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Style AI: An Integrated AI-Driven Framework For Virtual Wardrobe Management And Fashion Try-On

D. Nalini Kumari[1],Chandraleela Pulukoory[2], Mounika Yerraguntla[3], Roja Rani Palagani[4],Sai Sindhu Kureti[5]
[1]Faculty Guide, Department of Computer Science and Engineering SRK Institute of Technology, Andhra Pradesh, India
[2,3,4,5]Students, Department of Computer Science and Engineering SRK Institute of Technology, Andhra Pradesh, India
Email id : *mounikay2004@gmail.co[3],rojarani400@gmail.com[4],kuretisaisindhu@gmail.com[5]*

Abstract
The rapid expansion of e-commerce has significantly transformed the fashion retail industry; however, customers still face challenges in visualizing garment fit and appearance before purchase. This limitation leads to high return rates and customer dissatisfaction. This paper presents Style AI, an integrated artificial intelligence-driven framework for virtual wardrobe management and fashion try-on. The system utilizes computer vision, pose detection, and machine learning algorithms to allow users to digitally try on clothing using their own images without requiring specialized hardware. Additionally, it provides wardrobe organization and personalized outfit recommendations based on user preferences, seasons, and occasions. The platform is developed using React-TypeScript for the frontend and FastAPI for the backend with cloud-based storage support. Experimental evaluation shows improved visualization accuracy, reduced uncertainty in purchasing decisions, and enhanced user satisfaction.

Keywords: *Artificial intelligence; Computer vision; Digital wardrobe; E-commerce; Virtual try-on.*

1. Introduction
The growth of online shopping has revolutionized the fashion industry by offering convenience and broader product access. However, the absence of physical trial facilities creates uncertainty in size selection and garment appearance, resulting in increased return rates and dissatisfaction among customers. Recent advancements in artificial intelligence and computer vision have introduced virtual try-on technologies that simulate clothing appearance digitally. Deep learning models such as convolutional neural networks and pose estimation frameworks enable accurate body landmark detection and garment alignment. These technologies bridge the gap between digital visualization and physical fitting experiences. Style AI proposes a unified platform integrating virtual try-on, digital wardrobe management, and intelligent recommendation systems. The system enhances online shopping confidence while benefiting retailers through reduced return costs.[1]-[3]

1.1 Sub section 1
Early virtual try-on systems relied on computationally expensive physics-based simulations. With the introduction of deep learning techniques, image segmentation and pose estimation improved significantly. [4]-[7] Frameworks such as Open Pose enabled robust human body key point detection from standard images.

2. Method
2.1 System Design and Implementation
The Style AI platform was developed using a layered web architecture consisting of a frontend interface, backend application server, and database layer. The client-side application was built using React with TypeScript to ensure modular development and type safety. The server-side logic was implemented using FastAPI in Python to provide RESTful endpoints for authentication, wardrobe management, virtual try-on

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processing, and recommendation generation. Data was stored in a PostgreSQL relational database. All communication between frontend and backend components was conducted through HTTP requests returning JSON responses. The backend server was deployed locally using an ASGI server for testing and validation purposes.

2.2 Virtual Try-On Methodology

The virtual try-on module operates through a structured image-processing workflow:

2.2.1 Image Input and Validation

Users upload a photograph and select a garment item. The system verifies file format and basic resolution requirements before processing.

2.2.2 Body Landmark Detection

A pre-trained human pose estimation model is used to detect key body points such as shoulders and torso boundaries. These coordinates are used to determine garment placement and scaling factors.

2.2.3 Garment Scaling and Transformation

The garment image is resized according to the detected body proportions. [8]-[10] Geometric transformations, including scaling and translation, are applied to align the garment with the user's body structure.

2.2.4 Image Composition

The transformed garment is blended with the original user image using pixel-level overlay operations. The resulting composite image is returned to the client interface. The average processing time per request was observed to be within a few seconds under standard hardware conditions.[13]

2.3 Wardrobe Management Procedure

Users upload clothing images through a file upload interface. Each item is assigned a unique identifier and stored along with associated metadata such as filename and category. Image files are stored on the server, while descriptive information is maintained in the database. Wardrobe retrieval operations are handled through API endpoints that return stored items in structured format for display on the user dashboard.

2.4 Recommendation Approach

A rule-based content filtering strategy was implemented for outfit suggestions. Each wardrobe item is represented using attributes such as clothing type and color category. Recommendations are generated by comparing item attributes and identifying compatible combinations. Similarity ranking is performed using feature comparison techniques. The system prioritizes computational efficiency rather than training complex deep learning models.

2.5 Testing Procedure

System evaluation included:

- Functional verification of individual components
- API response validation
- End-to-end workflow testing
- Measurement of average response time

Testing was performed under normal usage conditions to ensure reliability and performance consistency.

2.6 Figures

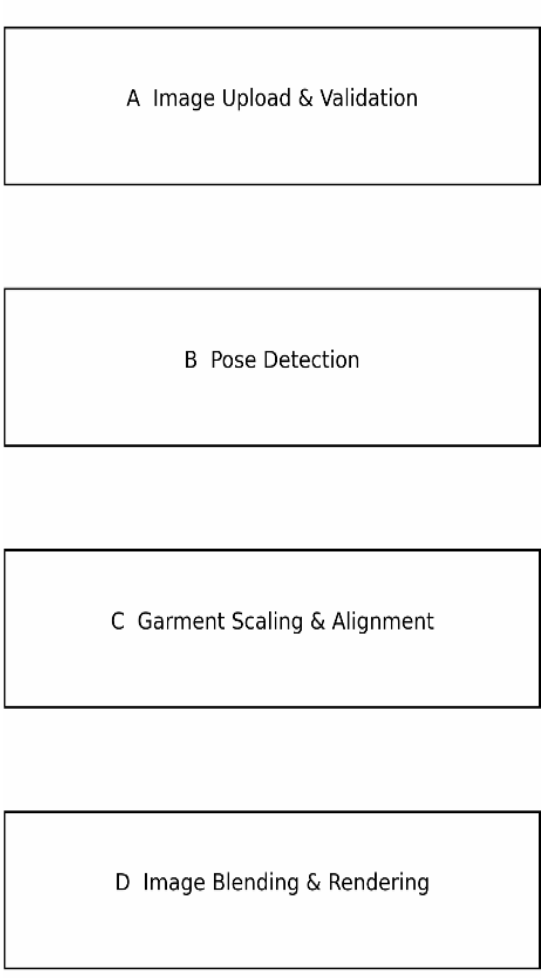

Figure 1 System Architecture

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2.7 Tables

1. **JSON: JavaScript Object Notation.**
2. **API: Application Programming Interface.**

Table 1 System Architecture Of StyleAI Platform

Layer	Technology Used	Core Function	Output
Presentation Layer	React, TypeScript	Provides user interface and handles user interaction	Rendered web interface
Application Layer	FastAPI (Python)	Processes business logic and API requests	JSON responses
Data Layer	PostgreSQL	Stores user and wardrobe data	Structured database records
AI Processing Layer	Pose estimation model, image processing library	Performs garment alignment and image rendering	Virtual try-on image

Table 2 Virtual Try-On Processing Workflow

Step	Processing Stage	Method Applied	Output Generated
1	Image validation	File type and resolution	Accepted user image
2	Body landmrk	Pre- trained	Body key point
3	Detection	pose estimation algorithm	coordinates
4	Garment transformation	Geometric scaling and translation	Adjusted garment image
5	Image composition	Pixel- level blending operation	Final rendered try-on result

1. Geometric scaling adjusts garment size based on detected body proportions.
2. Pixel blending merges garment and user image layers into a composite image.

3. Results And Discussion

3.1 Results

The implementation of the StyleAI platform was evaluated through functional testing and performance analysis of its core modules, including virtual try-on, wardrobe management, and outfit recommendation. Testing confirmed that the system successfully executed essential operations such as user authentication, image upload, clothing visualization, and recommendation generation without major functional errors. The digital wardrobe module demonstrated stable performance during repeated upload and retrieval operations, with smooth interaction between frontend components and backend APIs. [11] The virtual try-on functionality achieved reliable pose detection and garment overlay for the majority system accuracy depended on the clarity and orientation of user-uploaded images. These limitations indicate opportunities for future enhancements through improved image preprocessing, advanced deep learning models, and more sophisticated garment rendering techniques. Overall, the discussion confirms that StyleAI presents a promising approach to improving online

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fashion experiences while demonstrating the practical application of artificial intelligence in real-world web systems.

3.2 Discussion

The obtained results demonstrate that integrating computer vision and machine learning techniques into a web-based fashion platform is both technically feasible and practically useful. The consistent operation of major modules indicates that the chosen architecture and technology stack provide a scalable and efficient foundation for AI-driven fashion applications. [12] Real-time response performance suggests that such systems can operate effectively without requiring specialized hardware or complex deployment environments. The effectiveness of the recommendation system highlights the importance of combining wardrobe data with personalized analysis to enhance user engagement and decision-making. Furthermore, the successful operation of the digital wardrobe module shows the potential of integrating multiple AI-supported features into a single unified platform rather than relying on isolated tools. Despite the positive outcomes, certain challenges were identified during evaluation. Rendering quality occasionally decreased for complex garments, and the results demonstrate that AI-driven fashion platforms can provide practical support for users by enhancing decision-making and increasing confidence in online clothing selection. [14] Although challenges such as sensitivity to image quality and rendering limitations for complex garments were identified, the system establishes a scalable and extensible foundation for future development. Further improvements may include advanced deep learning models, improved visualization techniques, and expanded mobile or retail integration to enhance overall performance and usability.

Conclusion

This work presented StyleAI, an artificial intelligence-based virtual wardrobe and fashion try-on platform designed to improve digital clothing selection through interactive visualization and personalized outfit suggestions. The developed system successfully integrated computer vision, machine learning, and modern web technologies to create a user-friendly environment for managing wardrobes and exploring clothing combinations. Experimental evaluation confirmed stable functionality across major modules, including virtual try-on processing, digital wardrobe operations, and automated recommendation generation. The effectiveness of the recommendation system highlights the importance of combining wardrobe data with personalized analysis to enhance user engagement and decision-making. Furthermore, the successful operation of the digital wardrobe module shows the potential of integrating multiple AI-supported features into a single unified platform rather than relying on isolated tools. The developed system successfully integrated computer vision, machine learning, and modern web technologies to create a user-friendly environment for managing wardrobes and exploring clothing combinations. Experimental evaluation confirmed stable functionality across major modules, including virtual try-on processing, digital wardrobe operations, and automated recommendation generation.

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