AI-Based Virtual Try-On and Styling System

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Abstract — Artificial intelligence (AI) has greatly changed the fashion and vendor sector in numerous ways. Shopping online has been transformed, as have smart systems used to evaluate the characteristics of a person's body as well as the specifics of their chosen garments and any fashion preferences they may have. These entities have also enabled companies to offer customers customised experience. AI Based Virtual Try-On and styling technology allows customers to see clothing visually displayed as they would look on them as an item worn by a user digitally. To achieve a realistic perception of how the configuration fits a customer, the technology uses machine learning and image-processing algorithms. In addition, the AI Based Virtual Try-On & Styling System will provide users with personalised outfit recommendations that incorporate existing fashion trends and preferences. The access that vendors have to this type of technology is enabling them to reduce their return rates by increasing customers confidence when buying through the online channel, thereby facilitating improved decisions by consumers in making purchasing decisions.

Body features, detail and style of clothing combined with the wearer's own preferred style will produce realistic projections of possible outfits and provide suggestions that are specific to each customer's individual needs. By alleviating concerns about the fit, size, and appearance of an item, this technology helps to increase customer confidence and satisfaction with their online shopping experiences. This also helps to reduce the return rates and improve overall efficiencies, demonstrating its potential value as a tool on many modern fashion technology platforms.

Keywords*:* Artificial Intelligence, Virtual Try On, Fashion Styling, Machine Learning, Image Processing, Personalized Recommendation, E Commerce.

I. INTRODUCTION

With the rapid advancement of artificial intelligence (AI), various industries are experiencing a profound transformation - fashion in particular is undergoing great progress. With the rapid expansion of e-commerce, consumer shopping habits are being transformed; however, an ongoing, unresolved issue with online clothing store is a lack of physical access to try on items. Due to the absence of this opportunity, many consumers may second-guess whether or not a particular item will fit correctly or look appealing. This ultimately leads to decreased customer satisfaction and higher returns.

AI-based virtual try-on and styling system help alleviate these challenges through providing a digital representation of the consumer that allows the individual to visualize themselves in the clothing item being considered for purchase. This system utilizes computer vision, machine learning, and image processing techniques to create a hyper-realistic representation of how the item would fit and appear to the consumer. In addition to providing virtual fitting capabilities, intelligent styling modules will analyze consumer preferences, body shape, and current fashion trends to provide personalized style recommendations, thus improving the overall shopping experience. By implementing these types of systems, merchant will see increased consumer confidence in their purchasing decisions, therefore reducing the amount of returned products. As digital fashion technologies continue to evolve, the possibilities of virtual try-on and styling powered by artificial intelligence (AI) will allow vendors to offer consumers a more interactive, efficient, and personalized online shopping experience.

The rise of e-commerce has created a huge problem for consumers in that they can't go into physical stores to try on clothes before making a purchase. This means many people experience uncertainty around how an item will fit or look when it arrives at their house, which leads to dissatisfaction with their purchase and a higher-than-desired return rate. AI (artificial intelligence)-based virtual fitting rooms and styling systems are addressing this problem by utilizing machine learning, computer vision, and imaging technologies. By providing a realistic way to "try on" clothing based on the user's body shape and size, these systems will also offer personalized styling recommendations based on body proportion, personal taste and the latest fashion trends.

The adoption of AI-driven virtual fitting and styling systems provides many advantages for both customers and vendors. Customers will feel more confident in their purchasing decisions, which will translate into fewer returns and an enhanced overall experience with the Vendor. Vendors will be able to better manage their inventory, sell more, and create more personalized marketing.

II. RELATED WORKS

Virtual try-on technologies have gained momentum within both academia and industry since they first appeared a few years ago. The initial generation of systems was composed primarily of basic garment layering systems, in which pictures of garments were layered on top of the user's photographs. These systems offered an easy way to view an outfit, but often lacked realism, did not represent each user's shape, and didn't simulate how garments moved naturally.

The development of computer vision and deep learning techniques has allowed for better implementations of virtual try-on technologies. One of the most common methods is to use Generative Adversarial Networks (GANs) to produce photos of users wearing different clothes. This content creation method generates realistic images that accurately depict the user's body shape and pose at the time the photo was taken, improving the user experience significantly. There have also been implementations of convolutional neural networks (CNNs) that allow for improved feature recognition of garment patterns, textures, and styles for improved fit and style recommendations.

A number of studies have explored the combination of AI-based recommendations and virtual try-on platforms. Using past purchases and customer preferences, these recommendation systems suggest outfits based on the user's style and body type as well as the current fashion trends. Through the combined powers of virtual fitting and AI-powered recommendations, hybrid approaches for improving user interaction while shopping online continue to develop as the research explores the development of hybrid methods that will utilize image synthesis, 3D modeling, and machine learning to make virtual try-on systems more accurate, efficient, and widely used.

The research that currently exists illustrates the vast capabilities that are available through using AI in the field of fashion technology. The seamless integration of virtual fitting along with customized styling creates a much more interactive and easy shopping experience for online shoppers. The research supports the development of a complete AI-based solution that addresses limitations currently held by existing systems and improves the overall customer experience.

III. LITERATURE REVIEW

The earliest virtual fitting technology consisted of placing images on top of real-life views of people, using basic image overlay methods and manual alignment techniques; this type of virtual fitting produced limited realism for trying on clothes because those methods could not adapt to people's different types of poses or bodies very well. With advancements in computer vision and artificial intelligence, improvements in the realism and effectiveness of virtual fitting technology have occurred.

Recent research has focused on the integration of deep learning, and pose estimation, in order to create more accurate alignment of garments when trying them on virtually. Specifically, utilizing traditional methods (e.g., Pose Estimation, and Human Parsing) with pose estimation data along with image-processing algorithms have demonstrated that the extraction of key body points will allow for better geometric alignment of garments when trying them on virtually, and is a technique that has become the basis for many contemporary virtual try-ones.

Many researchers are working to advance multi-pose and garment warping; definitely not an understatement. To increase resilience against various human poses such as misalignment that occur within simplified methods of garment warping, most researchers today have used a combination of dense pose representation along with utilizing semantics for guidance. Specifically, many researchers have attempted to develop learned Dense Pose models for garments that link clothing contours with the body of the wearer to produce virtual try-on results that can be represented smoother than before.

In addition to being beneficial in terms of technological advancement alone, systematic reviews indicate the significant maturation process of virtual try-on technology as a research area. Reviews have categorised materials on virtual fitting room technologies over the period of time they've been researched. These reviews demonstrate a rapid progression from the simple two-dimensional visualisation systems to complex AI based visualisation systems which take account of visual realism, as well as user experience factors. The work being accomplished within this research domain also highlight that the domain of virtual try-on technology represents a convergence of AI, augmented reality and consumer behaviour; which offers insights into emerging trends and challenges for researchers moving forward.

Additional studies have looked into several areas of application-level advancements. For instance, in some research integrating machine learning with web interfaces, creating real-time interactive try-on systems that use lightweight libraries, such as OpenCV and Media Pipe, have been created that allow pose estimation, human tracking, and size recommendations.

IV. METHODOLOGY

The AI-based virtual dressing room system was conceived through an organised approach that integrates image processing, pose estimation, and smart garment fit technology, with each aspect working together to provide an easy way for users to try on clothes from home using a computer or mobile device. The general sequence of operation for the system includes capturing images, pre-processing images, detecting human body posture, aligning garments with the user, generating a virtual try-on image of the user in the selected garment, and displaying the results.

The first step in the development of the system is to take as input two types of images, a user image and a garment image selected from the clothing database. The user image is processed prior to the pose estimation step to reduce image size and noise as well as improve visual clarity. Background removal is also performed to increase the likelihood that the detection of the user's body will be correct.

Next, the human pose estimation algorithm identifies the user's major body points (shoulders, elbows, hips, knees) from the image and creates various measures from that information about the way that they are positioned and the shapes of their bodies.

Knowing this information will allow us to accurately depict the user in the chosen garment, given that the user can be accurately located. Following the extraction of a pose the segmentation process of the garment image is performed in order to separate the clothing item from the background. Then, resizing, transformational and alignment techniques based on user-defined body landmarks are performed. Intelligent scaling and warping methods are employed to obtain a true-to-life fit of the clothing item on the user's body with no distortion.

In the next stage of alignment, the idealized garment is placed over the user's existing image to create an output of the virtual try-on process. Texture continuity, realistic proportions and smooth transitions between the clothing and the user's image are all preserved in the final output. The final output of the virtual try-on process is transmitted to the user via an Internet-based user interface. The methodology employed in this process aids in achieving the highest degree of accuracy and realism while facilitating ease of use and thus allowing for the greatest utility of the technology for real-time virtual try-on applications for online fashion store.

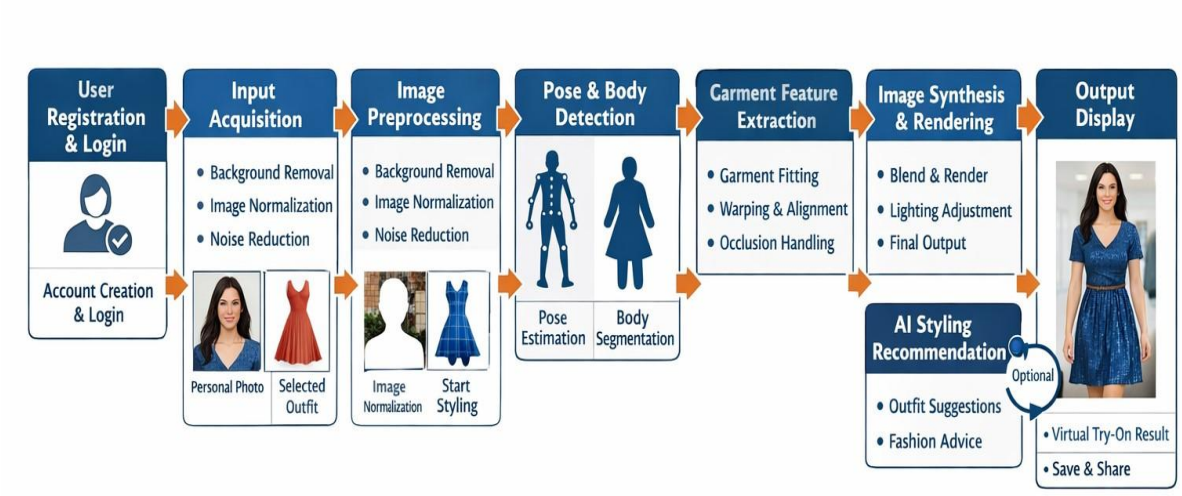

Fig.1. System Flow Diagram of the AI-Based Virtual Try On & Styling System

V. TECHNICAL IMPLEMENTATION

The proposed system is implemented as a full-stack web application:

Frontend: The frontend of the application was built using HTML, React.JS, and Tailwind CSS creating an interactive and responsive virtual try-on experience.

Backend: The backend was built with Node.JS and Express.JS and allows users to upload images, to submit requests to upload the images, and to coordinate with the AI processing module.

Database: The application's database is MySQL, which stores user profile data, images used for the virtual try-on, and user sessions associated with the virtual try-on.

AI Module: The AI module uses computer vision and deep learning to detect human body pose and create a realistic fitting for the garment.

API: The application's API includes multiple AI APIs and image-processing APIs for generating virtual try-ons, estimating human pose, and aligning garments to virtual try-ons.

VI. RESULT & DISCUSSION

The AI-Based Virtual Try On & Styling System was effectively developed and tested using a combination of computer vision and deep learning methods. The system takes a user image and a chosen clothing item as inputs and generates a realistic virtual try-on by matching the garment to the user body posture and shape. Experimental results show that the system accurately identifies important body landmarks through pose estimation techniques, allowing for precise garment alignment with various body postures. By combining pose detection with image processing, the system ensures that clothing naturally adjusts to differences in user orientation and body size. This leads to a visually consistent try-on experience that closely mirrors real-world fitting.

The system performs well with a variety of clothing items, including tops, dresses, and traditional attire. The outputs maintain good texture quality and garment shape, even when the user image contains slight variations in lighting or background. The processing time is also suitable for real-time or near real-time applications, making the system practical for use in online store settings. The research indicates that there is a great deal of promise for the use of AI-based Virtual Garment Try-On (VGT) Technology to revolutionize Online Fashion Storing. With the inclusion of Pose Estimation and Smart Fitting, VGT technologies eliminate the user's uncertainty of how an item will look and fit their body shape, which is a major challenge to Online Shopping.

However, there is plenty of potential for improvements going forward. Future advancements in 3D Modeling of the Human Body, development of new Algorithms for Simulation & Rendering Garments and better Representation of Fabric Types would lead to a more realistic Virtual Fitting experience. Additionally, further integration of VGT Technology into Augmented Reality (AR) or other forms of Collaborative Design will drastically enhance the experience a Fashion Merchant provides to their customers.

VII. CONCLUSION

The system being considered is an AI-based virtual try on and styling solution that leverages deep learning and computer vision techniques for the generation of realistic images of clothing on human figures. This solution contains a framework that employs pose estimation, body landmark identification and garment alignment technology to create fitted garments for users differing body types and postures. The automated styling function of the system also improves the user experience by providing suitable outfit recommendations.

Enhancing the realism of the technology developed through the use of incorporating three-dimensional body modeling, the use of physically-based cloth simulation, and real-time rendering technologies are some ways to enhance the future development of this technology scalability as well. The addition of new garment categories and body types and the ability for real-time mobile applications will also expand the use of the technology to even more areas of application within digital fashion and e-commerce.

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