International Journal on Science and Technology (IJSAT)
E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Virtual Trail Room: A Comprehensive Literature Survey

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Abstract

A virtual trial room system is what this paper intends to introduce. Using this, digital and real-time clothing try-on will be made possible through computer vision integrated with webcam functionality. Advanced computer vision algorithms will be used for detecting and tracking landmarks in a body, allowing for a precise overlaying of virtual garments, whose fitting would indeed be dynamic with the actual movement of the person making the purchase. Unlike specialized hardware-dependent systems, this solution is accessible at a wide range of levels and works effectively with a standard webcam. The innovation addresses some of the biggest online retailing problems, such as uncertainty about clothing fit, by providing an interactive and accurate visualization of garments. The real-time system's ability to simulate fit will also lead to increased customer satisfaction but will also have the potential to reduce product returns as well as improve the overall efficiency of e-commerce platforms. The proposed solution leverages readily available technology to effectively bridge the chasm between a world of physical shopping and online-based shopping, therefore opening up opportunities for improved consumer engagement in the fashion retail sector.

Keywords: Real-time try-on, Body landmark detection, Online retail Solutions, Digital fashion retail, Accessible Technology, Consumer Engagement, Shopping Experience Innovation

1. Introduction

In the last couple of years or so, shifts in the retail sector have significantly facilitated online purchasing for clothes sitting in their homes. However, the one problem still persists: shoppers cannot try on clothes to experience fit, style or look, which is by itself a challenge. This aspect becomes a factor contributing towards high returns in fashion shopping over the internet that impacts the customer and the retailer alike. Virtual trial rooms now promise to fill in the gap, as they enable users to virtually try clothes that might fit or look good on them. Virtual trial rooms use computer vision, augmented reality, and 3D modelling, to simulate an in-store experience for the customer, as a means to enable more confident buying while avoiding return rates.

The purpose of a virtual trial room is to serve customers through an engaging, interactive experience that enhances online shopping. Virtual trial rooms offer a "try before you buy" kind of opportunity, showing users how fit or style would look without physically touching the items. These systems also offer suggestions, changes in size, and options for customization. This is really fun and pleasurable because it fits them according to individual preference. Virtual try-on can increase sales and minimize return for those selling online because it ensures the virtual fitting is more accurate and satisfies the expectations of the customers more often.

From various technologies invented for virtual try-on, the approach using OpenCV and a webcam appears to be practical and accessible for small business or web-based applications. Unlike other advanced augmented reality systems, which are highly dependent on complex hardware or special devices, the OpenCV virtual trial room can be supported by a cost-friendly technology using a webcam, hence making it accessible and relatively easy to apply. OpenCV is one of the most widely used computer vision libraries, which makes the application feed the user's live video into it for the feature detection of their body; hence, real-time overlying with virtual clothing became possible. Such an approach would open virtual trial room functionality to a broad range of users, since it would not depend on any specialized hardware. This makes it especially relevant for the smaller e-commerce platforms or startups that are looking for an affordable yet effective solution.

The need for such a virtual trial room is quite obvious. Customers might have been heard complaining about the hassle of purchasing clothes without getting proper fitting at the store. There's nothing worse than a bad size or fit those results in multiple returns, which gets expensive for merchants, and disappointing for customers. Virtual trial rooms directly solve the problem by enabling users to make better decisions in advance by putting virtual clothing images on their own images. Besides, the facility of adjusting clothes, making size recommendations, and giving styling advice makes this searching time not only truer but also personalized and fun. The webcam-based trial room model because of its affordability opens this scope to a greater audience, makes it an ideal choice for those who want to offer a sophisticated user experience without a massive investment in costs.

This paper literature review will take all kinds of VR trial room types and the various technologies used in them - AR, 3D body scanning, AI stylists, MR - in an effort to put into context what would work and what wouldn't and against which background. The focus will then turn to the OpenCV and webcam-based system model in more specifics on its pros and cons as well as its potential application in retail. In doing so, the system model structure - the user interface, input processing, and virtual overlay modules of the clothing application - will describe how this approach supports real-time, interactive try-ons. Furthermore, the review will analyse existing studies and technologies that have shaped the development of this model; identify areas

where further improvements could enhance the user experience and increase functionality.

the OpenCV-based virtual trial room as a successful solution for an important problem in the fashion retail sector. It explores how, by taking both the technological landscape and the specific requirements of the model into account, a better understanding can be developed of how virtual trial rooms contribute

toward bridging the gap between physical and digital buying experiences. This research would thus provide a foundational support structure in developing user-friendly scalable virtual trial rooms that are not only beneficial to consumers but also to retailers.

2. Methodology

3.1.1 Virtual Dressing Room Application with Microsoft Kinect

Aladdin Masri and Muhannad Al-Jabi et al. [1] proposed a virtual dressing room application uses Microsoft Kinect technology to take the user's physical measurements and create a virtual dressing experience. In order to achieve precise positioning, scaling, and rotation of 2D clothing models and to align virtual clothes on the user's body in real time, the system uses Kinects to detect body positions based on RGB data and skeletal tracking depth. The program uses a C#-based WPF interface to merge all of these elements. The user can choose, resize, and virtually "try on" clothing thanks to the interface's user-friendly functionality. Using skeleton joint alignment, skin colour identification, and depth data, this technique creates an effective simulation that makes the try-on seem more realistic

3.1.2 Virtual Dressing Room Implementation Using Body Image – Clothe Mapping

Ahmad al-Qerem et al. [2] proposed a dressing room is simulated through holography and image processing. A holographic framework prevents positioning errors while applying clothing over the user, maps the digital clothing onto the body using front and back views, and captures the user's body image and key locations. It only selects suitable body parts within the holographic field to enhance fitting apparel. The digital image processing techniques are used for clothes overlays' modification, and the process of calibration at the fitting provides an extremely lifelike experience for the user while trying on.

3.1.3 Virtual Fitting Room Technology in Fashion Design with AR and 3D model

D Werdayani and I Widiaty et al. [3] proposed a the "Virtual Fitting Room Technology in Fashion Design" relies on 3D modelling and augmented reality to enable the customers to experience virtual try-on. In this approach, two- and three-dimensional virtual objects are overlapped on the real world through a webcam or Kinect sensor, thus making users see clothes overlays on their bodies in real time. Besides displaying the models wearing clothes that fit several different body measurements, the device also utilizes AR features through its ability to superimpose clothing items on a live video stream and to offer sizing advice. Further, Kinect's bone tracking is also used by the application to achieve accurate body measurements that may be helpful in coordinating virtual clothing with the motion of the user and create an exciting as well as dynamic shopping experience.

3.1.4 3D Virtual Dressing Room Application with Microsoft Kinect

Sachin Guldagad, Shrinath Aengandul, Lemadevi Thakare, Shivam Thakare et al. [4] proposed the application utilizes the following technologies: Microsoft Kinect, skeleton tracking, depth sensing, and gesture recognition. The application is developed using the C programming in which it relies on the middleware for real-time tracking and utilizes three streams of data that the Kinect system generates: image stream, depth stream, and audio stream with which it captures the body measurements and movements of the user. The system also uses skin colour detection to overcome occlusions and align 2D clothing models with the user's 3D body.

The team has developed a system through which people can try on clothes virtually in their 3D Virtual Dressing Room project using Microsoft Kinect. The Kinect captures the video streams and detects the skeleton of the user through skeleton tracking which provides the joint positions to align the clothing models precisely with the body of the user. Using the depth sensing capability of Kinect, the system will generate a depth map which shall have proper fitting with no occlusion. It will further be refined using the skin colour detection module to mask unwanted parts of the video feed. The system uses gestures from the user-such as swiping or raising their hands-to accept and choose clothes in the virtual world. Overall, the system allows the wearer to try clothes virtually in real time, so it is far more dynamic and customized to the wearer, and so does not require any trial and error for physical fittings.

3.1.5 VIRTUAL TRAIL ROOM 2D image analysis using deep learning and machine learning
Harish Kumar Jagadeswaran, Janarthanan et al [5] proposes this project and applies technology in analysing 2D images using deep learning and machine learning techniques. In specific applications, Convolutional Neural Networks (CNN) applies to object recognition and size prediction with a Random Forest classifier.

This system was conceptualized in utilizing 2D images obtained from smartphones to create an estimate of human body measurements and predict a clothing size. The system uses CNN to pick up and segment the body from the images captured and then extracts essential features needed for the computation of the measurements of the body. Images are captured and processed to pick out focal points from the body such as waist, shoulders, and hips to produce size data. This data is then passed to a Random Forest classifier, which makes predictions on what may be the most accurate clothing size for the user given their measurements. Then, the sizes charts from the various clothing brands will be compared to pick the perfect fit for the user, thereby facilitating smooth online shopping without necessarily requiring complex 3D body scanning technology.

3. Comparative Analysis of Detection Methods
Below is a comparison table summarizing the methodologies, strengths, and limitations of existing techniques, providing context for the advantages of our approach.

Paper title	Methodology	Strength	Limitation
Virtual Dressing Room App	Kinect, C# & WPF	Real-timetracking & alignment	Limited options; Kinect needed
Virtual Dressing Room Implementation Using Body Image– Clothe Mapping"	Image & Holography	Requires precise body Celebrity	Requires precise body positioning and calibration for optimal garment overlay

"Virtual Fitting Room Technology in Fashion Design"	Augmented Reality (AR), 3D modelling, Kinect	Interactive try-on experience with AR superimposition and skeletal tracking	Potential issues with real-time scalability and limited adaptability to complex backgrounds and lighting
"Virtual Dressing Room Application"	Microsoft Kinect with skeletal tracking, C#	Real-time body tracking and seamless clothing overlay using depth and RGB data	Hardware dependency on Kinect and computational requirements for skeletal mapping
"Virtual Dressing Room Using Augmented Reality and Computer Vision"	Augmented Reality (AR), OpenCV, Python, Pose estimation	Enables virtual try-on with high accuracy using OpenCV for pose detection and AR visualization	Limited scalability in dynamic environments with diverse lighting and background conditions
Proposed Approach: Interactive Clothing Try-On System with OpenCV for E-Commerce approach	OpenCV + Pose Estimation + 2D Image Overlay+ Real-Time Video Capture + Body Landmark Detection+ Media pipe + Feature Matching	Affordable, accessible with basic hardware like a webcam, real-time responsiveness, and user-friendly interface	Affordable, accessible with basic hardware like a webcam, real-time responsiveness, and user-friendly interface

4. Proposed Methodology:

Interactive Clothing Try-On System with OpenCV for E- Commerce approach

4.1 Approach Overview

In the Virtual Trial Room with OpenCV and Webcam project, you may employ many techniques and methods to accomplish effective and realistic results. The key methods and approaches that you can consider follow below.

1. Body Detection Using Computer Vision Techniques

- Pose Estimation: To correctly align virtual clothing to an individual, the system should be able to detect key body landmarks such as shoulders, torso, arms, and legs. OpenCV with the aid of libraries like Media pipe or Open Pose can catch these human body parts by estimating a user's pose, hence making virtual clothing align with the real position and movement of the user.

This will enable the system to observe the silhouette of the user and cut it from the background, which is critical for better alignment of virtual clothing around that body. For this, one can use background subtraction, chroma keying, or even semantic segmentation from pre-trained models.

2. It involves OpenCV-based real-time video processing:

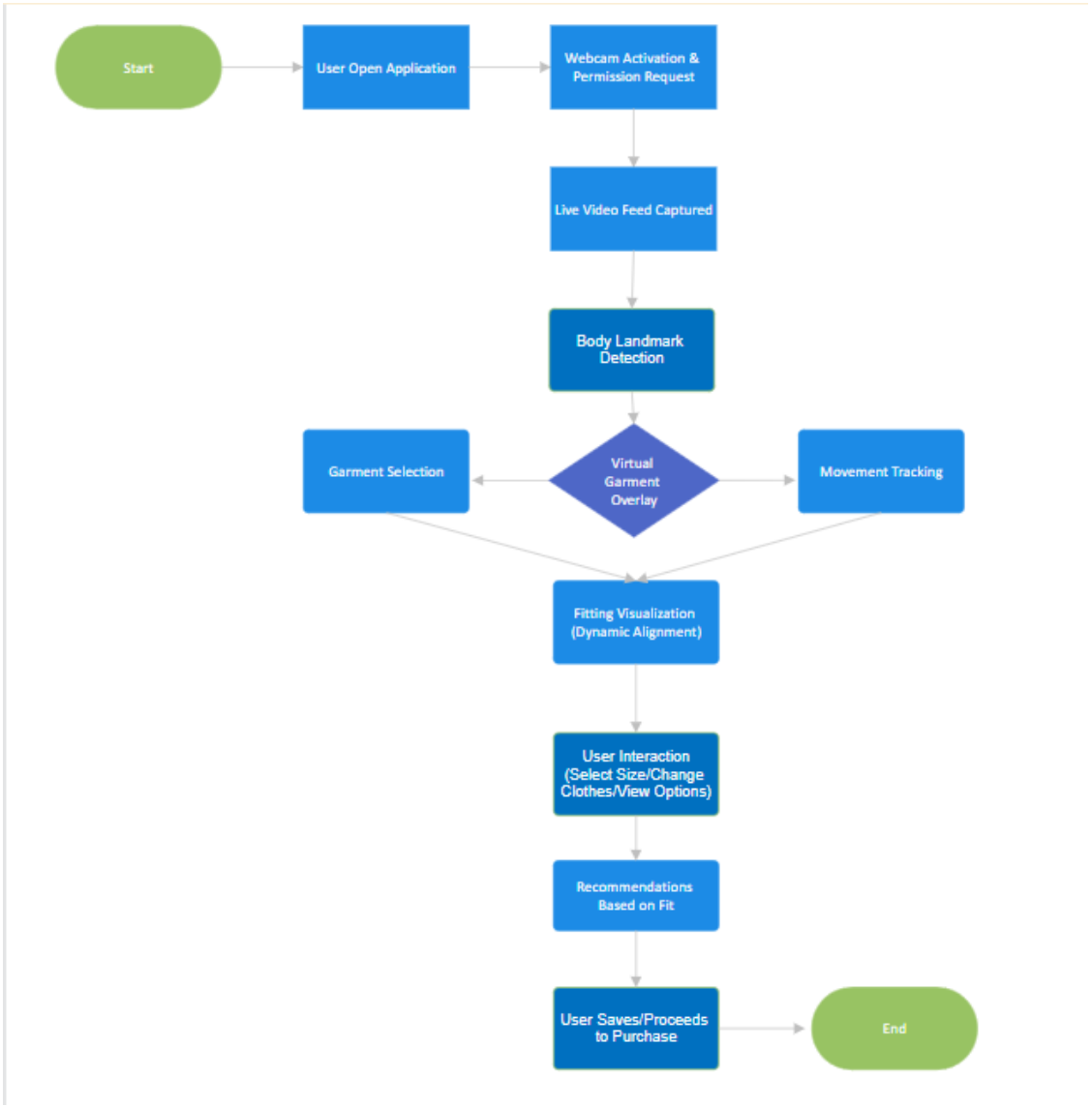
- Real-Time Video Capture and Analysis: The application makes use of video capture functionalities from OpenCV to create a live feed from the user's webcam, and then captures frames that are processed in real-time to apply virtual clothing overlays. The approach thus maintains responsiveness, an essential requirement for a natural try-on experience.
- Edge Detection and Contour Analysis: In order to improve the fitting and placement of clothing, edge detection such as OpenCV Canny Edge Detection can be employed in the body for the analysis of contours of that body. This will help in improving the good looks with which the pieces of clothing fit- especially some individual items, which would need accurate alignment such as t-shirts or pants.

3. Clothing Overlay and Fitting Mechanism

- 2D Image Overlay Techniques: Clothing images are overlaid correctly on the user's image. Scaling and rotation as well as translation transformations are used depending upon the body dimensions as well as the movements of the user to fit the clothing images in real-time. The clothing images can be warped using affine transformations so that they fit perfectly with the pose of the user.

Clothes will be resized dynamically to fit the user's body proportions by determining key landmarks on the body and make use of ratios of width, height, and landmark positioning to make sizing adjustments that won't disrupt fit among different users.

- Auto Size Suggestion: Based on the body measurements retrieved from the video feed, it will suggest the ideal size for the user. For instance, how the breadth of the body and torso's length can be used in order to determine more accurately whether a small, medium, or large size fits appropriately gives an ideal fit to the user.



4. User Interaction and Feedback System

- Interactive User Controls: Users need to select any types of clothes, resize items, and capture screenshots. Simple buttons or sliders in the UI can allow users to change their clothing items, adjust sizes, and enable/disabled other options, such as music on/off.

- Voice and Textual Feedback: Providing users with feedback in real-time may involve usage instructions or fitting tips, which makes the experience more engaging. Use of audio prompts like telling a user to stand in a certain position helps make the virtual trial process much smoother.

5. Optional Enhancements and Add-ons

Screenshot Capture with Save Functionality-Giving the users the functionality to capture a screenshot of themselves with the virtual clothing can add value so that it could be saved and shared.

Styling Suggestions and Advice -It should be able to provide styling suggestions or complementary pieces of clothing based on a body proportion analysis.

4.2 Comparative Advantages Over Existing Approaches

1. **Cost-Friendly Deployment:** It requires just a standard webcam and OpenCV for high-end AR or 3D scanning-based try rooms, making it extremely cost-friendly for small enterprises and especially for small e-commerce firms. Platforms smaller in size are now able to offer virtual try options without any investment in niche hardware or software because of easy access due to reduced cost barriers.

1. **Usability and Accessibility:** Generally, a person can easily access their webcam by clicking on the webcam of the laptop or computer. In general, virtual garment fitting is a pretty easy tool for most people to try. It doesn't require any special AR/VR gear, which is an advantage for reaching the mass population and making the product look appealing so that people use it more often. Customers can easily choose and resize with simple interfaces that are user-friendly.

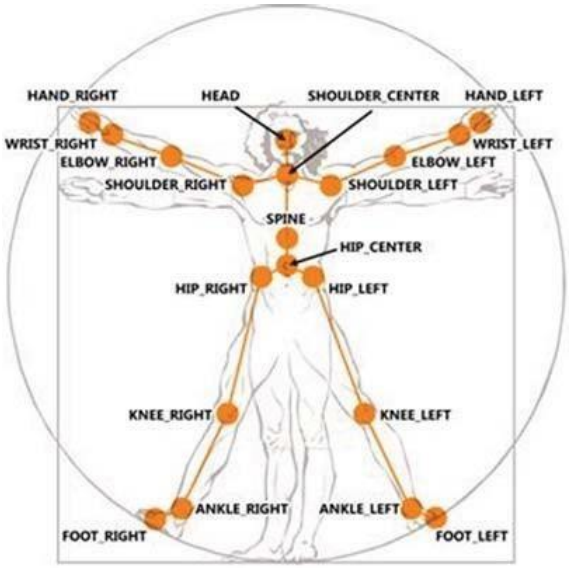
2. **Response Time in Real Time:** Effective real-time video processing by OpenCV has also made it possible to develop smooth, responsive virtual try-ons. Since the experience will be totally seamless and clearly coordinated with the user's motions due to fast identification of body landmarks, modification of clothing overlays, as well as transformations in real time, the experience is quite responsive and quick in reducing lag, hence more realistic and engaging.

3. **Flexibility in personalization and expandability:** It is also possible to have very high levels of customization with the OpenCV-based system, as well as provide options for various clothing pieces, and it also comes with the facility of resizing capabilities, along with other things such as music or screenshots. This is also scalable because it's not too hard to add new features or clothing categories. Thus, it is very malleable for firms that might want to expand their product lines over time without having to make such drastic changes.

4. **No need for Specialized Hardware:** This may also limit adoption to the fact that existing AR and body scanning virtual trial room techniques tend to be highly dependent on expert technology like depth sensors, Kinect, or 3D cameras. Removal of such prerequisites increases the accessibility and usability for a wide range of users by making the solution available to any user with a computer or mobile device that has a standard camera.

5. Application

1) **User Positioning** - In order for the body model to be traced accurately, the user is required to stand at the back with the webcam interface. It makes it possible to position the virtual clothing overlay correctly.



2) **Body Analysis** - With the help of the built-in webcam, as well as the OpenCV integrator, who covers all the measurements, regions of the upper body are scanned in motion such as shoulders and trunk, and distance metrics are utilized to center the three-dimensional image of the clothes on the body.

3) **Usage Hints** - The program offers instructions to assist the user in operating the application in virtual experience points and audio hints inform the user about the correct position of the head during the process.

4) **Wardrobe Choices** - A rich assortment of clothes from different categories, say, dresses, shirts, or pants, is available for the user to view and "try" on virtually.

5) **Item Surfing** - After selecting a particular site, the user ransack the catalog of available items that can be applied to the user picture.

6) **Fit Perfectly** - As the virtual garments do not have the user's measurements, the program assures the user that different pieces of clothing can be resized accordingly. In this way, users do not have to search for appropriate sizes. The system automatically determines sizes based on the retrieved body parameters detected and saves the user's time.

7) **Style Suggestions:** The system offers suggestions regarding how different parts should be assembled. Options and Features: The interface offers options for further customization, adjustments, or additional settings.

8) **Snapshot Option**: The application allows users to capture an image of themselves in the virtual clothing, making it easy to share or review

9) **Clothing Removal:** To switch outfits, users can press a button to remove the current virtual clothing and select a new piece, streamlining the try-on experience

6. Conclusion

The virtual trial room on OpenCV and Webcam revolutionizes the experience of online shopping by providing a cutting-edge, user-friendly solution that addresses some common problems like improper fitting and the high return rates resulting from the inability of customers to visualize clothing fit beforehand. A bridge between the physical and digital aspects of retail is offered through a system allowing customers to try out the wear over their screens with the aid of computer vision technology. In return, the satisfaction provided for the customer by this trial room includes one way through it a pictorial catalogue of all the available garments, size recommendations, and customizable attributes in keeping with individual preferences.

In addition, the project provides considerable benefits for both end-users and businesses operating on the e-commerce platform. Its low-cost implementation makes it affordable for retailers but has a scalable capability to meet any range of needs in an online marketplace. Reducing return rates and improving accuracy in product selection benefit consumers. Business operations can be optimized, and it is very effective. This would assist in creating higher engagement with the customers and contribute to loyalty and retention in the competitive landscape of e-commerce. Finally, the Virtual Trial Room marks a step forward toward improving the convenience, efficiency, and attractiveness of online shopping in general thus being an excellent contribution to the digital retail ecosystem.

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