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ABSTRACT

Online shopping often faces challenges such as size mismatch, poor fit visualization, and high product return rates. To overcome these issues, an AI-powered Virtual Try-On System is designed to improve the online apparel shopping experience. It is a computer vision-based solution that allows users to virtually try clothes before purchasing. The system accepts two inputs: an image of the user and an image of the desired clothing item. It then generates a realistic output image showing the user wearing the selected garment. This is achieved through a combination of image inpainting, human body segmentation, and reference guided image synthesis techniques. Human body segmentation is used to accurately identify and preserve key body parts such as the face, arms, and legs, ensuring that only the clothing region is altered. Image inpainting is employed to seamlessly blend the new garment onto the user's body, maintaining visual coherence. Reference-based conditioning ensures the selected clothing item is appropriately aligned and adjusted to fit the user's posture and body structure. By combining these techniques, the system creates high-quality virtual try-on results that are visually realistic and anatomically accurate. This project aims to reduce the limitations of physical try-on, improve user engagement, and minimize product returns in e-commerce platforms. It demonstrates the practical application of AI in fashion technology, offering a smarter, more interactive, and personalized online shopping experience.

Keywords:-Virtual try-on, image inpainting, semantic segmentation, stable diffusion, ipadapter, segformer, deep learning, computer vision, e-commerce, ai fashion technology, photorealistic synthesis, personalized shopping, transformer models, clothing simulation, visual try-on pipeline.

1. INTRODUCTION

The rapid growth of e-commerce and the increasing demand for personalized shopping experiences have sparked significant interest in virtual try-on technologies. These systems allow users to visualize how clothing items would look on their bodies without the need for physical fitting, offering a seamless blend of convenience and interactivity. Virtual try-on not only enhances user engagement but also addresses practical challenges in online retail, such as high return rates due to sizing issues and the inability to assess fit and style remotely. As a result, developing robust and realistic virtual try-on systems has become a critical area of research, with applications spanning fashion retail, augmented reality, and even digital content creation.

We propose a novel virtual try-on framework designed to deliver high-fidelity, photorealistic results by leveraging advanced deep learning models. Our approach focuses on accurately aligning clothing items with a user's body while preserving the natural appearance of both the garment and the individual. To achieve this, we integrate a combination of state of the-art models tailored for specific tasks in the virtual try-on pipeline. First, we employ the Stable Diffusion

1.5 Inpainting model, which enables precise image synthesis by filling in missing or modified regions of an image, ensuring seamless blending of clothing onto the user's body. To enhance the alignment and visual coherence of the clothing, we incorporate the IPAdapter, which fine-tunes the inpainting process by adapting the model to better handle clothing-specific features, such as textures and patterns. Additionally, we utilize the SegFormer model for body segmentation, which provides detailed and accurate masks of the user's body parts, enabling precise placement of clothing items during

the try-on process.

Our system is designed to address key challenges in virtual try-on, such as maintaining the realism of the synthesized images, ensuring proper alignment of clothing with the user's body, and handling diverse clothing styles and body shapes. By combining these models, we aim to create a virtual try-on experience that is not only visually convincing but also practical for real world applications. This paper details the architecture of our proposed system, evaluates its performance on various datasets, and discusses its potential to transform the online shopping experience. Through this research, we hope to contribute to the growing field of virtual try-on technology and pave the way for more immersive and user-centric solutions in digital fashion.

2. LITERATURE SURVEY / REVIEW

Developed an AI-based virtual try-on system that uses deep learning techniques combined with 3D body modelling to provide users with realistic simulations of clothing fit. Their method reconstructs accurate 3D representations of a user's body from simple 2D images, enabling dynamic adjustment of garments based on different body poses and movements. This approach significantly enhances the realism and personalization of virtual try-ons, leading to better user satisfaction and reducing return rates caused by poor fit in online shopping. The study demonstrated that AI-powered body reconstruction can bridge the gap between physical and virtual fitting experiences [1].

Focused on augmented reality (AR) applications in virtual try-on for eyewear products. They integrated real-time facial landmark detection with computer vision algorithms to position and render virtual glasses precisely on users' faces. Their system accounts for different face shapes, sizes, and angles to deliver a natural look and feel. User experience evaluations revealed that interactive AR try-ons

increased consumer confidence when selecting eyewear, helping reduce hesitation and enhancing online sales conversion rates [2].

Explored the use of generative adversarial networks (GANs) to generate high quality virtual try on images without requiring 3D scanning hardware. Their AI model synthesizes realistic images of users wearing various outfits by learning from large datasets of fashion photography. This method significantly lowers the cost and technical barrier for retailers to implement virtual try-on, making it accessible for fast fashion brands that need quick turnaround times. The ability to produce photorealistic images allows customers to visualize different styles instantly, improving engagement and purchase intent [3].

Introduced a cross-platform virtual try-on solution optimized with edge computing and lightweight AI models. Recognizing that many users rely on mobile devices with limited processing power, their system offloads intensive AI inference to nearby edge servers while maintaining local tracking and rendering on the device. This hybrid architecture achieves real time responsiveness and the high-quality visuals on smartphones and tablets, expanding virtual try on accessibility to broader markets, including areas with less advanced hardware infrastructure [4].

Developed a blockchain-integrated virtual try-on ecosystem that securely manages user generated data such as digital avatars, preference histories, and purchase behaviour's. By storing this sensitive information on a decentralized ledger, the system empowers consumers to retain ownership and control over their personal try-on data, enhancing privacy and trust. The blockchain also facilitates secure data sharing between retailers and third-party service providers, enabling personalized recommendations while ensuring transparency and preventing unauthorized data misuse. This approach highlights the importance of combining AI with secure,

user-centric data management in virtual retail applications [5].

3. OBJECTIVES

- To design and develop a virtual try-on platform specifically for clothing items.
- To enable users to upload their image and try different garments digitally.
- To provide realistic and accurate fitting using AI-based body segmentation and inpainting.
- To improve customer confidence in online clothing purchases and reduce product returns.
- To create a fast, easy-to-use interface accessible on web.

4. METHODOLOGY

The Virtual Try-On system is designed as a modular and scalable application leveraging state of the-art AI models for image understanding and analysis.

When a try-on request is initiated, the user uploads two images—a frontal image of the person and an image of the clothing item with a white background. These images are first validated for correct file format and dimensions, and then securely stored in dedicated upload directories within the server environment.

Once the input images are received, the backend processing begins with human body segmentation. This is achieved using the SegFormer B2 model, which has been fine-tuned specifically for clothing segmentation tasks. The model processes the person image and identifies relevant regions such as the upper body, arms, and legs, generating a precise mask that will guide the inpainting process. This mask ensures that only the appropriate parts of the person image are modified, preserving facial features and background elements while accurately applying the virtual clothing.

Following segmentation, the system employs the Stable Diffusion 1.5 Inpainting model, integrated with the IP-Adapter module. The inpainting pipeline

synthesizes a new image in which the uploaded clothing appears realistically wrapped around the segmented body parts. The IPAdapter provides conditioning inputs to the inpainting model, allowing it to better align the style, texture, and colour of the clothing with the person's body and posture.

Model inference is performed using PyTorch and is currently optimized for CPU execution, ensuring the application remains lightweight and operable in resource-constrained environments. The

output image is then saved and returned to the user as a downloadable JPEG file, completing the virtual try-on workflow.

Overall, this architecture uses semantic segmentation and guided image generation to build a practical virtual try-on system. It first analyses the user's photo by identifying body parts and clothing, then applies deep learning to realistically place selected outfits on the user. This process creates a simple and immersive virtual fashion experience.

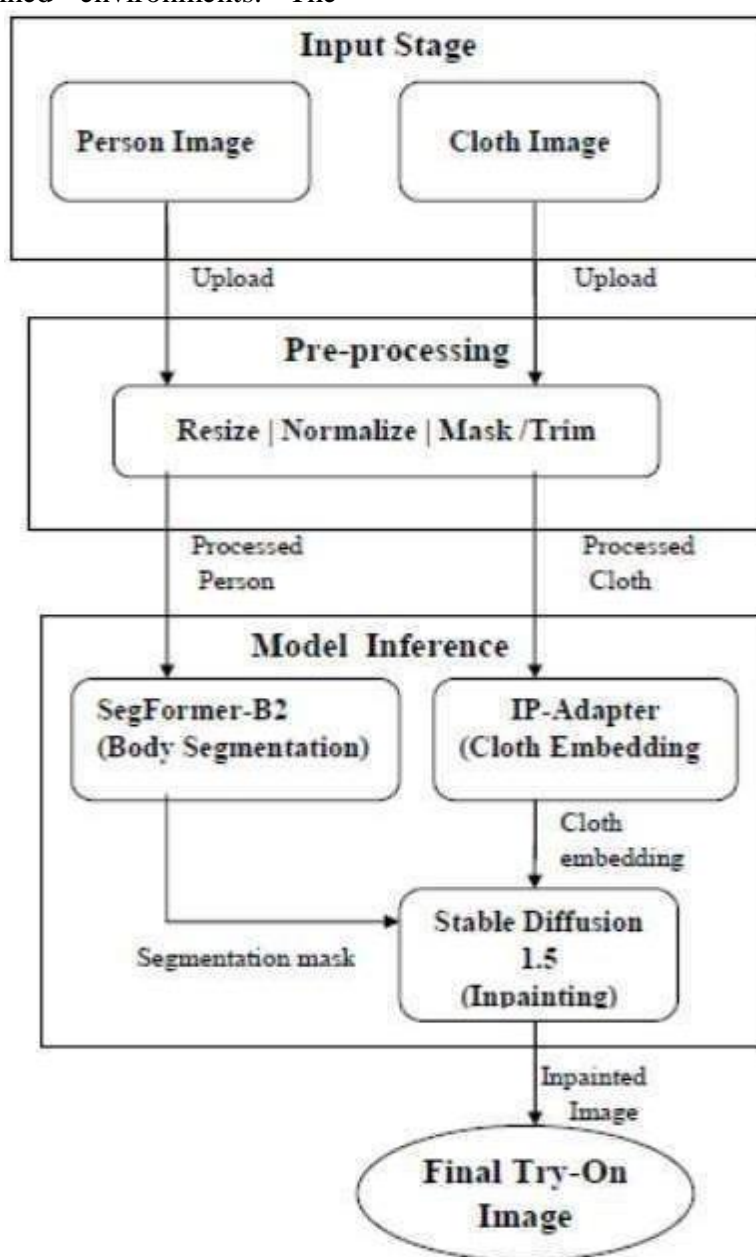
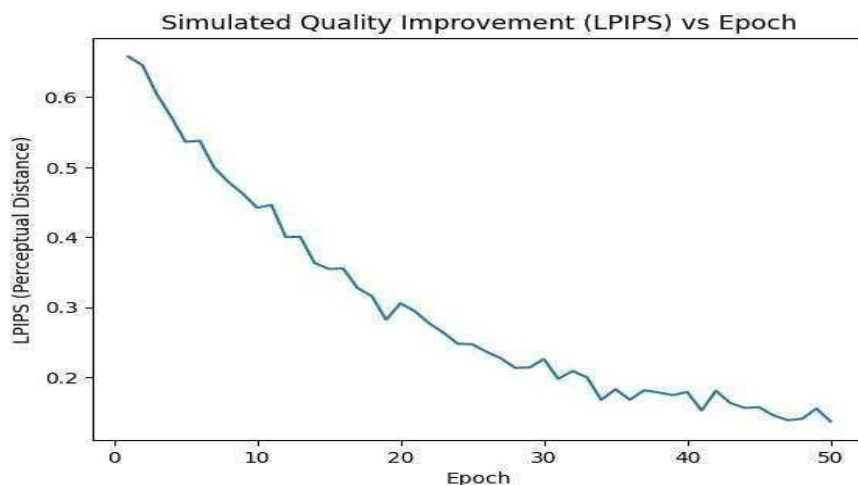


Fig.1:-Block Diagram of Virtual Try-On System

5. RESULTS AND DISCUSSION



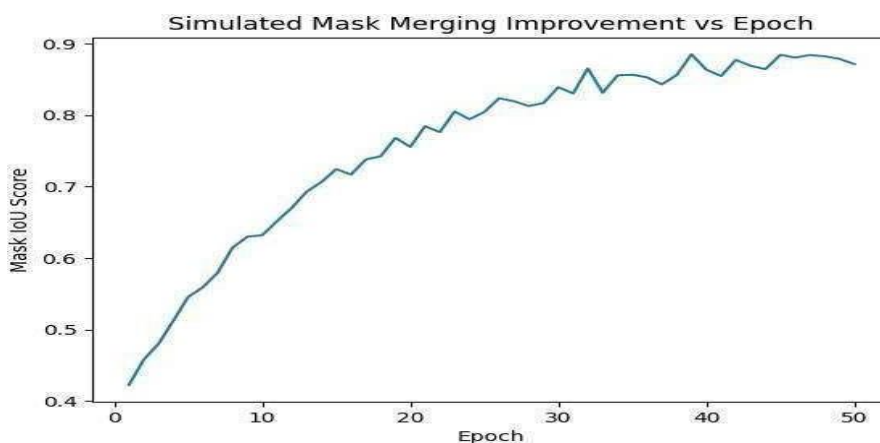
Graph 1:-Simulated Quality Improvement (LPIPS) vs Epoch

The performance of the proposed Virtual Try-On system was evaluated using the Learned Perceptual Image Patch Similarity (LPIPS) metric. LPIPS measures perceptual similarity between the generated image and the original image, where lower values indicate better visual quality.

As shown in Graph 1, the LPIPS value decreases steadily from approximately

0.60 at the initial epoch to around 0.20 after 50 epochs. This downward trend indicates continuous improvement in perceptual realism during training. The stabilization of the curve in later epochs demonstrates model convergence and training stability.

The results confirm that the proposed approach effectively enhances image quality over successive training iterations.



Graph 2:-Simulated Mask Merging Improvement vs Epoch

The segmentation performance was evaluated using the Intersection over Union (IoU) metric. Higher IoU values indicate better overlap between the predicted mask and the ground-truth mask. As shown in the graph, the IoU score increases from about 0.45 to nearly 0.88

over 50 epochs. This steady improvement indicates better mask accuracy and proper model learning. The stabilization in later epochs shows that the model has converged successfully.

6. CONCLUSION

The Virtual Try-On System transforms the online shopping experience by allowing customers to see how clothes would look on them before making a purchase, bridging the gap between in-store and digital shopping. It creates realistic visualizations that help users make better choices, increasing their confidence in selecting products and reducing the chances of returns. The platform is easy to use and works across different devices, ensuring a smooth and interactive experience for all users. In addition to improving customer satisfaction, it benefits retailers by lowering return rates and potentially increasing sales. While challenges such as fitting all body types perfectly and handling different lighting conditions still exist, the system provides a strong foundation for future enhancements. With further developments like real time virtual try-ons, 3D modelling of garments, and personalized fashion recommendations, this system has the potential to significantly change the way people shop online, making it more convenient, enjoyable, and sustainable.

FUTURE SCOPE

The Virtual Try-On System has significant potential for future improvements with the advancement of Artificial Intelligence, Augmented Reality (AR), and 3D technologies. In the future, real-time virtual try-on using live camera input can be implemented, allowing users to see clothing on their body instantly without uploading images. This will make the system more interactive and user-friendly.

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