International Research Journal on Advanced Engineering and Management
https://goldncloudpublications.com
https://doi.org/10.47392/IRJAEM.2025.0400
e ISSN: 2584-2854
Volume: 03
Issue:07 July 2025
Page No: 2539 - 2544

Virtual Mirror- A Hassle-Free Approach to Trial Rooms

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Abstract
The Virtual Mirror offers a digital alternative to traditional trial rooms, allowing users to try on clothes virtually. Built with ReactJS for the frontend, Node.js for backend processing, and MySQL for database management, the system provides an intuitive and responsive user experience. By uploading a photo or 3D scan, users can visualize garments accurately over their body, with attention to fabric texture, fit, and posture. This innovation reduces in-store visits, lowers return rates, and enhances shopping personalization. Combining deep learning and modern web technologies, the Virtual Mirror improves customer satisfaction and redefines how apparel is experienced in online retail.

Keywords: *Virtual-Mirror, Augmented Reality, Real-Time Interaction, Garment Visualization, Video Processing, Real-Time Overlays, Virtual Fitting.*

1. Introduction
The retail industry is undergoing a profound digital transformation, with increasing emphasis on using technology to enhance customer experiences and streamline operations. One of the most impactful innovations in this space is the Virtual Trial Room (VTR) — a technology-driven system that allows users to try on garments digitally through smart devices equipped with cameras. By eliminating the need for physical changing rooms, virtual trial rooms cater to modern shopping preferences for convenience, hygiene, speed, and personalization. With the rapid rise of e-commerce and contactless shopping, customers face new challenges particularly the inability to assess the look and fit of garments before purchasing. This often leads to dissatisfaction, increased product returns, and a lack of confidence in online fashion purchases. Virtual mirrors address these challenges by leveraging real-time image processing, augmented reality, and computer vision to simulate how a piece of clothing appears on the user's body in a digital environment. These systems provide an interactive and engaging solution, effectively narrowing the gap between physical and online shopping experiences. The importance of virtual trial rooms extends beyond online platforms. In physical retail stores, they offer a cleaner, faster alternative to traditional changing rooms, particularly in a post-pandemic world where hygiene and minimal physical contact have become priorities. For retailers, this technology helps reduce overhead costs, manage inventory more effectively, and lower the number of product returns by enabling more informed buying decisions. The motivation behind developing a virtual mirror stems from the common drawbacks of traditional trial rooms: long queues, limited privacy, unhygienic conditions, and the physical effort required to try multiple garments. Many shoppers, especially in crowded or time-constrained scenarios, skip the trial step entirely, which can affect sales and customer satisfaction. Our aim is to deliver a hassle-free, user-centric, and technologically advanced alternative that enhances both in-store and online retail experiences. To address these challenges, we designed a solution that uses ReactJS for a modern, responsive frontend interface, Node.js for efficient backend logic, and MySQL for structured data storage. The system incorporates live camera input, user-friendly controls, and advanced tracking methods to deliver a near-realistic virtual try-on experience. This innovation marks a step forward in redefining how consumers interact with fashion products in the digital age. In today's fast-paced

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world, people prefer quick and convenient shopping experiences, whether online or in stores. The Virtual Mirror helps save time by letting users try on clothes without changing physically, which is especially helpful during busy shopping hours or when shopping from home. It also reduces the need for physical contact, making it a safer and more hygienic option, especially after the COVID-19 pandemic. For shop owners and fashion brands, it means fewer product returns, better customer satisfaction, and improved sales. As more people get comfortable with using digital tools, virtual trial rooms are becoming not just a trend, but a necessary part of modern retail.

2. Problem Statement

In today's fashion and retail world, especially with the growth of online shopping, one major problem for customers is not being able to try on clothes before buying them. This often leads to confusion, wrong choices, and clothes that don't fit or look right. As a result, many products are returned. Physical trial rooms help in stores, but they also have issues like long lines, hygiene concerns, time wastage, and lack of privacy — making the shopping experience uncomfortable for many people. Since more people now prefer digital and contactless ways of shopping, there is a need for a simple, easy-to-use, and effective alternative to traditional trial rooms. Many current tech solutions are too complicated or not used widely, and they don't fully solve the problem. So, there is a clear need for a virtual try-on system that is accurate, fast, and easy for everyone to use. Our project, called Virtual Mirror – A Hassle-Free Approach to Trial Rooms, solves this problem by creating a web-based tool where users can try on clothes virtually using their device's camera. It uses ReactJS for the front end, Node.js for the backend, and MySQL for storing data. It also includes computer vision and machine learning to make the experience more realistic and personalized. The goal is to give users a better and easier way to try clothes, reduce the need for physical trial rooms, and improve the shopping experience both online and in stores.

3. Literature Review

In [1], Hu synthesis et al. introduces SPG-VTON, a multi-pose virtual try-on network that employs semantic prediction guidance to enhance clothing alignment and realism. The model integrates a semantic prediction module, clothes warping module, and a try-on module, achieving superior performance on datasets like MPV and DeepFashion. In [2], propose the Hierarchical Cross-Attention Network (HCANet), which incorporates a novel hierarchical cross-attention mechanism in both geometric matching and try-on stages. This approach effectively captures long-range correlations between the person and clothing, resulting in highly realistic virtual try-on outcomes. In [3], Fele et al. present C-VTON a context-driven virtual try-on network that addresses challenges like pose variations and self-occlusions. By utilizing a geometric matching procedure and a context-aware image generator, C-VTON produces photo-realistic and visually convincing results, outperforming existing methods on the VITON and MPV datasets. In [4], Yu et al. introduce the Smart Fitting Room a one-stop framework that combines retrieval-based and generative methods to provide a personalized virtual try-on experience. The system integrates a hybrid mix-and-match module and an enhanced virtual try-on module, delivering high-quality try-on effects and personalized fashion recommendations. In [5]. Karn et al. explore the application of style transfer techniques in virtual try-on systems Their approach leverages style transfer to map clothing styles onto target images, facilitating realistic virtual try-on experiences without the need for extensive datasets. In [6], a study focuses on virtual try-on technology tailored for videoconferencing scenarios. The proposed system emphasizes temporal consistency to ensure stable and realistic virtual fitting experiences during live video interactions, addressing challenges unique to real-time applications. In [7], The VR Designer application, discussed enhances fashion showcases through immersive virtual garment fitting. By integrating virtual reality technologies, it offers high-quality garment-avatar simulations, providing designers and consumers with an interactive platform for virtual try-ons. In [8], Recent advancements have focused on improving the realism and efficiency of VTO systems. The "Mobile Fitting Room" project introduced an on-device diffusion-based VTO system, addressing challenges like high-quality

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garment placement and model compression for mobile devices. Yu et al. (2024) proposed the "Smart Fitting Room," a matching-aware VTO framework that combines retrieval-based and generative methods to offer personalized try-on experiences. In [9], The evolution of virtual try-on (VTO) systems has significantly impacted the fashion and retail sectors, especially with the increasing reliance on e-commerce platforms. Recent research efforts have concentrated on enhancing the realism, adaptability, and user experience of these systems. In [10], Song et al. (2023) provided a comprehensive survey on image-based VTO systems, analyzing state-of-the-art techniques and highlighting future research directions. Additionally, a systematic review by another study synthesized findings from 69 research articles, identifying key factors influencing consumer behavior and adoption of VTO technologies.

4. System Architecture

The architecture of the proposed Virtual Mirror system is structured into three primary layers: Frontend (Client-side), Backend (Server-side), and Database (Data Storage). Each layer is designed to handle specific responsibilities to ensure a smooth and interactive virtual try-on experience

4.1. Frontend: ReactJs

- **Component-Based UI:** The user interface is built using ReactJS, which allows the application to be modular, scalable, and responsive. Individual components are used for different features such as camera interface, garment selection, user profile, and the virtual try-on view.
- **Camera Access & Live Feed Rendering:** The application utilizes the browser's media device API to access the user's camera in real-time. This live feed is rendered onto the UI, enabling users to view themselves on screen as they virtually try on different garments. Real-time rendering ensures an immersive and realistic fitting room experience.

4.2. Backend: Node.js

- **REST API Services:** The backend is developed using Node.js and exposes RESTful APIs to facilitate communication between the frontend and the database. These APIs handle user authentication, garment data retrieval, and session management.
- **Session Management:** The system employs secure session handling to manage user interactions during login, garment selection, and try-on activities. Middleware such as JWT (JSON Web Tokens) or Express-session is used to maintain authenticated sessions and ensure data integrity.

4.3. Database: MySQL

- **User Profiles:** MySQL stores user-related data, including login credentials, personal preferences, and historical try-on information. This helps in providing a personalized experience and in maintaining user-specific analytics.
- **Garment Metadata:** The database maintains detailed metadata of garments such as size, colour, type (e.g., shirt, dress, jacket), brand, and image overlays used for virtual try-on. This metadata allows the system to filter and display relevant clothing options dynamically based on user preferences and fit recommendations.

5. Implementation Details

This project was built step-by-step using easy-to-understand tools and technologies. Here is how it works:

5.1. Frontend (User Interface) – ReactJS

- We used ReactJS to create the website where users can try on clothes.
- Webcam access is added using a tool called react-webcam, so users can see themselves live on screen.
- Clothes are shown on the body using Canvas or WebGL, making it look like you are wearing them in real time.

5.2. Backend (Server) – Node.js

- Node.js runs the server, which connects the website to the database.
- It provides APIs to:
  1. Log in and sign up
  2. Show available clothes
  3. Save the try-on history
- JWT (JSON Web Token) is used to keep user login secure.

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5.3. Database – MySQL

- MySQL is used to store all the important data like:

1. User accounts
2. Clothing items
3. Try-on activity logs

6. Results

To validate the functionality and effectiveness of our Virtual Mirror system, we developed a complete web-based prototype that includes user authentication, image input, and virtual costume try-on features. Below are the main interfaces and their functionalities:

6.1. User Authentication Interface

- **Login and Sign-up Pages:** The system incorporates secure user authentication mechanisms. New users can register via the sign-up interface by providing their name, email, password, date of birth, and mobile number. Registered users can log in using their email and password. The interface is designed with a modern UI, ensuring a user-friendly experience (Figure 1 and Figure 2).

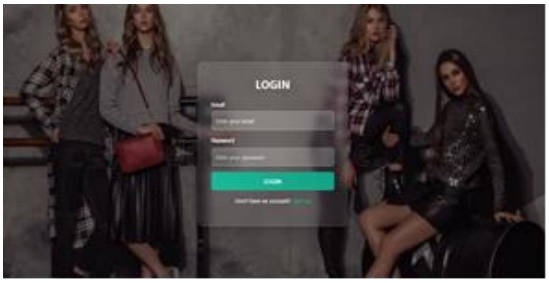

Figure 1 Login Screen with A Sleek Background for Fashion Appeal.

Figure 2 Sign-Up Screen Requesting User Details for Personalization.

6.2. Virtual Try-On Interface

After successful login, users are redirected to the Virtual Mirror Studio, which is the core functionality of the application. This interface includes a live camera feed where users can try on virtual clothes in real-time.

- The clothing gallery is displayed on the side, allowing users to browse and select different outfits.
- The studio includes three main control buttons:

Reset: Clears the current overlay and resets the camera.

Download Image: Allows the user to save a snapshot of the virtual try-on.

Figure 3 Virtual Mirror Studio Displaying the Clothing Gallery and Functional Buttons (Reset, Download Image, Log Out) Alongside the Live Camera Feed

6.3. Image-Based Try-On and Fine-Tuning Interface

In addition to real-time webcam usage, users can upload their image and apply virtual costumes manually. This interface allows users to fine-tune costume alignment using interactive sliders:

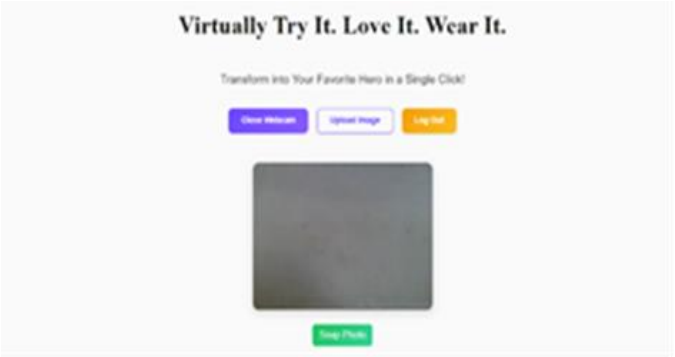

Figure 4 Interface for Image Input Via Webcam or Upload, With A Live Preview and A "Snap Photo" Feature for Capturing User Input

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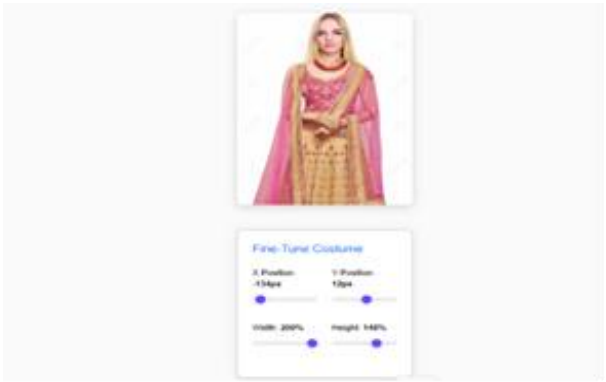

Figure 5 Overlay Interface Where Users Can Adjust the Position and Scale (X, Y, Width, And Height) Of the Virtual Costume to Achieve Accurate Alignment

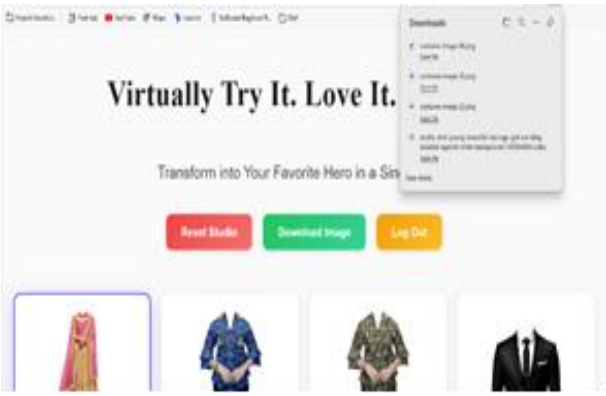

Figure 6 Final Overlay Interface Showing the Applied Costume with A Download Option to Save The Generated Try-On Result

7. Future Directions

There are many ways to improve the Virtual Mirror system in the future:

- **3D Clothing Models:** Integrating 3D clothing models into a virtual try-on system significantly enhances realism by allowing users to view garments from multiple angles with depth and texture. Using technologies like WebGL and Three.js, designers can load and render 3D garment files in formats like. glb or .obj, which simulate the natural drape, stretch, and movement of fabrics on the body. When paired with real-time body tracking or pose estimation, these 3D clothes adjust dynamically to the user's movements, offering an immersive experience. This not only improves user satisfaction but also helps potential buyers understand how the clothing will look and feel in real life, reducing returns and increasing purchase confidence.
- **AI Recommendations:** AI-powered recommendation systems can transform the virtual try-on experience by offering personalized clothing suggestions based on the user's style, size, body shape, or past interactions. Leveraging machine learning algorithms such as collaborative filtering, decision trees, or deep neural networks, the system analyzes user behavior, preferences, and even visual data to predict and suggest items that are likely to appeal to each individual. For example, a user who frequently selects minimalist styles in neutral tones may be recommended similar items in future sessions. This personalization not only saves time but also enhances user engagement and significantly boosts conversion rates by aligning with the shopper's unique fashion sense.
- **Gesture Control:** Gesture control adds an innovative, hands-free interaction layer to virtual try-on apps, allowing users to navigate, switch outfits, or zoom in on details simply by moving their hands or body. By incorporating gesture recognition libraries such as MediaPipe or TensorFlow.js Hand Pose, the app can detect and respond to gestures in real-time through the device camera. This feature is particularly useful in public settings—like malls or retail kiosks—where users may prefer not to touch shared surfaces. It also enhances accessibility, offering a convenient alternative for users with mobility issues, and adds a futuristic, game-like feel that makes the experience more engaging and memorable.
- **Mobile App Version:** Creating a mobile app version of the virtual try-on platform using React Native allows users to access the experience on the go, making it convenient and accessible anytime, anywhere. React Native enables developers to build high-performance apps for both Android and iOS using a single codebase. This app can utilize the phone's built-in camera for real-time try-ons and integrate seamlessly

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with sensors, voice control, or gesture recognition for a richer experience. With cloud integration, user profiles, preferences, and history can sync across devices, allowing users to continue their shopping journey from where they left off. A mobile app opens opportunities for shopping on the move, whether at home, in-store, or while traveling.

- **Voice Commands:** Voice control introduces a highly accessible and intuitive method of interaction, enabling users to operate the virtual try-on app using spoken instructions. By integrating technologies such as the Web Speech API or Google Speech-to-Text, the app can recognize natural language commands like “Try on a red jacket” or “Show me more casual outfits.” This hands-free feature is especially valuable for users with visual impairments, physical disabilities, or anyone seeking a faster, touchless experience. Voice interaction makes the try-on process feel more conversational and personalized, breaking down barriers and allowing a wider range of users to enjoy the benefits of virtual fashion technology, shown in Figure 1 to 8.

Conclusion

The Virtual Mirror is a smart system that allows users to try on clothes virtually using a live camera and digital clothing overlays. It improves the shopping experience by making it faster, cleaner, and more convenient, removing the need for physical trial rooms. Customers can make quicker decisions, and stores can reduce returns and save display space. It supports both online and in-store use, making it accessible to more users. In the future, it can be enhanced with AI for size suggestions, AR for realistic effects, and gesture or voice controls, offering a more accurate and engaging virtual try-on experience.

Acknowledgements

The authors would like to express their gratitude and respect towards Mr. Ketan Jadhav, Department of Computer Science and Engineering, YSPM’s YTC Faculty of Engineering, Satara for timely advice, suggestions, and regular assistance in our project work.

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