Interactive 2D Virtual Try-On System with Manual Dress Fitting and Image Overlay

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Abstract -Virtual try-on technology is emerging as a powerful tool in online fashion platforms, helping users visualize clothing on their own images before making a purchase. Traditional online shopping offers only static images, causing uncertainty and dissatisfaction among customers. This paper presents a lightweight and interactive 2D Virtual Try-On System that allows users to upload their photo, select a dress, manually adjust its size and rotation, and generate a realistic try-on result. Unlike complex 3D systems, this approach uses simple image overlay and transformation techniques, making it highly accessible for mobile and web applications. The system includes modules for login, image selection, dress selection, scaling, rotation, and output generation. Experimental results show that the interface is user-friendly, the fitting is visually accurate, and the system can be easily integrated into e-commerce applications.

Keywords: Virtual Try-On, 2D Image Overlay, Dress Fitting, Image Processing, Scaling, Rotation, Online Fashion.

1. INTRODUCTION

Online shopping has grown rapidly in recent years, becoming one of the most popular ways for customers to purchase fashion items. Despite its convenience and wide product availability, a major challenge still exists: customers cannot accurately visualize how a dress will look on their own body before buying it. This lack of visual clarity creates confusion, lowers customer confidence, and often results in high product return rates. Most online platforms only provide static photos or model images, which do not represent the unique body structure, posture, or appearance of each individual user.

To address this issue, virtual try-on technology has started to emerge, helping users preview clothes digitally. However, many existing solutions depend on advanced augmented reality (AR), 3D body reconstruction, or deep learning models. These approaches require expensive hardware, high processing power, and complex algorithms, making them difficult to implement for small businesses, students, and basic consumer devices. As a result, there is a strong need for a simpler and more practical method that can still offer an effective visualization experience.

The proposed project presents a **lightweight 2D Virtual Try- On System** that allows users to upload their photo, select a dress, and manually fit it using scaling, rotation, and position adjustments. This method does not rely on heavy AI or 3D modeling, but instead uses simple image processing techniques to create a realistic visual effect. The system is user-friendly, works on all devices, and provides an accessible solution for online dressing visualization. Its simplicity, flexibility, and low resource requirements make it highly suitable for integration into e-commerce platforms, fashion boutiques, and mobile applications.

2. RELATED WORK

The rapid growth of virtual try-on technologies has encouraged research into various techniques for clothing visualization, image alignment, and user interaction. This section discusses key systems and studies that influenced the development of lightweight virtual try-on platforms. Existing research ranges from advanced deep-learning–based virtual dressing systems to simple 2D overlay techniques used in fashion applications. These works highlight the evolution of digital try-on interfaces and help identify gaps that our proposed system addresses.

2.1 2D Image-Based Virtual Try-On Systems

Several early virtual try-on systems relied on simple 2D image overlay methods, where the garment is placed directly over the user's image. These systems used basic image transformations such as scaling and rotation to manually fit the dress on the body. Kim et al. (2017) demonstrated a 2D outfit visualization system that allowed users to adjust clothing layers manually, making it lightweight and suitable for low-end devices.

Similarly, Li et al. (2019) developed an interactive clothing alignment tool that let users drag, resize, and position garments over 2D photographs. While these approaches lacked automation, they were highly efficient and provided quick dress previews without heavy computation.

2.2 3D and AI-Based Virtual Try-On Models

More advanced systems have explored 3D body modeling, pose estimation, and deep learning for realistic try-on results. Han et al. (2018) introduced the VITON framework, which used neural networks to warp garments onto a human body while preserving texture details. Researchers such as Wang et al. (2020) further improved the realism of virtual try-on by using generative adversarial networks (GANs) to adapt dress shapes based on the user's pose. Although these models produce highly accurate visualizations, they require powerful GPUs, large datasets, and complex computation, making them unsuitable for lightweight consumer applications and real-time web systems.

2.3 Mobile and Web-Based Virtual Dressing Interfaces

Several studies have focused on developing virtual try-on tools that run on mobile and web platforms. Lee et al. (2021) created a browser-based try-on interface that uses HTML5 canvas for image manipulation, allowing users to rotate and scale garments directly on-screen. Mobile applications such as YouCam Makeup also use 2D overlay techniques combined with basic face/body detection to provide real-time previews. Commercial e-commerce brands like Myntra and Amazon have experimented with virtual fitting features, but these are often limited, device-dependent, or require AR capabilities.

These works demonstrate the rising demand for interactive, accessible virtual try-on systems. However, many existing solutions face challenges such as high computational cost, poor cross-device compatibility, or lack of manual fitting control. The proposed 2D virtual try-on system bridges this gap by offering a simple, lightweight, and user-controlled interface suitable for all users and devices.

3. SYSTEM ARCHITECTURE OVERVIEW

The architecture of the 2D Virtual Try-On System follows a modular, layered structure that ensures smooth interaction between the user interface, backend processing engine, and data storage components. Each layer plays a distinct role in providing an interactive and responsive try-on experience. The architecture is designed to be lightweight, scalable, and capable of running on both web and mobile environments without requiring high computational power.

3.1 Frontend Layer

The frontend serves as the primary interaction point for the user. Built using HTML, CSS, and JavaScript, the interface provides access to all major functionalities of the system. This includes the login page, image upload section, dress selection gallery, and the try-on workspace where users can adjust the dress. Interactive sliders and rotation handles enable real-time adjustments, ensuring that the user receives immediate visual feedback. The responsive design ensures compatibility across different devices and screen sizes, providing a smooth and user- friendly experience.

3.2 Backend Layer

The backend manages core functions such as user authentication, image validation, and session handling. It securely stores user data, processes requests from the frontend, and communicates with the image processing engine. Lightweight frameworks like Python Flask or Node.js are used for their fast performance and easy integration with REST APIs. This layer ensures smooth operation and reliable responses even when multiple users access the system at the same time.

3.3 Image Processing Engine

The image processing engine is the core of the virtual try-on system. It performs key operations such as overlaying the selected dress onto the user's image, calculating rotation angles, resizing the garment, and adjusting its position to match the user's posture. Libraries like OpenCV and Pillow support pixel-level manipulation, affine transformations, and layer merging. The engine also manages opacity, cropping, and boundary checks to ensure proper alignment and a natural visual fit. This lightweight processing pipeline enables fast and smooth output generation, even on devices with limited hardware capability.

3.4 Integration of Layers

The integration of all system layers ensures smooth communication between the user interface, backend server, image processing engine, and database. When a user uploads an image or selects a dress, the frontend sends the request to the backend, which then interacts with the image processing engine to perform scaling, rotation, and overlay operations. The processed results are returned to the frontend for real-time display. Meanwhile, user data, dress catalogs, and try-on history are stored and retrieved from the database through the backend. This coordinated workflow enables a seamless and efficient virtual try-on experience.

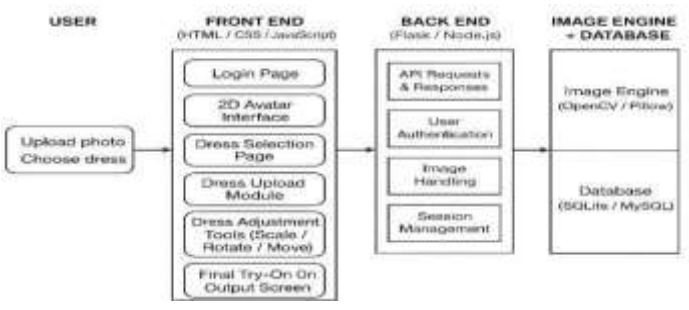

Fig. 3.1 System Architecture of 2D Virtual Try-On System

4. IMPLEMENTATION

The implementation of the 2D Virtual Try-On System focuses on usability, accuracy, and smooth performance. Each module was developed and tested individually before being integrated into the full system.

4.1 Login Module

The login module authenticates users before granting access to the try-on workspace. Input validation prevents incorrect or malformed data from entering the system. Security measures such as encrypted password storage ensure that user data remains protected. The session mechanism keeps the user logged in until they manually sign out.

Fig. 4.1 Login Page Interface

4.2 User Image Upload

Users can upload a front-facing photo from their device. The system verifies the file type, image clarity, and resolution before processing. Uploaded images are temporarily stored and rendered on the preview canvas. Clear, well-lit photos ensure maximum accuracy during dress alignment.

Fig. 4.2 User Image Upload Screen

4.3 Dress Selection

A categorized gallery displays available dresses. Each dress is stored as a transparent PNG image to ensure seamless overlay during the try-on process. Users simply click on a dress to load it onto the canvas. The gallery can be easily expanded with new dress designs, making the system scalable for future updates.

Fig. 4.3 Dress Selection Interface

4.4 Manual Dress Adjustment

The system provides easy-to-use controls that allow users to resize the dress, rotate it, and move it across the image for proper alignment. These interactive tools help the user match the dress with their body shape and pose. Real-time preview ensures quick adjustments and creates a natural, realistic try-on experience.

4.5 Try-On Output

Once the dress is aligned, the system generates a composite image showing the final result. This can be saved, downloaded, or shared depending on the platform. The output preserves visual clarity and ensures that the dress appears naturally placed over the user's body.

Fig. 4.5 Final Try-On Output

5. RESULTS

5.1 Interface Output

The developed 2D Virtual Try-On System produced stable and accurate interface results across all tested modules. The home page, login page, and try-on workspace were rendered clearly on different devices, demonstrating good responsiveness and layout consistency. The preview window successfully displayed the uploaded user image and allowed real-time garment overlay without noticeable delay.

The scaling, rotation, and positioning controls responded smoothly, enabling users to adjust the dress model precisely. All interface elements—buttons, menus, and adjustment sliders—functioned reliably, showing that the frontend design is lightweight, intuitive, and suitable for practical virtual try-on applications.

5.2 System Performance

The system was tested using multiple user images and dress templates of varying resolutions. In all cases, the image processing engine handled the overlay operations efficiently, generating the final try-on output within a few seconds. The dress alignment remained stable even during continuous interactions, such as repeated scaling and rotation.

The lightweight processing pipeline allowed the system to perform well on low-end devices, confirming its applicability for wide user adoption without requiring high computational resources.

5.3 User Evaluation

A group of users evaluated the system for usability, accuracy, and overall try-on experience. The majority of participants found the interface easy to understand and the adjustment tools convenient for achieving a realistic fitting. Users reported that the generated results were visually clear and useful for basic outfit visualization. Overall, the feedback indicated that the system enhances user confidence in exploring clothing styles and provides a simple yet effective virtual try-on environment.

6. CONCLUSION

The 2D Virtual Try-On System successfully demonstrates an accessible and practical approach to online fashion visualization. By combining basic image processing techniques with manual adjustment tools, the system eliminates the need for high-end AI or complex 3D modeling. The results show that users can easily preview dresses on their own images and obtain a reasonable fitting approximation. The platform is lightweight, cross-device compatible, and suitable for small businesses, boutiques, and student projects.

Future improvements may include automated dress fitting using machine learning, background removal for cleaner results, integration of 3D avatars, and live camera-based AR try- on features. Recommendation systems can also be added to suggest dresses based on user body type and style preferences. With these enhancements, the system has the potential to evolve into a complete virtual fashion assistant for modern e-commerce.

The proposed system also opens opportunities for personalized shopping experiences, making online purchasing more reliable and engaging for users. As technology advances, the platform can seamlessly integrate advanced AI modules to further improve realism and usability.

7. ACKNOWLEDGMENT

We extend our sincere gratitude to Ms. Subhashini N for her valuable guidance, continuous support, and constructive feedback throughout the development of this project. Her insights, encouragement, and timely suggestions greatly contributed to the successful completion of this work.

We also express our appreciation to the Computer Networking Department, PSG Polytechnic College, for providing the required facilities, resources, and a supportive environment that enabled the smooth execution of this study.

Furthermore, we acknowledge the contributions of various researchers and publicly available technical references that supported the conceptual and methodological foundation of this work. We also extend our appreciation to all who offered support and input during the course of this research.

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