IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 5, April 2026
Impact Factor: 8.2

Transplant Track: Virtual Try-On Enabled E-Commerce System Using AR

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Abstract: *Online shopping is now a part of our lives, and there is still one issue that cannot be overcome yet, customers cannot.in fact can sample goods before purchasing. This tends to cause confusion with size, style and appearance and leads to disappointments and returns. Our project presents a solution to this issue; it suggests an E- Commerce platform that is created with an Augmented Reality (AR) Try-On functionality. Under this system, the user is able to use his or her phone or laptop camera to have a virtual test of something such as clothes, eyewear or anything else accessories in real time. The platform is based on AR and computer vision technologies that place 3D product models properly on the user, to give a realistic perception of the product appearance on the user before purchase. Alongside this feature, the site also offers everything a good e- commerce site should offer such as recommendations, shopping cart, product catalog secure check-out and integration of payment. This project will facilitate a blend of the comfort of the internet shopping and the assurance of a trial in a physical store enhance customer satisfaction, lower the rates of returns, and demonstrate that AR is able to change the future of ecommerce..*

Keywords: AR Virtual Try-On, E-Commerce, Computer Vision, 3D Visualization, AR Retail

I. INTRODUCTION

Convenience and the ability to access the online shopping platforms have made the online shopping platforms a dominant channel of retail. Regardless of this expansion, the customers tend to have reservations regarding buying fashion products, as they are not able to test them physically to determine the fit and look. This shortcoming helps to enhance high rates of products returning and customer dissatisfaction.

AR allows interactive visualization through the application of virtual objects on the real settings. The virtual try-on technology enables users to visualize the products prior to making a purchase by use of a camera. The proposed research is grounded on the idea of a scalable AR-based virtual try-on system and e-commerce platform, which will improve decision making and user experience.

Main Contributions:

- AR web platform try-on system.
- Flask display implementation with 3D.
- Scalable architecture Lightweight.
- E-commerce was improved through decision-support.

II. RELATED WORK

The initial virtual fitting solutions were based on a static overlay and a marker-based AR system, which was not realistic and usable. Deep learning pose estimation, avatar-based fitting rooms, and mobile AR applications are used in recent research. Despite the enhanced interaction of these systems there are still problems of accuracy of interaction,

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computational cost, realism of cloth simulation and compatibility with devices. The system proposed is concerned with lightweight pose estimation and the rendering on a browser to enable scalable deployment on devices.

III. SYSTEM ARCHITECTURE

The suggested system is based on the layered architecture that includes frontend interface, backend services, computer vision processing, 3D render, and data storage.The frontend was developed in HTML, CSS and bootstrap, which offers product surfing, authentication and interaction with the camera. The Flask backend is an application logic management, user data, and product management system. The computer vision layer identifies the body landmarks with the method of pose estimation. The rendering layer brings the 3D product models and superimposes them on the live camera view. Product metadata, the 3D assets, and interaction logs are stored in the data layer. This scalability and real-time performance is provided by this modular design.

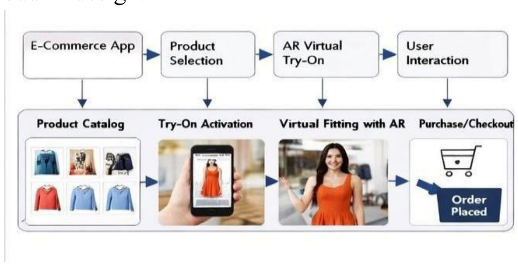

Figure 1: Virtual – Try System Architecture

IV. PROPOSED METHODOLOGY

The process of a virtual try-on starts with the choice of products and the activation of the camera. Body or facial landmarks are extracted in the input stream in the form of pose estimation. The retrieved and aligned 3D product model is based on the landmarks detected.The functions of transformation manipulate position, scale, and orientation and render the end AR image. The visualization has features of resizing, rotation and capture, by which users can interact.

V. MATHEMATICAL MODEL

Let:
U represent the user image
L denote the identified landmarks. P represent product model
T are parameters of transformation. R represent rendered output
The landmark detection function denotes a feature of the system that enables identifying the locations of particular characteristics the image. Landmark Detection Function The landmark detection function refers to an aspect of the system that allows locating the location of specific features within the image.

$$L = f(U),\ T = g(P, L),\ R = h(P, T)$$

Where:
f = pose estimation model
g = resistance of alignment and scaling operation
h = AR rendering engine
E = S Lpredicted [?] Lactual 2
This would guarantee proper positioning of virtual products.

VI. DATASET DESCRIPTION

This data will be product images, 3D products, and landmark annotated data. The datasets of products consist of clothing, eyewear, jewelry, and footwear models in the standard 3D formats. The pose estimation datasets offer body

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keypoints annotations that are used to train alignment. Further, the user evaluation dataset is gathered that has the try on sessions, feedback score and performance measures. Preprocessing of data also involves image resizing, optimization of 3D models, and normalization of landmarks so that they have steady execution all around.

VII. Implementation

This system is applied in HTML, CSS, and Bootstrap on the frontend and Flask on the backend processing. REST APIs can be used to communicate between modules. AR libraries on browsers are used to render three- dimensional model products and have the ability to transform and overlay in real- time. The system resists various product divisions and preserves devices performance using lightweight calculations.

(a) Product Display (b) AR Try-On View

Figure 2: Output Image

VIII. RESULTS AND DISCUSSION OF THE EXPERIMENT.

Alignments, rendering latency, frame rate and user satisfaction were used to test the system in both desktop and mobile devices. The findings indicate enhanced confidence in making purchases and interaction in comparison to conventional mediums. Under normal conditions, real-time visualization was obtained, but it is not as fast on low-end devices and with low lighting. The results demonstrate that AR- based try-on systems are viable to be used in real-life settings.

Method	Realism	Latency	User Experience
2D Overlay	Moderate	Low	Basic
3D Rendeing	High	Moderate	Good
AR-Based (Proposed)	Very High	Low	Excellent

Figure 3: Comparison on virtual-try

Evaluation Metrics in order to fully evaluate the performance of the suggested AR-based virtual try-on system, several quantitative and qualitative evaluation metrics were taken into consideration.

The fitting accuracy between the ground- truth and predicted keypoints was determined using landmark alignment error. The latency and the number of frames per second (FPS) was also tested to measure real-time performance.

DOI: 10.48175/568

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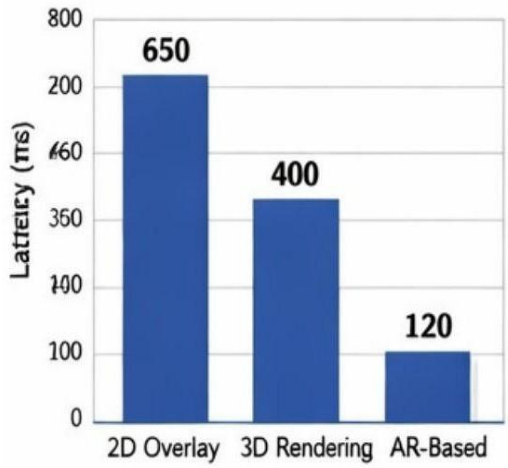

Figure 4: Latency Graph

Besides that, structural similarity and user perception ratings were also evaluated to determine visual realism and usability. All these measures are effective to make sure that the system is not only computationally efficient but also of high-quality virtual fitting to be used in practice as in e- commerce.

IX. NOVELTY OF PROPOSED WORK

The technical strength of the offered system is that it is a lightweight web-based system that enables the AR visualization to be directly implemented into an e-commerce workflow without any specific hardware. In contrast to a range of available solutions which may be based on the heavy model or avatar-based simulation, the suggested solution is based on the real-time landmark recognition with the help of the browser- based 3D representation that can be easily scaled up.

Novel Points

Lightweight model real-time AR try-on systems on the web. Combination of try-on and recommendation ready architecture. Scalable design which is not device-specific. Integrated graphic and decision support system. Real world application emphasis on actual retail

Uses and Benefits.

The system increases customer confidence, engagement, and reduces the returns. It facilitates customized shopping and competitive advantages to retailers. It has been used in fashion retail, eyewear, jewelry visualization, footwear fitting, cosmetic preview and immersive online marketplaces.

XI. LIMITATIONS

The system relies on the quality of cameras, the state of lighting and the capacity of the device. Simulation realism of cloths is still not easy, and the accurate size prediction needs more studies.

Future Work

The future features are AI-size prediction, physics-based cloth simulation, avatar-based try on, multi-user support, and immersive commerce environment integration. Low- end optimization and recommendation systems are the important areas of research.

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XII. CONCLUSION

The paper has introduced a Virtual Try-On Enabled E-Commerce System based on Augmented Reality to improve online shopping. The system is designed to provide a realistic view of the product prior to purchase through the implementation of computer vision, AR rendering and web technologies.

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