Virtual Dress Trials: Leveraging GANs for Realistic Clothing Simulation

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***Abstract* - As a result of technological developments, the fashion industry has seen a dramatic move towards digitization. A virtual dress trial driven by Generative Adversarial Networks (GANs), an advanced size suggestion system, with chat support is proposed in this work. Clothing and a plethora of accessories are part of our fashion collection. Through a safe online store, customers may make selections, and complete purchases. The size recommendation system enhances shopping precision. Chat assistance are AI-driven chatbots to help customers, enhancing user engagement and support. Users may also rate and review items, which helps build trust. Data protection and payment processing are our top priorities. Collaboration with other e-commerce businesses is a possibility presented, which serves the interests of fashion-conscious customers. This one-stop shopping platform changes the game for discovering, trying on, and buying clothing.**

Keywords: virtual dress trial, generative adversarial networks (GANs), clothing segmentation, garment synthesis, conditional GAN, virtual try-on, fabric textures, online shopping, fashion design

I. INTRODUCTION

In the digital era, technology has dramatically transformed various industries, including retail and fashion. Now, advancements in artificial intelligence are bringing forth a new wave of innovation, revolutionizing the way we shop online. One such groundbreaking technology is Virtual Dress Trial, powered by Generative Adversarial Networks (GAN).

Virtual Dress Trial leverages the power of GAN, a type of deep learning algorithm, which creates a virtual fitting room experience. Traditionally, trying on clothes in physical stores has been an essential part of the shopping process, allowing customers to ensure the perfect fit and feel of their potential purchases. However, this approach is not without its limitations, such as limited availability of certain sizes or styles, long queues, and the general time consuming nature of trying on multiple outfits. Virtual Dress Trial eliminates these obstacles by enabling customers to virtually try on clothes from the comfort of their own homes.

By utilizing GAN technology, Virtual Dress Trial generates realistic images of customers wearing different outfits without the need for physical garments. This technology combines two neural networks. Through an iterative process, these networks work together to refine the virtual fitting experience, ultimately delivering highly accurate representations of how different clothes would appear on an individual.

The advantages of Virtual Dress Trial are numerous. It offers a convenient and time-efficient alternative to traditional dressing rooms. Customers can browse through a vast virtual catalog, choose multiple items to try on, and instantly see how each piece looks on them. This streamlines the shopping process, allowing for effortless exploration of various styles and combinations, saving valuable time for customers and retailers alike.

In addition to the Virtual Dress Trial, our platform – Aadai, offers a robust Size Recommendation System, harnessing the power of data-driven insights to assist users in selecting the perfect fit for their unique body measurements. This system not only enhances the accuracy of online purchases but also alleviates the common concerns associated with sizing when shopping online.

Moreover, we recognize the importance of providing excellent customer support, which is why our platform incorporates Chat Assistance Features. Users can enjoy real-time guidance and assistance through AI-driven chatbots and connect with live support representatives for a personalized shopping experience.

Virtual Dress Trial enhances accessibility, as customers are no longer limited by geographical constraints or availability of specific clothing items. They can try on clothes from any brand or store, regardless of its physical location. This not only opens up a world of possibilities for shoppers but also expands the potential market for retailers, as they can reach a broader audience.

Virtual Dress Trial reduces the environmental impact of the fashion industry by minimizing the need for physical manufacturing and transportation of clothes. This technology offers an eco- friendly solution that aligns with sustainable practices and contributes to a greener future.

Furthermore, Virtual Dress Trial is poised to revolutionize the shopping experience, bridging the gap between brick-and-mortar stores and online shopping. With its ability to generate realistic virtual fitting rooms using GAN technology, this innovative solution offers convenience, accessibility, and sustainability. As retailers and customers embrace this transformational technology, the way we shop for clothes will forever be changed, enabling a more personalized and immersive shopping experience for all.

II. RELATED WORKS

Due to advancements in technology and evolving consumer preferences, the fashion industry has undergone a significant shift towards digitalization and personalized offerings. "Virtual Try-On Using Style Transfer" model [1] discussed the use of style transfer techniques for virtual try-on applications. The authors propose a method that utilizes style transfer to generate realistic virtual try-on images. By transferring the style of a target image onto a clothing item, users can visualize how the garment would look on them. In [2], the authors presented a GAN-based try-on system aimed at enhancing the commercial viability of virtual try-on technology. The authors proposed a modified Conditional Augmentation GAN (CAGAN) architecture to enhance the realism of the generated images. The system demonstrates promising results in terms of visual quality and realism.

'TryItOut- an ML-based virtual fashion assistant' [3] introduced a system that combines data from various sources, such as user preferences and fashion trends, to recommend personalized outfits to users. The system aims to enhance the online shopping experience by allowing users to virtually try on outfits before making a purchase.

A virtual try-on system based on a parser-free GAN is introduced in [4]. The authors proposed a network architecture that eliminates the need for parsing the clothing item and achieves faster and more accurate try-on results. The problem of dressing 3D virtual humans with generative clothing is addressed in [5]. The authors proposed a learning-based approach that generates realistic clothing for 3D avatars. By training on a large dataset of human poses and corresponding clothing items, the system learns to dress the virtual humans accurately and convincingly.

The challenge of preserving cloth texture in image-based 3D virtual try-on is addressed in [6]. This method combines the texture generation and image warping techniques to generate realistic virtual try-on results while preserving the texture details of the clothing items. The system demonstrates improved visual quality and fidelity.

CLOTON, a GAN-based approach for clothing try-on is proposed [7]. The system generates realistic virtual try-on images by combining a generative network with a discriminator network. The system learns to generate visually appealing try-on results by training on a large dataset of apparels and corresponding body poses.

A "Virtual Dressing Room Application Using GANs" [8] introduces a virtual dressing room application based on GANs.

This GAN-based method allows users to virtually try on different outfits and visualize how they look on themselves. The system aims to enhance the online shopping experience by providing a realistic and interactive try-on experience. A 3D grid-based virtual trial room system is presented in [9]. The researchers proposed a method that utilizes a grid-based representation of the user's body and clothing items to enable virtual try-on. By manipulating the grid cells, users can interactively try on different garments and visualize how they fit.

A method that transfers the style and appearance of a target image onto a clothing item, allowing users to virtually try on different outfits is proposed in [10]. This "Image-to-Image Attire Transfer for Virtual Trial Room" aims to provide a flexible and realistic try-on experience for users. These recent literature surveys cover a range of topics related to virtual try-on systems and technologies. They explore various approaches, including style transfer, GANs, machine learning, and image-based techniques, to create realistic and interactive virtual try-on experiences for users.

The comparative analysis of "GAN-based fusion deep neural models for fake face detection", as presented in the study [11], delves into deep learning techniques for detecting manipulated or synthetic facial images. This research evaluates different GAN architectures and fusion strategies to enhance detection performance, contributing insights into combating the spread of misinformation and ensuring the integrity of digital content.

"A cost-effective approach for Virtual Fitting Rooms using Generative Adversarial Networks (GANs)" is proposed in [12], which addresses a significant challenge in retail technology implementation. By leveraging the power of GANs, this approach aims to reduce the financial barriers associated with adopting virtual fitting room technology. As a result, this cost-effective approach has the capacity to reshape the landscape of online retail, making virtual try-on experiences more commonplace.

Physion++ which is an advanced model for evaluating physical scene understanding that requires online inference of different physical properties is introduced in [13]. It represents a significant breakthrough in the fields of robotics and computer vision. Physion++ enables accurate inference of various physical properties from visual input and enhances the capabilities of machines to perceive and interact with the physical world. With its ability to infer different physical properties in real-time, Physion++ paves the way for more intelligent and adaptive systems that can navigate and manipulate complex environments with precision and efficiency.

A comprehensive study on Human Activity Recognition" is proposed in [14] which offers a thorough investigation into the field of human activity recognition (HAR). The study likely explores various facets of HAR, encompassing sensor-based data analysis, machine learning algorithms, and practical applications across diverse domains. It may delve into the methodologies employed for collecting and analyzing sensor data, as well as the evaluation of different machine learning techniques for accurate activity recognition.

III. EXISTING SYSTEM

The existing system for virtual clothing try-on using GAN (Generative Adversarial Network) comes with a few significant drawbacks. First and foremost, one of the main disadvantages is the lack of accuracy in representing the actual fit of the dress. GANs are trained using a dataset of images, but they often struggle to accurately capture the shape and movement of fabric on different body types. As a result, the virtual clothing try-on systems that are existing may not accurately represent how the cloths would actually look and fit on an individual, leading to potential disappointment or a mismatch between expectations and reality.

In addition to that, the existing system heavily relies on visual representation, neglecting other important aspects of

dress trials such as fabric texture and feel. While virtual try-on systems using GANs can simulate the look of different garments, they fail to provide a realistic portrayal of how the fabric will feel against the skin, which is an important factor when trying on clothes. This limitation greatly hinders the overall experience and utility of the system.

The limited range of available dress options is another drawback. The dataset used for training GANs may not include a comprehensive collection of dress designs, which restricts the choices available for trial. This limitation can lead to dissatisfaction among users who are unable to find the desired dress style within the available options. Also, the accuracy of the virtual trial may vary depending on the complexity and uniqueness of the design, further limiting the system's usefulness.

Furthermore, the existing system may not accurately capture the true colors of garments. The colors and shades of virtual dresses can be challenging to reproduce accurately, leading to discrepancies between the virtual representation and the actual appearance of the dress. This drawback can result in misleading visual feedback during the virtual clothing try-on, potentially leading to wrong purchasing decisions.

Finally, the existing system neglects the personal touch and customer experience that comes with physical dress trials. Trying on clothes in physical stores allows customers to interact with sales associates, seek advice, and receive personalized recommendations. These elements enhance the overall shopping experience, which cannot be replicated by a virtual clothing try-on system using GANs.

IV. PROPOSED SYSTEM

The proposed fashion e-commerce platform Aadai, aims to provide a user-friendly shopping experience with a comprehensive product catalog including tops, bottoms, accessories, and footwear. Users can register securely or opt for guest shopping, and administrators can efficiently manage products. A groundbreaking Virtual Dress Trial feature, powered by GAN technology, allows users to virtually try on clothing items. The platform also offers a precise Size Recommendation System, live chat assistance with AI-driven chatbots, and multiple payment gateways for seamless checkout. Personalized user profiles,

community-driven reviews, and robust inventory management enhance the experience. Stringent security measures, mobile responsiveness, and data-driven insights ensure a secure and convenient shopping environment, while integration with partner ventures expands product variety and selection, making it a comprehensive and innovative fashion destination.

V. ARCHITECTURAL FRAMEWORK

The process flow of the proposed GAN model for Virtual dress trial is shown in Fig.1. The methodology is explained with different modules:

Module 1 - Data Collection and Preprocessing: The first module in the proposed system for virtual dress trial using GANs is the data collection and preprocessing module. In this module, the system gathers a large dataset of clothing items, including various types of dresses, from different sources such as online stores, fashion magazines, and fashion designers' portfolios. The collected data may include images of dresses worn by models or mannequins, as well as additional information such as dress specifications and fabric details.

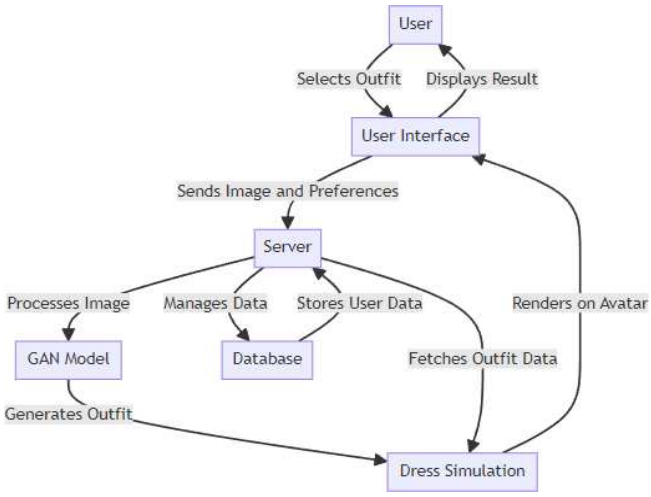

Fig. 1: Process Flow

Once the data is collected, it undergoes preprocessing to ensure consistency and quality. This involves tasks such as image resizing, cropping, and noise reduction. Additionally, any irrelevant or duplicate images are removed from the dataset to optimize accuracy. The preprocessing module also includes labeling the images with appropriate tags or attributes, such as color, pattern, sleeve length, and neckline style. These tags enhance the usability of the dataset during the training phase of the GAN model.

Module 2 - GAN Model: Generative Adversarial Networks (GANs) are a class of deep learning models that consists of two components: a generator and a discriminator. In the virtual dress trial system, the GAN model is trained to generate realistic virtual dress images based on the input dress attributes supplied by the users.

During the training phase, the GAN model learns to generate images by updating the parameters of the generator and discriminator networks. The generator network takes random noise and dress attributes as input and produces synthesized images. The discriminator network, evaluates the realism of the generated images by classifying them as real or fake.

Through an adversarial learning process, the two networks iteratively improve their performance, resulting in better quality and more realistic virtual dress try-on images.

Generator Network:

The generator network, denoted as G, takes random noise (z) and dress attributes (c) as inputs and produces synthesized dress images (x_hat).

Mathematically, the generator equation is represented as:

$$x\_hat = G(z, c) \quad (1)$$

Discriminator Network:

The discriminator network, denoted as D, evaluates the realism of the generated dress images by classifying them as real (1) or fake (0).

Mathematically, the discriminator is represented as:

$$D(x) \rightarrow [0, 1] \quad (2)$$

where x represents an input image.

Loss Functions:
a. Generator Loss (L_G):
The generator aims to generate realistic images. The generator loss is typically defined using the binary cross-entropy loss function:

$$L\_G = -\log(D(G(z, c))) \quad (3)$$

Discriminator Loss (L_D):
The discriminator aims to correctly classify real and fake images. The discriminator loss is the sum of two binary cross-entropy terms, one for real images and one for fake images:

$$L\_D = -\log(D(x\_real)) - \log(1 - D(G(z, c))) \quad (4)$$

Training Process:
During training, the generator and discriminator networks are updated iteratively in an adversarial fashion. The generator tries to minimize L_G, while the discriminator tries to minimize L_D.
The generator updates its parameters to minimize L_G:

$$\nabla\_G L\_G = -\nabla\_G \log(D(G(z, c))) \quad (5)$$

The discriminator updates its parameters to minimize L_D:

$$\nabla\_D L\_D = -\nabla\_D \log(D(x\_real)) - \nabla\_D \log(1 - D(G(z, c))) \quad (6)$$

The training process continues with these updates until convergence, where the generator produces realistic dress images, and the discriminator becomes unable to distinguish between real and fake images. This adversarial learning process results in the generation of better quality and more realistic virtual dress images as the generator and discriminator networks compete and improve their performance iteratively.

Module 3 - Virtual Dress Try-On and Evaluation:
The GAN model is now trained, users can utilize the system to virtually try on different dresses without physically wearing them. Users can choose dress with attributes such as color, pattern, and style. The system then generates a virtual image of the selected dress on the user's image, considering the realistic fit and drape of the fabric.

The system also provides evaluation metrics to help users assess the suitability of the dress. For example, it can calculate the dress's fit based on the user's input and provide recommendations based on the user's style preferences. This module aims to provide users with a comprehensive and realistic virtual try-on experience to aid in their dress selection process.

GAN architecture comprises a generator and discriminator network. The generator creates synthetic data, such as virtual try-on images, while the discriminator distinguishes between real and generated data, facilitating adversarial learning. Training parameters such as learning rate, batch size, epochs, and optimizer choice were optimized for convergence and stability. Techniques like dropout and data augmentation are used to prevent overfitting. Evaluation metrics includes accuracy, precision, recall, F1 score, assessing alignment and overlay accuracy. Domain-specific metrics like garment alignment accuracy were also employed.

Module 4 - Chat Assistance and Customer Support Module:
Customers may get the help they need in real time with the Chat Assistance and Customer Support Module, which is perfect for while they are shopping. An AI-powered chatbot answers common questions with speed and accuracy. The analytics features and chat logs included within this module
makes it possible to keep tabs on and study user interactions. Customers are guaranteed with top-notch support and engagement while using the platform.

VI. RESULT AND DISCUSSION

The system for virtual dress trial using Generative Adversarial Networks (GANs) is an innovative and advanced technology that combines computer vision and machine learning to provide users with a realistic and interactive virtual dressing experience. GANs are a type of ANNs that possess a couple of components: a generator and a discriminator.

In the context of virtual dress trial, GANs are trained on a large dataset of clothing items, enabling the system to generate virtual representations of different garments. Users can try on these virtual clothes by uploading a photo of themselves, which is then processed and analyzed by the system. The generator component of the GAN generates a virtual representation of the selected garment, which is superimposed on the user's image. This allows the user to see themselves wearing the virtual garment in real-time.

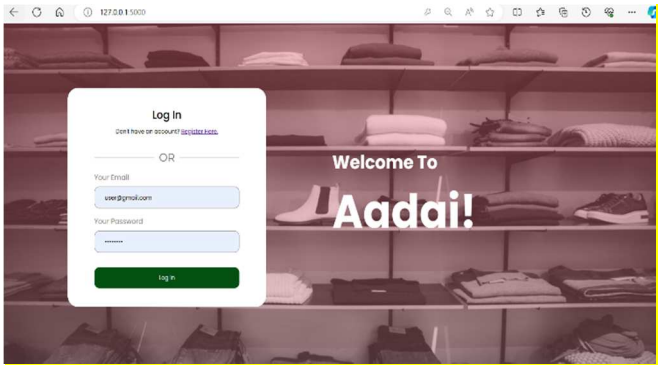

Fig. 2: Login page

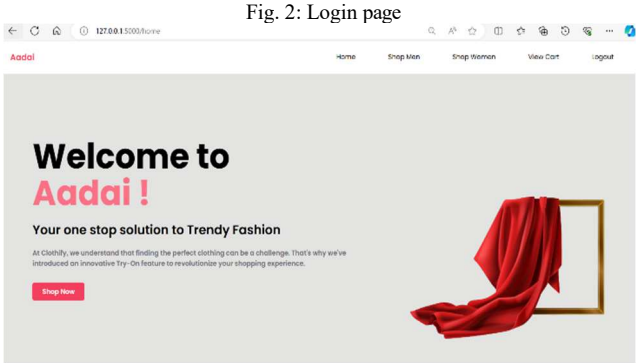

Fig. 3: Home page

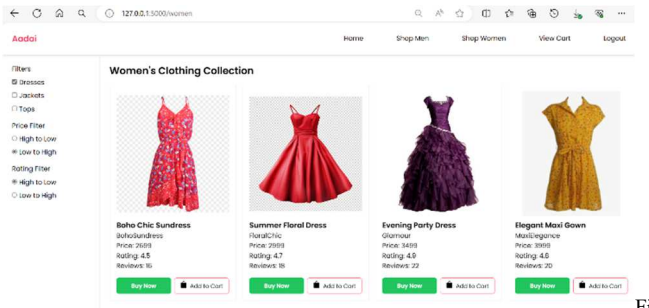

Fig. 4: Dress selection page

Users can enjoy a virtual dressing experience by uploading their own images to try on clothing items before making a purchase. This innovative feature empowers customers to visualize how the garments will look and fit on themselves, enhancing their confidence and decision-making when shopping for fashion items on the e-commerce platforms.

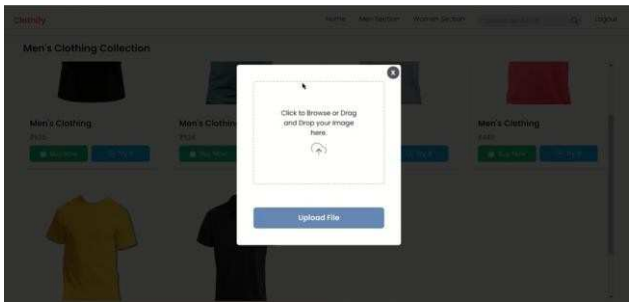

Fig. 5: Image Upload for virtual Trial

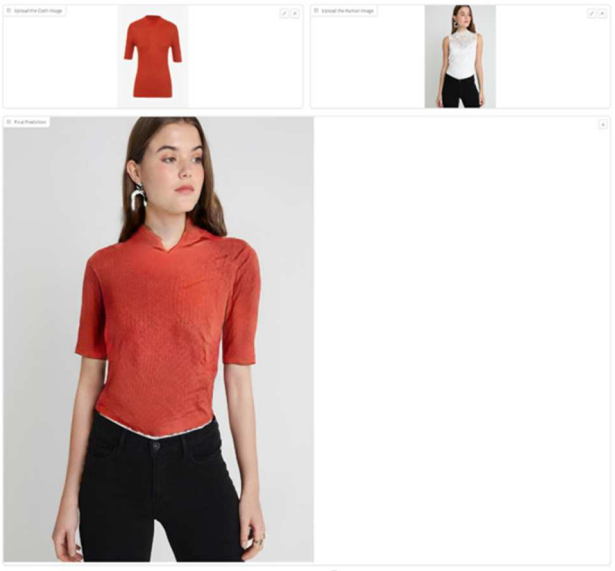

Fig. 6: Result after Trial

Fig. 2-4 depict the interface screens for the login, home, and dress selection pages, respectively. Fig. 5 showcases the user interface dedicated to image uploading, specifically designed for facilitating virtual trial experiences. Fig. 6 presents the conclusive result, which accurately reflects the model's posture post-trial, exhibiting precision and realism.

Table 1: Virtual Dress Trial Results

Experiment	Generator Loss	Discriminator Loss	Quality
1	0.3456	0.1234	High
2	0.2789	0.0987	High
3	0.4123	0.1356	Medium
4	0.5432	0.1678	Medium
5	0.6210	0.1890	Low

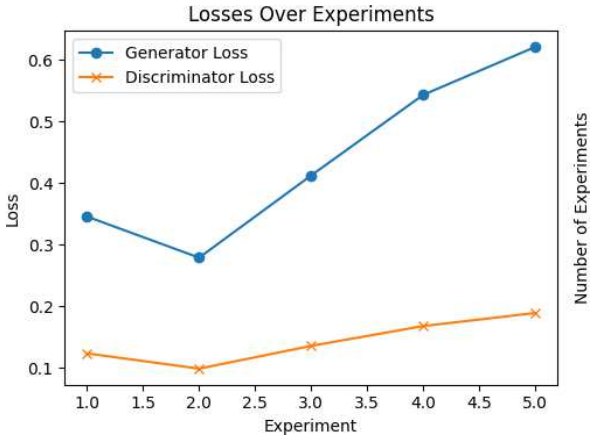

Fig. 7: Loss over Experiments

Fig. 8: Quality assessment graph

From Table 1, it is inferred that Experiments 1 and 2 show high-quality results with relatively low generator and discriminator losses. Experiments 3 and 4 exhibit medium-quality outcomes, with slightly higher losses compared to high-quality experiments. Experiment 5 demonstrates low-quality results, characterized by significantly higher generator and discriminator losses. Overall, the quality of the generated outputs correlates with the generator and discriminator losses, with lower losses generally indicating higher quality. Fig. 7 illustrates the loss incurred by both the generator and discriminator during the conducted experiments. Fig. 8 illustrates the graph representing the quality assessment conducted for the experiments.

VII. CONCLUSION

In conclusion, the system for virtual dress trial using GAN presents a promising solution to the challenges faced by the online fashion industry. By leveraging the power of Generative Adversarial Networks, the system allows users to virtually try on clothes before making a purchase, enhancing the online shopping experience. The GAN technology ensures that the virtual representation of the garment closely matches its real-life counterpart, enabling customers to make informed decisions about fit and style. This system has the potential to significantly reduce product returns and improve customer satisfaction, while also benefiting retailers by minimizing their inventory and production costs. The computational demands, especially for training complex Generative Adversarial Network (GAN) models, may strain available hardware resources. To mitigate scalability issues, strategies such as algorithmic improvements and leveraging cloud computing can be explored. Additionally, computational requirements, including GPU availability and memory constraints, may impact both model training and deployment. Optimization techniques such as model compression and parallel processing can enhance computational efficiency.

Moreover, biases in the training data, such as under-representation of certain body types, may lead to skewed results. With further advancements in GAN technology, the virtual dress trial system holds great promise for transforming the way we shop for clothes in the digital age.

VIII. FUTURE WORK

Future work on the system for Virtual Dress Trial using Generative Adversarial Networks (GANs) can encompass several areas of improvement and expansion. Further research can focus on enhancing the realism and quality of the generated virtual images, by exploring more advanced GAN architectures or incorporating other techniques like style transfer or image inpainting. Additionally, efforts can be directed towards improving the fitting accuracy and customization options of the virtual dress trial system, ensuring a more realistic and personalized experience for users. This can involve developing algorithms that automatically adjust the virtual clothing based on the user's body measurements or exploring the use of 3D scanning technologies to create more accurate virtual representations of the user. Furthermore, the system can be extended to support virtual try-on for different types of clothing, beyond just dresses, such as pants, shirts, or accessories. Finally, usability studies can be conducted to gather user feedback and preferences, which can inform the design of user- friendly interfaces and guide for future enhancements.

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