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AI Fit-Virtual Clothing Try On System using Deep Learning

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Abstract: The rapid rise of online shopping has contributed greatly to a paradigm shift in fashion consumer buying behavior yet, trying out clothes physically has remained a significant drawback for both offline and online fashion shopping. Customers are often uncertain about sizing, looks, and comfort of wear of garments, leading to consumer dissatisfaction and an increased return of purchased products. In offline fashion shopping, existing tryout booths in stores face constraints of limited accessibility, waiting times, and health concerns. To deal effectively with these limitations, this article proposes AI-Fit Virtual Clothing Try-On Using Deep Learning. The proposed AI-Fit system allows users to virtually view different clothes digitally without having to physically wear them using computer vision and deep learning algorithms. The system makes use of a real-time video feed obtained from a regular camera to locate the decisive points on the human body. The clothing images are then processed using deep learning algorithms to adjust them according to the user's body movement and size as detected from the decisive points on the body. Thus, the elimination of the need for manual clothing trials achieved through the AI -Fit solution also lowers the time and effort involved, besides increasing customer confidence in buying decisions. The combination of the QR code purchasing method facilitates a smooth transition from virtual try-on to purchasing. From the perspective of retailing, the system helps in minimizing the need for the use of actual fitting rooms, in addition to reducing effort and facilitating effective handling of goods. The proposed method is thus interactive, effective, and affordable, ensuring customer satisfaction and an optimized digital buying environment. It is suggested that future improvements could include the use of gesture control.

Keywords: Virtual Clothing Try-On, Deep Learning, Computer Vision, Human Body Landmark Detection, E-Commerce, Fashion Technology, Image Processing, Online Retail, Customer Experience

1. Introduction

The fashion retail industry has experienced a rapid transformation towards using online platforms that provide convenience and easy access to the products. The problem of not being able to physically try on the garments is one of the drawbacks that create uncertainties in relation to the size, fit, and look, leading to dissatisfaction and return of the product [9]. The conventional way of shopping in the physical stores is also plagued with problems like limited access to fitting rooms and queues that customers have to wait in line while using the rooms, as well as hygiene-related factors [9].

"Virtual try-on" systems solve these problems by allowing users to preview clothing virtually. The early solutions utilized size charts or image patterns with a low level of personalization [4]. More complex methods that utilized 3D reconstructions or depth cameras are not scalable [7]. Modern computer vision and deep learning algorithms offer efficient methods for 2D virtual try-on with regular cameras,

especially for upper body items like men's and women's tops [5,8].

The current state-of-the-art solutions for virtual try-ons in the 2D domain are based on pose estimation techniques, warp-based approaches, and flow-based methods to render clothes seamlessly overlaid, resulting in higher levels of consumer confidence and decreased return rates [1][3]. Yet, most of today's solutions are computationally expensive or not seamlessly integrated with web platforms [3], [6]

To address these issues, this paper proposes a lightweight virtual fitting system called AI-Fit for virtual try-on using a webcam for men and women's top wear clothing. The proposed system provides customers with real-time garment alignment and visualization through a web interface to enhance customer experience and support purchasing decisions [1], [10].

1.1 The Significance of Virtual Try-On Systems

Virtual try-on technologies fill an important gap in the fashion retail sector, both online and offline, by allowing consumers to visualize clothes on their own image. Virtual try-on technology helps consumers build confidence by reducing uncertainty associated with the fitting and looks of the clothes on them. In addition, the technology assists the retail sector in reducing the rate of returns by enabling them not to depend on fitting rooms [7], [10].

1.2 Objectives of the Proposed AI-Fit System

The key aim of the AI-Fit system is to enable the development of light and real-time 2D try-on technology using the conventional webcam and freely available software tools. The AI-Fit system aims at maximizing the correct fitting of the tops for males and females using human pose estimation and machine learning methods. The other aims of the AI-Fit system are the development of user-friendly interaction, real-time display, and integration with online purchasing platforms for the betterment of the online purchasing experience [1], [5], [8].

2. Related Work

1. MG-VTON: Towards Multi-Garment Virtual Try-On
This work presents the challenge of virtually dressing multiple layers of clothes on a single user. The authors seek to enhance realism through models accounting for interdependencies among various garment layers, yielding greater visual precision for more complicated outfits [1].

2. CP-VTON: Clothing Transfer Using Human Parsing and Pose Estimation
This paper will focus on realistic clothing transfers on a single person while preserving the structures of a human body. Its objective is to integrate human parsing and pose estimation for better alignment, hence reducing garment distortion.

3. ClothFlow: A Flow-Based Model for Clothing Try-On
The authors address the challenge of modeling non-rigid deformation of garments, including natural folds and wrinkles, on the same user. The objective is to apply flow-based warping techniques for realistic 2D deformation of clothing [3].

4. Toward Virtual Try-On: Image-Based Cloth Transfer Using Deep Learning
This work aims to solve the problem of overlaying clothes on images of one person with different poses and backgrounds and intends to apply deep learning for end-to-end cloth transfer to yield realistic visualization of top wear [4].

5. Pose-Guided Human Image Synthesis Using Deep Neural Networks
This work focuses on the challenge of aligning garments with dynamic human poses in single-person images. Its objective is, by using the concept of pose-guided neural networks, to generate high-quality, appealing top-wear try-on images [5].

6. GarmentGAN: Realistic Clothing Simulation Using Generative Adversarial Networks
One such problem that has been identified is generating realistic textures of garments for one user. The purpose is to utilize GANs in order to produce high-fidelity overlays of clothing for improved realism [6].

7. 3D Virtual Fitting Room Based on Human Body Reconstruction
The research points out that there are some limitations with the 3D reconstruction methods from the view of a single user: hardware dependency and complexity. This paper thus aims to establish a virtual fitting system that balances realism and computational efficiency [7].

8. Deep Learning for Human Pose Tracking in Virtual Try-On
The authors address the challenge of precisely tracking one user's movements in real time for virtual try-on. They aim to join deep learning-based pose estimation with 2D garment visualization for better interactivity [8].

9. Deep Learning Based Virtual Dressing System for Online Shopping
This study underlines the need for integrating single-person virtual try-on with e-commerce. The objective of the paper is to represent a lightweight system allowing the real-time garment visualization and smooth online shopping integration [9].

10. Cloth Virtual Try-On Detection Using the EfficientNetB4 Model
The problem identified is to efficiently detect and classify the type of clothing worn by a single user. The goal is to apply EfficientNetB4 for fast and accurate clothes detection that can enhance 2D top-wear virtual try-on systems.

3. Experimental Method

The AI-Fit system operates in a sequence of well-defined processing steps to offer a real-time virtual try-on experience in 2D resolution via a standard RGB camera. The system provides an end-to-end experience where a pre-chosen garment can be overlaid instantly upon the user's video feed.

3.1 Camera-Based Image Acquisition
The high-resolution RGB camera is mounted in front of the user to record sequential images of live video. Once a user comes into the field of view of the camera, the images are sent to the processing module.

3.2 Human Detection and Pose Estimation
Every incoming frame is then analyzed by computer vision techniques to determine if a human figure is visible. Landmarks of a human body, like shoulders, upper body, waist, and hips, are detected using pose estimation techniques, which yield a skeleton of a person.

3.3 Garment Database and Selection Interface
A digital repository supports storing various clothes as well as their characteristics, which include type, size, color, and texture. Once a user chooses a clothing item, a garment model corresponding to that clothing item is processed from a database.

3.4 Garment Scaling and Warping
Utilizing these skeletal key points, the chosen image of the garment will then undergo dynamic scaling, rotation, and warping. This will enable precise alignment of key areas consisting of shoulders, neckline, sleeves, and waist with respect to the user's body skeleton structure.

3.5 Overlay Processing in Real Time
The adjusted garment is superimposed over the real-time video feed of the user. A rendering module is used to update each frame in real time, ensuring the garment reacts accordingly to movements and stays properly aligned on the user's body.

3.6 User Interaction and Garment Re-selection
The system can be operated by the user for a changeover between different garments, colors, or sizes. Each changeover results in an automatic update on the overlay.

4. Results and Discussion

4.1 System Performance and Real-Time Processing
The AI-Fit virtual try-on system was also analyzed for real-time functionality, utilizing an RGB standard webcam, as it was designed for single user functionality, which is not currently supported, meaning one user cannot use the system while another tries to use the system during the test processes within an indoor setting.

Frames from live video were recorded and processed. This was done with minimal latency. Pose estimation algorithms were effective in the detection of upper body points like the shoulders and torso of active users. These points were used to identify clothing positions. They were robust irrespective of indoor lighting conditions and moderate user movement.

4.2 Garment Alignment and Visual Realism
The system was solely dedicated to the visualization of garments from the category of "top ware," that is, tops and tees for men and women. The selected garments from the digital repository were then "dynamic resized and projected on the user's live video.

The overlay self-adjusted to postures even in regions of alignment that are critical around the neckline and shoulders. For supported categories of clothing involving tops, the system delivered a natural fit. The current system does not address lower body clothing generation, layered clothing, and accessories.

4.3 User Interaction & Responsiveness
The technology provided a facility for a user to switch between tops instantly and choose tops depending on their size and color. The effect of the selected tops on the image is instantaneous, and this helps the user compare the tops without having to try them on.

4.4 Practical Implications and Limitations
AI-Fit proves to work on limiting the usage of physical fitting rooms by virtue of single-user virtual fitting solutions for upper-body clothing articles alone. But there are certain drawbacks to this system too. This system presently supports top-wear and single-user systems only. Accuracy of garment alignment will depend on the process of pose estimation by virtue of varying illuminations and rapid movements. This system cannot work on full-body clothes and multiple-user systems yet.

Figures

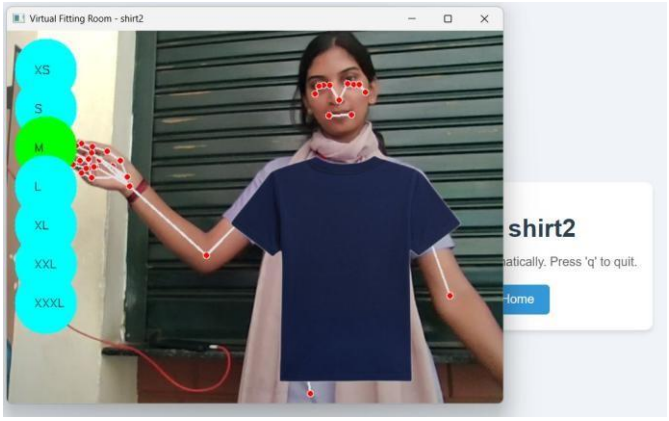

Fig 1: Virtual Try On Men's cloth

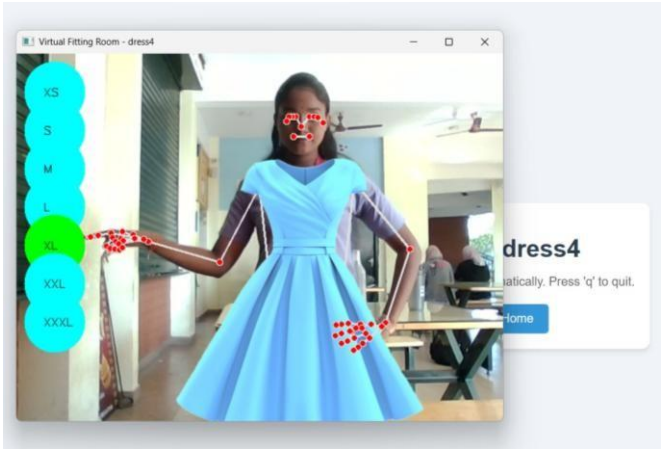

Fig 2: Virtual Try On Women's cloth

5. Conclusion and Future Scope

This system overcomes two of the major limitations related to traditional stores: reliance on trial rooms and the tedious process involved in garment trials. It integrates an image capture unit using a camera with a state-of-the-art human pose estimation technique using a computer vision approach and a real-time rendering engine to provide customers with an interactive virtual environment. In this, they can visualize wearing clothes without actually putting them on. The shopping experience will be enhanced because customers can quickly compare styles, colors, and sizes without fatigue and the hassle related to multiple trials. This technology will also contribute significantly to operational benefits for retailers in terms of minimizing congestion in trial rooms, facilitating better store layouts, and being able to maintain only a limited amount of merchandise while keeping a huge digital catalog, which will improve efficiency in all respects. The system presented here does real-time overlay and fitting of garments for a single user effectively. The shortcomings in the current version are three-fold: first, it concentrates on garments related to the upper body only; second, it does not offer gesture-based interaction; and third, the support for multi-user environments is limited. In spite of these limitations, the prototype presents a scalable and pragmatic solution to bridge the gap between physical and digital retail, ensuring better purchase decisions, reduced returns, and improved customer satisfaction. Based on this, the solution of using such virtual trial solutions in modern retail in-store and online environments is recommended to enhance convenience, engagement, and operational performance. The system can be further refined with gesture-based controls to enable touchless navigation, full-body and multi-view visualization of garments to handle a wide range of garments, and accurate size recommendations by integrating body measurements with brand-specific size charts. Further integration with e-commerce can enable customers to try garments virtually at home and checkout seamlessly. Analytics may be provided to retailers with insights on usage patterns, hot items, and inventory optimization. Expanding the system for handling multiple users and smart mirror configurations may further enhance interactivity and personalization, which will ensure the evolution of the Virtual Mirror into a comprehensive, future-ready solution that transforms fashion retail into a speedier, more engaging, and technology-driven experience.

Authors' Contributions

Author 1 contributed towards the conceptualization of AI-Fit, system architecture design, and definition of problem statements. Author 2 worked on the implementation of computer vision algorithms in pose estimation and garment alignment. Author 3 worked on the implementation of the online interface design, garment database management, and integration of AI-Fit components. Author 4 worked on system testing, performance analysis, analysis of results, and manuscript writing. All authors reviewed and approved of the manuscript.

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