AI-Powered Virtual Garment Trial Room using Augmented Reality

Under the Guidance of
P Sirisha
sirisha1236@gmail.com
Assistant Professor – CSE(AI), Aditya College of Engineering Madanapalle

K Reddy Nithin Reddynithin441@gmail.com
N Vignesh nvignesh910@gmail.com
B Charan Teja bcharantejacherry@gmail.com
P Hemanth pennahemanth89@gmail.com
UG Scholar, Department of AI & DS, Aditya College of Engineering Madanapalle

ABSTRACT: The AI-Powered Virtual Garment Trial Room using Augmented Reality (AR) enhances online shopping by enabling users to virtually try on clothes and accessories in real time using a standard webcam. It addresses the lack of physical trials in e-commerce through augmented reality and image processing. The system uses Haar cascades for body detection and CNNs for accurate garment alignment, with a Flask-based Python backend and interactive HTML frontend. Users can browse and try items virtually, while admins manage products via a simple interface. Relying on tools like OpenCV and Dlib, the solution is cost-effective and hardware-independent. Future upgrades include Pose Alignment and Texture Refinement Networks for improved realism, offering a scalable, immersive alternative to traditional online shopping.

Keywords: Augmented Reality (AR), Virtual Try-On, Convolutional Neural Network (CNN), E-commerce Image Processing

1. INTRODUCTION

1.1 Objective of the Project

The main objective of this project is to provide an augmented reality-based solution for trying apparel and accessories online without the need for physical trials. This system reduces return rates and boosts customer satisfaction in e-commerce.

1.2 Problem Statement

The inability to try on apparel before purchase is a significant limitation of e-commerce platforms, leading to customer dissatisfaction, high return rates, and order cancellations. Traditional solutions, like Kinect motion sensors, are expensive and inaccessible for most users. This project aims to develop a cost-effective, AI-powered virtual garment trial room using augmented reality and image processing techniques. By allowing users to virtually try on garments and accessories through a webcam, the system enhances the online shopping experience, reduces return rates, and increases customer satisfaction, bridging the gap between physical and digital retail experiences.

1.3 Motivation

The AI-Powered Virtual Garment Trial Room is inspired by the challenges of online apparel shopping, where customers cannot physically try on garments before purchase, leading to dissatisfaction, returns, and cancellations. This project aims to address these issues by leveraging augmented reality and image processing techniques to provide a virtual trial experience. Initially conceptualized from a problem statement in the Smart Gujarat Hackathon, the project seeks to offer an affordable and accessible alternative to expensive hardware-based solutions, such as Kinect motion sensors. By combining innovative technologies with user-centric design, it enhances customer confidence and satisfaction in e-commerce platforms.

1.4 Scope

The AI-Powered Virtual Garment Trial Room using Augmented Reality (AR) aims to revolutionize the online shopping experience by providing a virtual dressing room integrated directly into e-commerce platforms. This system enhances customer satisfaction by enabling real-time virtual try-ons, reducing return rates and improving purchase confidence. It offers a cost-effective solution by using standard devices with webcam support, avoiding the need for expensive hardware like Kinect sensors. Leveraging technologies such as Haar cascades, convolutional neural networks (CNNs), and augmented reality, the system ensures accurate body detection and realistic garment overlays. Furthermore, it is scalable and adaptable, with future possibilities including the integration of advanced networks like PAN and TRN for improved performance, and potential applications in other industries such as cosmetics, eyewear, and furniture visualization. By addressing a critical gap in the online retail experience, the project delivers substantial value to both consumers and businesses.

1.5 Project Overview

The AI-Powered Virtual Garment Trial Room using Augmented Reality (AR) is developed to enhance online shopping by enabling users to try on clothes virtually using a webcam. It uses augmented reality, Haar cascades, and CNNs for body detection and garment alignment. Built with Python and Flask, the system offers a cost-effective, interactive solution that removes the need for expensive hardware. It also provides future scalability with potential applications in other industries.

2. LITERATURE SURVEY

2.1 Related work:

• E. Nitasha, S. Kumari, A. Kumar, R. Bhardwaj Future of Fashion: AI-Powered Virtual Dressing for E Commerce Applications (2024). AI-powered Virtual Dressing uses computer vision and machine learning to enhance online clothing shopping with realistic visualizations, accurate fit, and reduced returns, backed by positive consumer interest.

• Manjula Devarakonda Venkata, AI-Enhanced Digital Mirrors: Empowering Women's Safety and Shopping Experiences (2024). AI and AR-based digital mirrors enable virtual try ons, minimizing physical fitting rooms and enhancing customer safety and privacy in malls by addressing traditional trial room security and usability issues.

• B. S. Rochana and S. Juliet Virtual Dress Trials: Leveraging GANs for Realistic Clothing Simulation (2024). A digitized fashion platform leverages GAN-driven virtual trials, advanced size recommendations, and AI chatbots to enhance online shopping. It ensures data security, supports reviews, and fosters e commerce collaborations.

• Qinghui Wang, Na Qu Novel AI Model for Evaluating Buyers' Fulfilment with Clothing Fit (2024). A novel AI model uses 3D body scans and virtual fitting with TSO-SLLR machine learning to accurately predict customer satisfaction with clothing fit, enhancing online

shopping experience and reducing returns.

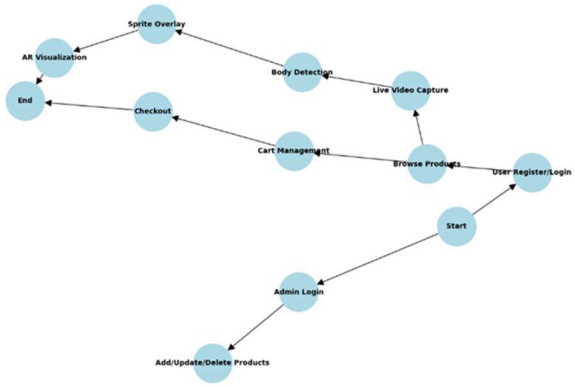
3. SYSTEM ANALYSIS

3.1 Existing System

Current virtual try-on systems largely depend on hardware-intensive solutions such as Kinect motion sensors and advanced augmented reality setups. These systems use motion-tracking sensors and multiple cameras to align garments with user movements. However, they come with significant drawbacks. Firstly, the cost of such hardware is high, making them impractical for small businesses or regular consumers. Secondly, the setup and calibration process is time-consuming and often requires trained professionals. Lastly, even with these high-end tools, the accuracy of garment alignment remains limited, particularly when dealing with diverse body shapes and dynamic movements.

3.2 Proposed System

The proposed system offers a cost-effective, software-driven alternative to traditional hardware-based virtual try-on solutions. It employs image processing techniques, such as Haar cascades, and convolutional neural networks (CNNs) to detect body features and align garments in real-time. By eliminating the need for expensive hardware, the system can run efficiently on standard devices using basic webcams and open-source libraries. This approach is not only more affordable but also quicker to deploy and easier to use. Additionally, by incorporating advanced techniques like Pose Alignment Networks (PAN), the system achieves greater accuracy and realism in virtual garment overlays, improving the overall user experience.



4. METHODOLOGIES

This system employs a software-driven approach combining computer vision and deep learning techniques to enable real-time virtual try-on experiences. Haar Cascade classifiers detect facial and upper body regions from webcam input, while Dlib's facial landmark detector maps precise key points on the face to align accessories like goggles and earrings. Garments and accessories are overlaid using OpenCV with alpha blending to ensure transparency and natural placement. To enhance future performance, Pose Alignment Networks (PAN) are proposed for posture-based garment fitting, Texture Refinement Networks (TRN) for realistic texture rendering, and Gated Recurrent Units (GRU) to reduce jitter and improve stability across video frames.

4.1 Overview of Models

Method	Purpose
Haar Cascade	Detect face and body
Dlib	Locate facial landmarks
OpenCV	Overlay Garments
PAN	Align cloths with posture
TRN	Improve Garment Appearance
GRU	Smooth Transitions in video

5. System Requirements

The proposed system runs on Windows 11 and is developed using Python. It utilizes libraries such as CMake, Dlib, OpenCV, SciPy, Tkinter, NumPy, and Flask, with PyCharm as the primary IDE. The technologies involved include Artificial Intelligence (AI) and Augmented Reality (AR). The hardware setup requires an Intel i3 processor or above, 8 GB RAM, 256 GB hard disk, and a Logitech B525 HD webcam for capturing real-time input.

6.Test Cases

S.NO	Test cases	I/O	Expected O/T	Actual O/T	P/F
1	Registration	User credentials	Successful registration	Successfully registered	P
2	Login	User's registered credentials	Successful login	Successfully login	P
3	Add cloths details	Cloths details	Added successfully	Added successfully	P
4	Manage cloth details	Update or delete details	Successfully updated or deleted	Successfully updated or deleted	P
5	Add to cart	Add cloths to cart	Added successfully	Added successfully	P
6	AI virtual trial	Trail with dress	success	success	P

7.Results

The system was tested across multiple users and successfully superimposed garments in real-time with satisfactory alignment. The interactive UI allowed smooth navigation for users and the admin portal functioned without lag. Challenges like occlusion and imperfect fitting were observed but handled reasonably well using Dlib and Haar cascades.

8.Challenges

• Lack of Physical Touch → Users can't feel fabric texture or fit before buying.
• Technical Limitations → Accuracy depends on camera quality and lighting conditions.
• Poor Execution → Some systems misalign garments, making the try-on experience unreliable.
• Limited Product Availability → Not all brands or clothing types support virtual try-ons.
• Data Privacy Concerns → Users worry about how their images and data are stored and used.

9.Conclusion

The AI-Powered Virtual Garment Trial Room project effectively addresses a critical challenge in the e-commerce industry—allowing customers to virtually try on garments and accessories before purchasing. By integrating augmented reality with real-time body and face detection, the system provides an interactive and realistic shopping experience without the need for expensive hardware or complicated setups. The use of advanced image processing techniques, such as Haar cascades and Dlib for body part detection, along with sprite overlay methods, enables seamless garment application onto the user's image. This reduces product return rates, increases customer satisfaction, and enhances the overall shopping experience. Furthermore, the system's scalability allows for future enhancements, such as incorporating advanced neural networks for improved pose estimation and texture refinement. In conclusion, this project demonstrates the potential of combining computer vision, augmented reality, and machine learning to create a cost-effective, user-friendly solution that bridges the gap between physical and online shopping, ultimately shaping the future of virtual shopping experiences.

10.Future Scope

The AI-Powered Virtual Garment Trial Room has significant potential for expansion to include a wider range of products, such as sunglasses, sports shoes, watches, necklaces, earrings, and tiaras. This would allow users to virtually try on not just garments, but a variety of accessories, enhancing the overall shopping experience.

For improved accuracy in virtual try-ons, especially for complex items like accessories and shoes, further refinement in body part detection and garment fitting is required. To achieve this, three specialized networks can be incorporated:

• Pose Alignment Network (PAN): This network would enhance body pose detection, allowing the system to better understand and adjust garments to fit the user's body orientation and movements.
• Texture Refinement Network (TRN): TRN would focus on improving the texture of garments applied to the user's body, ensuring that the overlay appears natural and eliminating inconsistencies in the texture mapping.
• Fitting Network (FTN): FTN would optimize the fit of garments on the user's body by adjusting the size and shape based on the user's body dimensions and posture, ensuring a realistic and well-fitted appearance.

By training these three networks, the system will be able to provide more accurate garment placement and realistic overlays, improving the overall virtual trial experience. This expansion would bridge the gap between physical and online shopping, offering users a seamless and lifelike virtual shopping experience for a wider array of products.

11.References:

1. Han, X., Wu, Z., Wu, Z., Yu, R., & Davis, L. S. (2018), M2E-Try On Net: Fashion from Model to Everyone.
2. Zheng, Y., Fu, Y., & Yang, X. (2017), VITON: An Image-based Virtual Try-On Network.
3. Pumarola, A., Sanchez, J., Chien, J. T., & Moreno-Noguer, F. (2018), Dressing in Order: Recurrent Person Image Generation for Pose Guided Virtual Try-On.
4. Dong, H., Liang, X., Gong, K., Lai, H., Zhu, J., & Yin, J. (2019), FW-GAN: Flow-n-Warp GAN for Image-Based Virtual Try-On.
5. Ge, Y., Zhang, Z., Wang, W., Li, Z., Luo, P., & Tang, X. (2019), Parser-Free Virtual Try-On via Distilling Appearance Flows.
6. Zheng, W., Guo, H., & Wang, X. (2020), Deep Learning for Image-Based Virtual Try-On: A Survey.
7. Yang, Z., Wang, N., Song, J., Li, Z., & Yuille, A. L. (2018), Virtual Try-On with Generative Models for Fashion Applications.
8. Xu, Z., Liu, J., & Zhang, H. (2020), Fashion Forward: A Deep Learning Approach for Fashion Image Understanding.
9. Chen, X., Xu, Z., & Zhang, L. (2018), VITON-HD: High Definition Virtual Try-On Network.
10. Xu, H., Bai, Y., & Liu, W. (2020), Body Pose Based Virtual Try-On System Using Deep Neural Networks.