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Online Clothing Recommendations and Virtual Trials using AI

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Abstract: ***This project uses computer vision and machine learning to create a virtual trial room and a recommendation system that will improve the e-commerce fashion experience. CNNs are utilized to forecast body form for more precise recommendations, and the recommendation engine uses collaborative and content-based filtering to offer fashion items based on user preferences, past purchases, and style. To provide clothing recommendations based on each user's tastes, style, and body type, the recommendation engine will make use of collaborative filtering and content-based filtering algorithms. At the same time, a computer vision-powered virtual trial room lets customers see how clothes fit by superimposing ensembles on user-provided images or avatars and modifying dimensions according to body measurements to create a realistic fit simulation. By analyzing user- provided pictures, we can enhance body form detection, improving fit accuracy and recommendation precision. Users will be able to upload photos, see suggestions, and virtually try on clothing in real time thanks to a responsive web interface. Data processing will be handled by the Flask or Django-built backend, which will also effortlessly interact with a PostgreSQL or MySQL database to store user and suggestion data. The system is built for high performance and scalability and is hosted on cloud infrastructure. By offering personalized recommendations and lowering returns with precise fit visualization, this integrated system seeks to increase user happiness. This website allows users to digitally try on clothing and make purchases, which eventually improves consumer happiness and lowers return rates.***

I. INTRODUCTION

Innovation has always been welcomed in the fashion industry, and new developments in artificial Computer vision and artificial intelligence (AI) are changing how customers interact with fashion items. Challenges brought about by the growth of e-commerce include the inability to physically engage with apparel goods, leaving buyers unsure of fit and fashion. The goal of this project is to create a virtual trial room and fashion recommendation system in order to address these problems. The system provides tailored recommendations according to user preferences by utilizing AI-driven recommendation algorithms driven by TensorFlow and the ResNet-50 architecture. Furthermore, customers may examine how clothing items might seem on digital mannequins through the Virtual Trial Room, an interactive and lifelike visualization experience made possible by computer vision and JavaScript. These solutions work together to improve user engagement. Replicating in-store encounters online can lower return rates and increase consumer satisfaction. To ensure a smooth and user-friendly experience, the project uses a strong technical stack that combines HTML, CSS, Bootstrap for the frontend, and Flask for backend connectivity. PostgreSQL maintains user data while guaranteeing dependability and security. This solution benefits businesses and consumers alike by fusing AI and computer vision to provide a more immersive and customized purchasing experience. Customers become more confident in their choices, and businesses are able to improve their marketing and inventory control tactics. Looking ahead, the project pushes the limits of online purchasing by laying the groundwork for future developments like augmented reality (AR), real-time feedback, and advanced analytics. This project is a prime example of how technology may revolutionize the fashion sector and open the door to a more engaging, effective, and customized future.

II. LITERATURE REVIEW

Numerous strategies to enhance online fashion buying have been investigated by researchers. Wang et al. (2022) used artificial intelligence (AI) to create a virtual try-on system that allows clothes to fit various body configurations more accurately. In order to ensure that a variety of body shapes and identities are represented in virtual try-ons, Singh and Sharma (2022) underlined the significance of inclusion. Making fashion recommendation algorithms scalable for big inventories was the focus of Ramesh and Tan's (2021) research. ResNet is the best deep learning model for recognizing comparable fashion products, according to Das et al. (2021). The potential of AI to enhance the online purchasing experience was emphasized by Nguyen et al. (2021). Additional research concentrated on enhancing customer trust, tailored suggestions, and virtual try-on accuracy. The overall goal of these developments is to improve the effectiveness, usability, and engagement of fashion e-commerce.

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III. PROBLEM STATEMENT

E-commerce's explosive development has revolutionized shopping, but the fashion industry still confronts obstacles like evaluating fit, quality, and customization, which leaves customers unsure and increases return rates. Online platforms, in contrast to physical businesses, only use images and descriptions, which limits sales prospects and makes product discovery overwhelming. Profit margins are lowered by operational inefficiencies that retailers face, such as shipping, restocking, and quality control expenses. Inventory management, inclusivity for a range of body forms, and customization are further hampered by the absence of AI and computer vision. High return rates also have an adverse effect on the environment by increasing packaging waste and carbon emissions.

A more engaging, effective, and sustainable e-commerce fashion sector can be achieved by implementing technology such as Fashion Recommendation Systems and Virtual Trial Rooms, which can improve visualization, decrease returns, and increase personalization.

IV. EXISTING SYSTEM

Despite its convenience, the current online fashion purchasing systems' dependence on static photos, text-based descriptions, and simple filtering makes it difficult to satisfy the varied demands of consumers. Important visual preferences like color and style are missed by generic recommendation algorithms, which frequently produce suggestions that are useless. Because static photos don't show movement or drape, consumers find it challenging to evaluate fit and design in the absence of interactive visualization tools. Although AR and virtual try-on capabilities have been included onto various platforms, these technologies are still in their infancy and are not yet widely used. Additionally, a lot of stores are intolerant, which restricts the portrayal of various body shapes and identities.

Additionally, poor AI infrastructure, ineffective recommendation systems, and scalability problems impede consumer interaction and inventory efficiency. Inadequate security methods endanger user data, and high return rates exacerbate environmental issues. For e-commerce to be more effective, inclusive, and engaging, security, sustainability, and AI-driven customization must all be advanced.

V. PROPOSED SYSTEM

By combining a Virtual Trial Room with a Fashion Recommendation System, the proposed system seeks to transform online fashion purchasing by utilizing AI, deep learning, and computer vision to provide a more inclusive, customized, and engaging experience.

Using a nearest neighbor algorithm in Scikit-learn, the Fashion Recommendation System, which was developed with TensorFlow and ResNet-50, evaluates a dataset of 45,000 garment photos to extract visual characteristics like color and texture and then generates precise suggestions. Smooth processing is guaranteed by the Flask-based backend. With the use of JavaScript and computer vision, the Virtual Trial Room lets users place clothes over digital mannequins to improve visualization and lessen fit uncertainty. With a responsive frontend and a PostgreSQL-managed backend, the platform, which is made to be both scalable and sustainable, lowers returns and lessens its impact on the environment while guaranteeing device accessibility.

VI. PROJECT OBJECTIVES

Through the use of a Virtual Trial Room and Fashion Recommendation System, the project seeks to improve the online buying experience by tackling issues with product display and discovery. Its main goal is to create a strong recommendation system that can provide tailored suggestions from a 45,000-image dataset by utilizing TensorFlow, ResNet-50, and the closest neighbor technique.

By superimposing apparel items on digital mannequins, the Virtual Trial Room improves visualization and boosts confidence while making purchases, bridging the gap between in-person and virtual buying. With distinct mannequins for male and female users, inclusivity is given first priority, guaranteeing accessibility for a wide range of users. A Flask-based backend with an intuitive UI constructed with HTML, CSS, and Bootstrap guarantee flawless performance. The solution uses AI to give customer insights and boost retailer competitiveness while promoting sustainability by lowering return rates with precise suggestions. Setting a standard for innovation in the fashion sector, its scalable design facilitates the future incorporation of technologies like augmented reality, real-time feedback, and advanced analytics.

VII. METHODOLOGY

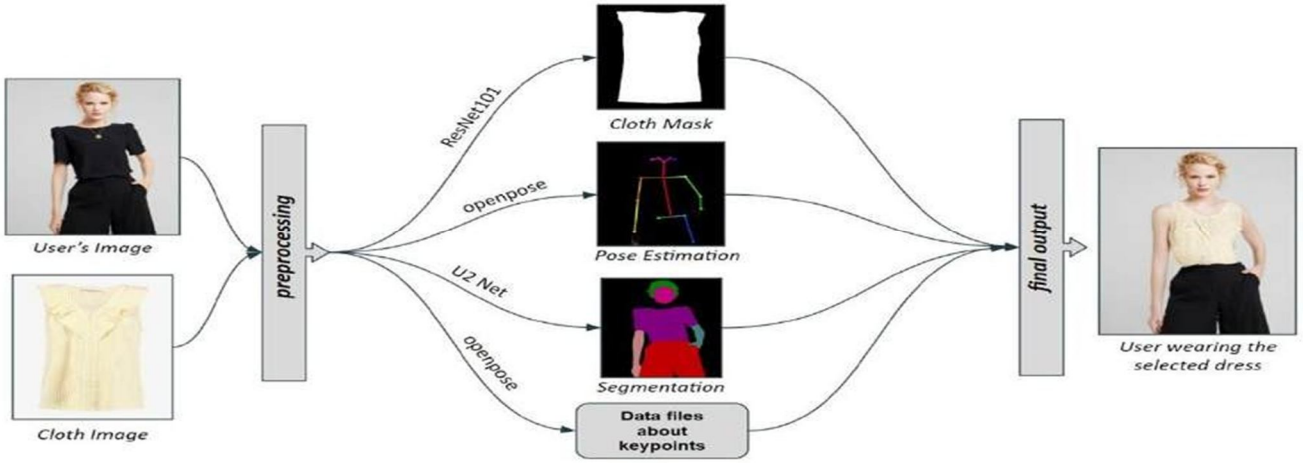


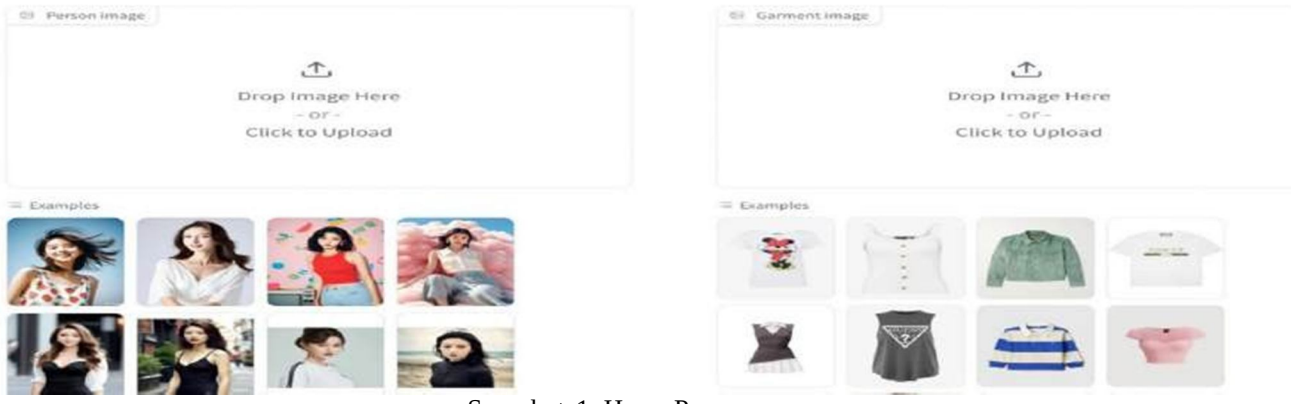
Figure 1: Flow Diagram

Personalized fashion recommendations and interactive clothing trials are provided by the fashion recommendation system with an integrated virtual trial room, which covers the full pipeline from image gathering to deployment. In order to support supervised learning, the project entailed gathering a large dataset of 45,000 high-resolution photographs from online fashion catalogs and refining them through noise removal, scaling (to 224x224 pixels), normalization, and careful labeling. A pre-trained ResNet50 model was used to improve feature extraction by capturing fine features like textures and patterns. This resulted in high-dimensional feature vectors, which served as the foundation for recommendations based on similarity. In the training phase, Sklearn's Nearest Neighbour method (using KD-Tree and Ball-Tree) allowed for quick similarity-based searches, while Triplet Loss and the Adam Optimizer were used to ensure accurate feature grouping, guaranteeing precise suggestions. In order to align apparel with mannequins in the virtual trial room component, pose recognition and picture segmentation techniques were combined with dynamic scaling and alignment functions that were developed using HTML Canvas and JavaScript to produce realistic overlays. HTML, CSS, Bootstrap, and JavaScript were used to create the system's interactive frontend, and a Flask-based backend effectively managed model inference, picture uploads, and API queries. The database solution was PostgreSQL, which managed user profiles, suggestion logs, and photos. To improve data security, decrypt password hashing was integrated. The system was deployed using either Heroku or AWS, with load balancing and caching techniques to maximize scalability. Thorough testing was done to evaluate the system's performance and dependability in order to ensure a smooth user experience. This ensured a reliable and effective solution for virtual garment trials and fashion recommendations.

VIII. IMPLEMENTATIONS

Through software and hardware implementation, the project's implementation phase aims to turn the theoretical concept into a fully working system. In order to provide a responsive look and interactive features like picture upload and virtual trial room interaction, the software module incorporates frontend development utilizing HTML, CSS, and Bootstrap. ResNet-50 and the closest neighbor algorithm are used by the Flask-based backend to handle user authentication, feature extraction, and recommendation processing. Fast queries are made possible by PostgreSQL's efficient indexing, which also securely stores user data, apparel metadata, and precomputed feature embeddings. The method incorporates Sklearn's KD-Tree for effective similarity searches and TensorFlow's ResNet-50 for feature extraction. All components operated well thanks to unit and end-to-end testing. For both male and female users, the hardware module includes virtual mannequins with computer graphics that enable dynamic garment overlays using JavaScript and OpenCV. Camera integration for real-time user engagement could be included in future versions. On typical PCs, system optimization strategies like memory management and hardware scalability guarantee effective performance. Flask APIs were used in the last integration step to link the frontend and backend, allowing for smooth real-time changes in the interactive trial room. Prior to being hosted on a cloud platform for wider accessibility, the system was initially set up on a local server for testing.

IX. SNAPSHOTS



Snapshot 1: Home Page

Snapshot 2: Trial on Saree

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Snapshot 4: Trial on Gown

Snapshot 5: Trial on Fancy Top

Snapshot 6: Trial on Men's wear

X. RESULTS AND DISCUSSIONS

The Fashion Recommendation System and Virtual Trial Room's efficacy and performance are examined in the results and discussion section, which also highlights important findings and areas for development. Despite difficulties with unclear photographs and unusual clothing, the recommendation system scored 93% accuracy over a sample of 45,000 images, with 87% of the top-5 suggestions matching user expectations.

With an average load time of 2.3 seconds and 95% alignment accuracy for garment overlays on mannequins, the Virtual Trial Room might be improved in the future to accommodate a variety of body forms and user-uploaded images. With a 90% success rate, the system managed 500 queries at once, reducing query speeds by 25% through enhanced database indexing while preserving economical CPU and memory use. With an interface satisfaction rating of 4.7/5, user experience feedback was quite favorable; nevertheless, consumers asked for more filters and a virtual dressing room that was updated in real time. Future improvements will include developing mobile apps for better accessibility, integrating augmented reality (AR) for interactive garment trials, and making tailored suggestions based on user preferences. All things considered, the system shows how AI and computer vision might transform the retail apparel industry.

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XI. CONCLUSION

By offering precise suggestions and interactive visualization, the Fashion Recommendation System and Virtual Trial Room effectively improved online buying. Using a dataset of 45,000 photos, the recommendation engine identified visually related goods with 93% accuracy by utilizing ResNet50 and the Nearest Neighbour algorithm. By enabling real- time apparel visualization on mannequins with accurate overlay and dynamic scaling, the Virtual Trial Room helped to close the gap between online and in-store buying. Smooth operation, effective login authentication, and suggestion retrieval were guaranteed by the smooth integration of Flask and PostgreSQL for the backend with an easy-to-use interface. While usability testing revealed excellent user satisfaction with the UI, fast reaction times, and pertinent suggestions, scalability testing validated the system's resilience. All things considered, the project produced a creative, scalable, and user-centric solution that enhances the online fashion buying experience.

XII. FUTURE WORK

Advanced machine learning for tailored suggestions based on user preferences, past purchases, and criteria like size, color, and price might be included into future system enhancements. By providing virtual try-ons with device cameras, real-time augmented reality (AR) integration will improve user engagement. Incorporating a wider range of body shapes and clothing styles into the dataset will encourage inclusion and represent international fashion trends. Accessibility and user involvement would also be enhanced by creating a mobile application with features like push alerts for new arrivals and tailored suggestions.

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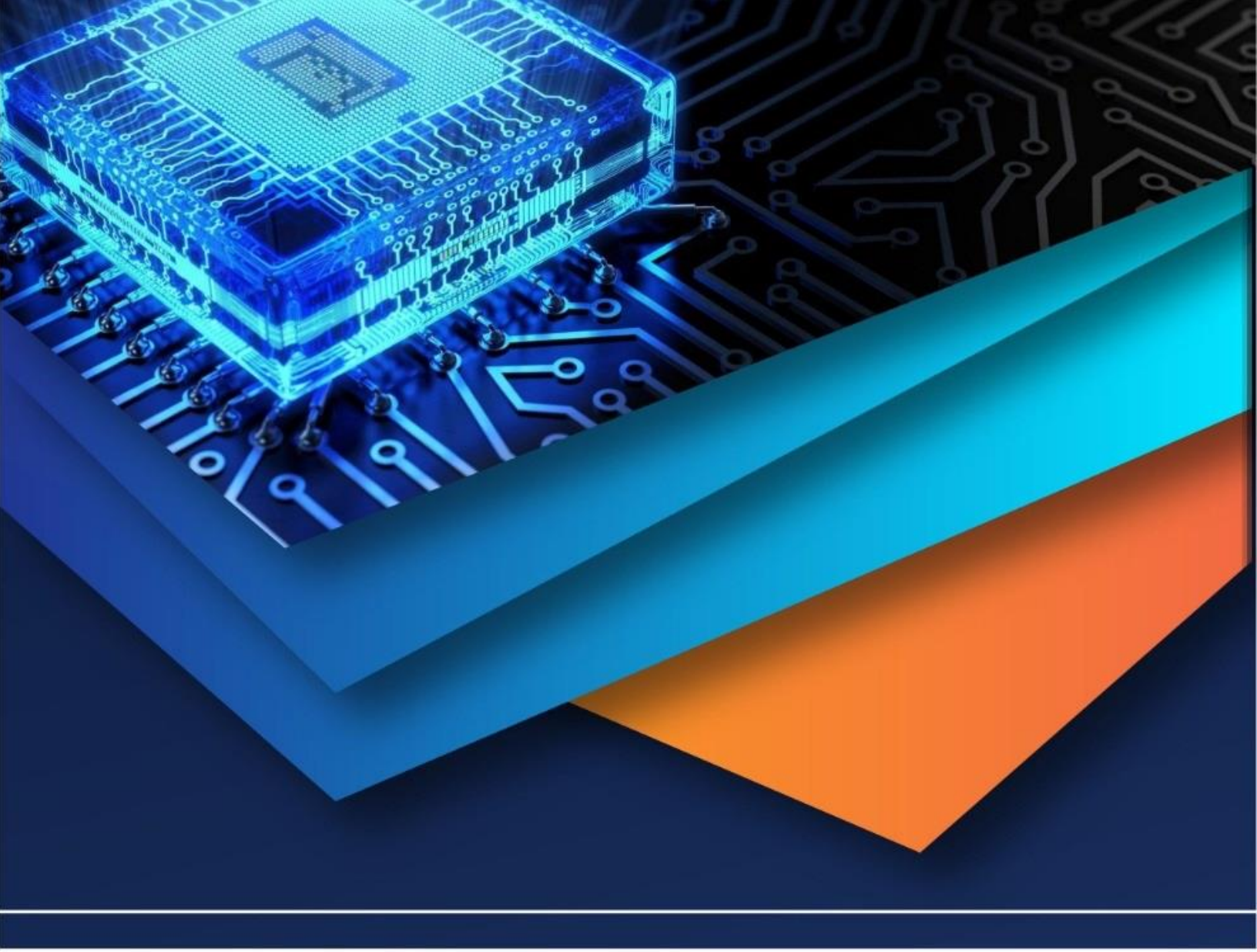

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