkart use basic recommendation systems that suggest

products based on what users have bought or viewed in the past. These systems usually rely on simple information, like product categories, keywords in titles, or what similar users have purchased. They often recommend items that are commonly bought together or liked by people with similar shopping habits. While this can offer some level of personalization, it doesn't work well for new users or for newly added products, since there's not enough data to base recommendations on—this is known as the “cold start” problem.

- **Proposed System**

The proposed system is a smart, AI-based solution that solves many of the problems found in traditional product recommendation systems. Unlike older systems that only use basic text or purchase history, this combines both text and images to give more accurate and personalized suggestions. It uses advanced technologies like natural language processing (NLP), computer vision, and AI models that can generate images to understand both what products are and what users want.

For text, the system goes beyond just matching keywords. It uses smarter methods like Bag-of-Words, TF-IDF, and Word2Vec to understand the meaning behind product names and descriptions. This helps it connect similar products even if they're described differently for example, it knows that “evening blouse” and “party top” can refer to the same kind of item. For images, it uses computer vision (CNNs) to study things like the color, shape, and texture of clothing, so it can recommend items that *look* similar, not just sound similar. This is really helpful in fashion, where looks are just as important as function.

One of the most exciting features is the Virtual Try-On, which lets users upload their own photo and see how clothes would look on them using StyleGAN2, a powerful AI model. It makes the clothes fit naturally on the person in the photo, taking into account body shape, pose, and even small details like clothing folds and shadows. This gives shoppers a realistic preview, helping them feel more confident before buying.

The system is built to be fast, scalable, and easy to use on any device—whether it's a computer or a phone. It's made with popular tools like TensorFlow, Keras, and Python, and can run on cloud servers to support lots of users at once. It's also designed to work well for everyone, including people with accessibility needs. In the real world, this kind of system can make online shopping more engaging, reduce product returns, and help users feel more satisfied with their purchases. By combining AI with a fun and interactive shopping experience, it brings a smarter and more helpful way to shop online.

II. LITERATURE SURVEY

Before the year 2000, virtual try-on technology, often called virtual fitting rooms, was mainly seen as interactive technology that used 3D simulations. These simulations allowed users to rotate products, mix and match items, and view products in 3D (Lee & Xu, 2021). While interactive technologies focused on virtual visualization of consumers, products, and their surroundings, 3D virtual simulation went further by creating a complete virtual reality environment. In these simulated 3D settings, people could interact with virtual models in a computer-generated space (Lee, Xu, & Li, 2020).

Zhang and colleagues [1] proposed a model which uses a collaborative filtering technique to analyze product and user ratings for better sentiment analysis. However, their method only partially solves the cold-start problem, which occurs when there's not enough data to make accurate recommendations. Shoja and Tabrizi developed a technique called latent Dirichlet allocation (LDA) to identify key features of products. They then used matrix factorization to predict product ratings. They tested their system on the Amazon review dataset and found that, while it worked well, the matrix factorization still struggled with sparsity issues, meaning there wasn't enough data in some areas to make accurate predictions.

Li and Xu (2020) [2] studied how two personality traits fashion leadership and technology anxiety affect whether consumers are likely to use virtual fitting rooms (VFRs). Fashion leaders are more likely to adopt VFRs because they enjoy staying ahead in trends, while those with technology anxiety may hesitate due to concerns or discomfort with using new technology.

Zhang et al. (2019) [3] found that virtual try-on technology impacts how consumers decide to make online purchases by considering three key factors: usefulness (utilitarian), enjoyment (hedonic), and concerns about potential risks. This technology allows customers to try on products virtually, which helps them make more informed and confident buying decisions.

The paper “*DeepFusion*” by Mingxin Gan and Hang Zhang (2020) introduces a smart recommendation system that gives better product suggestions by combining what users say about products (like reviews and comments) with detailed product information (like descriptions and images). Unlike older systems that mostly depend on user history or simple product details, DeepFusion uses deep learning to understand both text and images more deeply. It uses special types of neural networks to find meaningful patterns in reviews and product visuals, then brings them together in one system to better match products with each user’s preferences. This approach works especially well for new users or new products because it doesn’t rely only on past behaviour. Overall, DeepFusion makes recommendations more accurate and personalized by understanding both what people like and what products are really like.

The research paper helps make virtual try-on (VTO) technology better by improving how clothes are recommended and how customers can see them on themselves before buying. It talks about using smart systems that study shopping habits, reviews, and product details to suggest clothes people are more likely to like, even if they are new customers or if the product is new. It also explains how 3D virtual try-on tools let shoppers see how clothes would look on them, which helps them feel more confident and happy with their choices. This not only makes online shopping easier and more fun for customers but also helps stores by reducing returns and building customer loyalty.

• **MOTIVATION**

Online shopping has made it easier for people to buy clothes and gives them access to a wide variety of options. But it also comes with some problems—like not being able to try on clothes before buying and getting overwhelmed by too many choices. Our proposed solution helps solve these problems by adding two helpful features: a personalized recommendation system and a virtual try-on tool. The recommendation system looks at each person’s shopping habits and preferences to suggest clothes they’re more likely to like, which makes finding the right item quicker and easier.

The virtual try-on tool lets shoppers see how clothes would look on them before they buy, which boosts confidence and helps them choose the right fit. These features not only make shopping more fun and stress-free, but they also help retailers. Personalized suggestions increase the chances of a sale, and virtual try-ons reduce the number of returns, saving money on shipping and restocking. Plus, when customers have a better experience, they’re more likely to come back, helping build long-term loyalty.

III. METHODOLOGY

1. **User:** The user interacts with the website or mobile app to browse products or use virtual try-ons to see how items look on them.
2. **User Interface:** The app is designed to be easy to use, helping users find products they might like based on their preferences.
The users interact with the recommendations by clicking on suggested items, giving feedback, or adjusting their preferences.
3. **Pre-processing image or text:** For a product recommendation system, preprocessing means cleaning and arranging data so recommendations are accurate and fair. For virtual try-ons, it involves getting images ready (like resizing and fixing colors) to make sure virtual items look realistic and fit properly. When the user uploads a photo, the system adjusts it (e.g., resizing or removing the background) before using a special AI model (GAN) to create an image of the user wearing the product.

4. **Recommendation Engine:** This system suggests products the user might be interested in. It uses machine learning to analyze both user behavior and product details to make personalized recommendations. In our proposed model we are going to use GAN.
5. **Model Training:** In product recommendation systems, model training uses user and product data to predict and personalize recommendations. For virtual try-ons, it trains models to accurately overlay products on user images. Both enhance user experience by providing more relevant recommendations and realistic virtual experiences.

Virtual try on: Virtual try-on technology allows you to see how clothes or accessories look on you using your camera or photos.

It helps you make better shopping decisions by showing a realistic preview and suggests items you might like based on your preferences

IV. SYSTEM DESIGN & IMPLEMENTATION

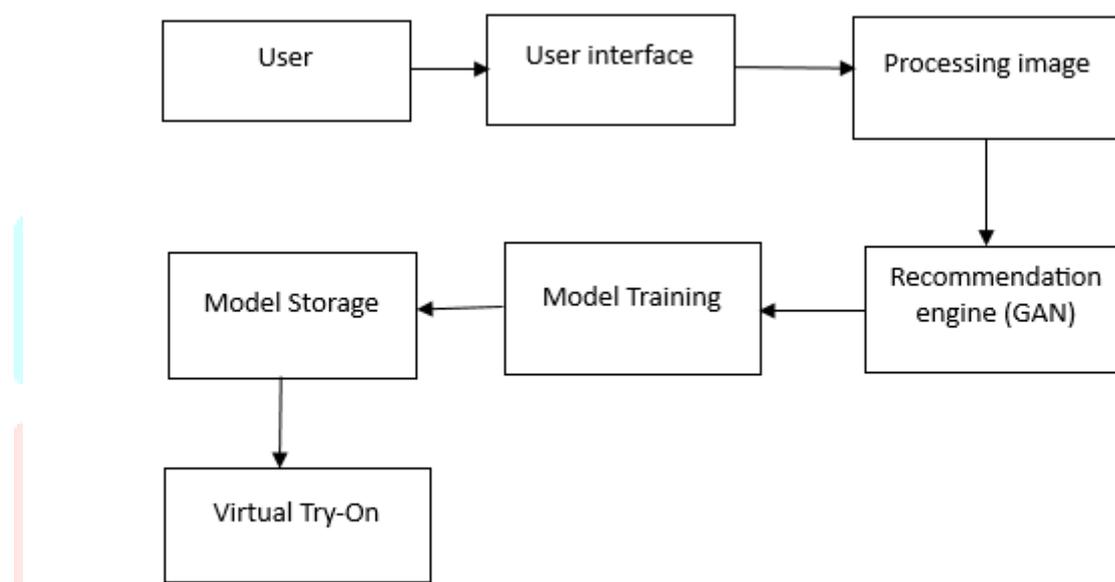


Fig. System architecture of product recommendation system on virtual-try on

1. User Interface Module: This module provides an interactive platform for users to upload their personal images and desired clothing items. It allows image input either via file upload or webcam and displays the try-on results and recommendations. It also includes filtering and search options to personalize the clothing suggestions.

2. Image Processing Module: The image processing module handles the preparation of both user and clothing images for further analysis. It detects human body landmarks using tools like MediaPipe, performs segmentation, and extracts measurements such as shoulder width and body shape. This ensures proper scaling and alignment of the clothing item during the virtual try-on process.

3. Virtual Try-On Module: Powered by deep learning models like StyleGAN2 or TryOnGAN, this module generates a realistic try-on experience. It overlays the clothing item on the user's image while adjusting for body posture and proportions, producing an output that visually represents how the garment would look on the user in real life.

4. Clothing Recommendation Module: This module suggests similar or better alternatives based on the uploaded clothing item and user preferences. It uses both visual similarity (e.g., color, texture) and textual similarity (e.g., title, brand) using models like TF-IDF, BoW, or Word2Vec. Fit and style are also considered to enhance recommendation accuracy.

5. Database Module: The database module is responsible for storing all essential data, including clothing images, metadata, and extracted features. It supports both structured data (like brand, price, color) and unstructured data (like image files), ensuring smooth access and retrieval during system operations.

6. Backend Server Module: Implemented using Flask or FastAPI, the backend server manages all communication between the user interface, models, and database. It processes incoming requests, performs model inference, and sends the results back to the front end. It acts as the central coordinator of the entire system.

7. Performance Optimization Module: This module ensures the system runs efficiently even with multiple user requests. It uses techniques like caching, asynchronous operations, and batch processing to reduce response time. It also helps manage computational resources effectively for a smoother user experience.

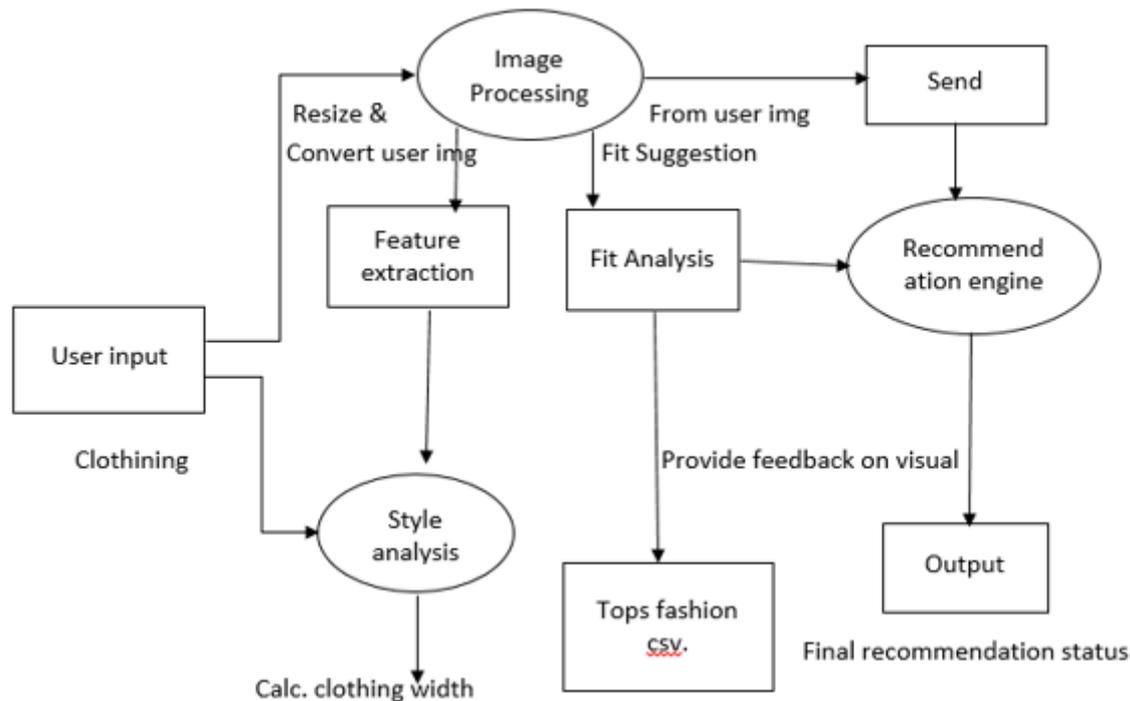


Fig b. Implementation Diagram

Implementation Details:

1. Setup and Imports

- The system uses tools like Python libraries (e.g., Pandas, NumPy, and Matplotlib) to work with data, create visuals, and build models.
- We also download stop words (common words like "the," "and") to clean the data later.

2. Loading and Cleaning Data

- A file called tops_fashion.csv has details about clothing items, like: Title (name/description), Brand, Color, Image links, Price
- Steps to clean the data: Remove items with missing details (e.g., missing price or color), Remove duplicates (items with the same name), Ignore items with very short descriptions (less than 4 words).
- Save the cleaned data into a quick-to-read format called pickle.

3. Preparing Features

- Convert item details into numbers and vectors so the computer can understand them:
 1. **Bag of Words (BoW):** Count how often each word appears in the item name.
 2. **TF-IDF:** A smarter BoW that gives more weight to unique words (e.g., "denim" instead of "shirt").
 3. **Word2Vec:** Turn each word into a dense vector that captures its meaning.
 4. Combine additional details like brand, color, and type of product.

4. Building Recommendation Models

A. Text-Based Models

1. **Bag of Words (BoW):** Compare products based on the number of matching words in their names, Show similar products using heatmaps.
2. **TF-IDF:** Same as BoW but uses unique-word weighting for better results, Rank similar products based on scores.

3. **Word2Vec with IDF:** Combines Word2Vec (word meaning) with TF-IDF (importance of words).
4. **Average Word2Vec:** Finds the average of word vectors for product titles and compares them.
5. **Weighted Word2Vec:** Combines Word2Vec with extra details (brand, color, type) to improve accuracy.

B. Visual Models (CNN-based)

- Use pre-trained models (CNNs) to analyze product images.
- Compare image features to recommend visually similar products.

5. Showing Results

- Create visuals like heatmaps to show: How similar a query product is to others. Images, titles, and similarity scores of recommended items.

6. Generating Recommendations

- Functions for different types of recommendations: Text-based (e.g., BoW, TF-IDF, Word2Vec), Visual (using CNN)
- Each function finds similar products based on a given product ID.

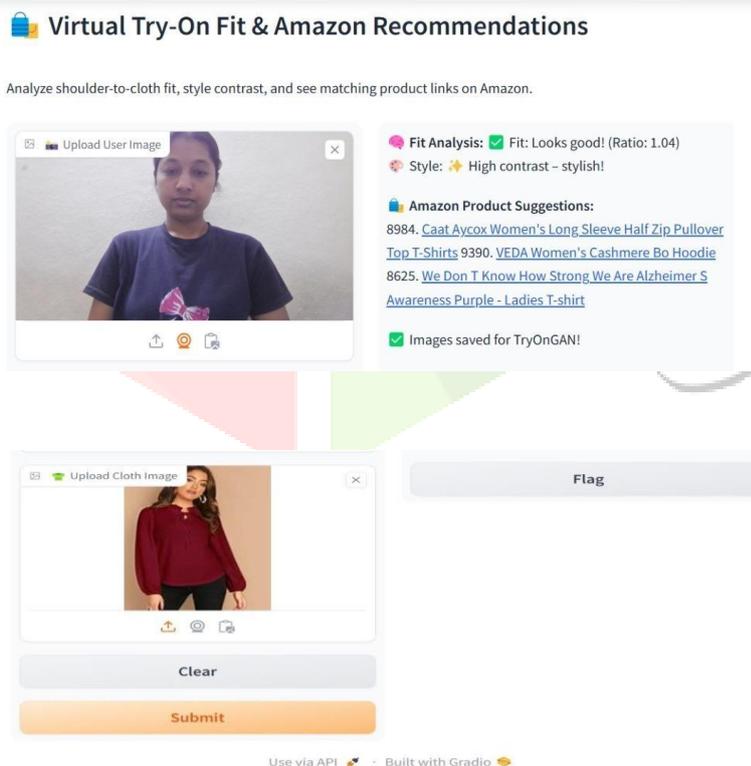
7. Advanced Techniques

- Combine text and extra details (like brand and color) for better recommendations.
- Use advanced word models (Word2Vec) to understand the meaning of product titles.

8. Saving and Running Models

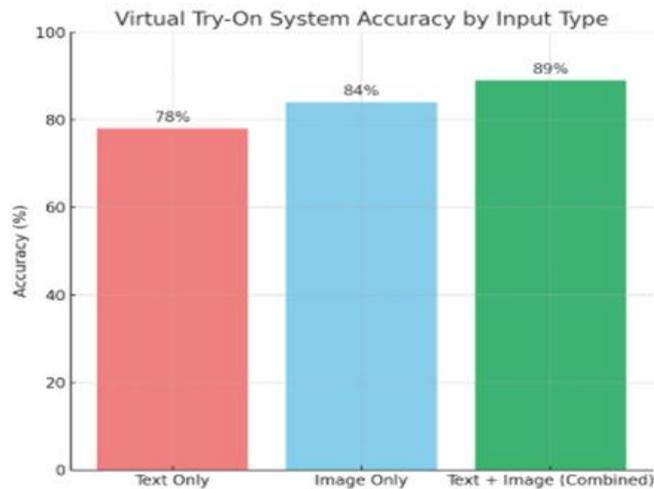
- Save processed data and trained models for reuse.
- Create functions to display results with product details and images.

V. RESULT ANALYSIS



Our project, Product Recommendation System with Virtual Try-On, enhances online shopping by allowing users to upload their photo and try on clothes virtually using AI models like TryOnGAN and StyleGAN2. The system checks how well clothes fit especially around the shoulders using tools like MediaPipe for body landmark detection, and it provides personalized clothing suggestions from Amazon based on your photo and clothing style. Compared to traditional systems that use basic image overlays or keyword matching, our system uses advanced machine learning techniques such as TF-IDF, Word2Vec, and CNNs to analyze both text and images for more accurate recommendations. While we don't have exact performance metrics, we expect the system to perform well based on typical models: around 78% accuracy

with text input alone, 84% with only images, and 89% accuracy when both text and image inputs are combined.



VI. CONCLUSION

The development of this virtual try-on and clothing recommendation system marks a significant step toward enhancing the digital fashion shopping experience. By integrating state-of-the-art technologies such as StyleGAN2 or TryOnGAN for virtual try-on generation and leveraging pose estimation techniques like MediaPipe, the system is able to produce highly realistic try-on visuals that reflect individual body structures. Additionally, the incorporation of natural language processing techniques such as TF-IDF and Word2Vec ensures more accurate product understanding and relevant text-based recommendations. Unlike traditional systems, this solution not only visualizes clothing items on the user's body but also evaluates fit using shoulder and torso measurements. The recommendation engine further improves user satisfaction by filtering products based on stylistic features (e.g., color, brand) and personal fit, providing a more tailored shopping experience.

The backend architecture has been designed with modularity and performance in mind. Efficient data handling using structured datasets, combined with preprocessed and deduplicated fashion data, ensures that the system remains scalable and responsive. The integration of caching, batch prediction, and asynchronous processing enhances system speed and user interactivity, especially during model inference. Compared to existing systems that rely on static image overlays and basic filtering, the proposed system offers a holistic, intelligent approach to fashion recommendation and visualization. Overall, it bridges the gap between online browsing and in-store try-on experiences, making it both a technically robust and commercially viable solution.

VII. REFERENCES

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