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Trylia: A Web - Based Virtual dressing System Using OpenCV, CVZone, and Machine Learning

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Abstract: This research paper introduces Trylia: Your Virtual Dressing Room system that helps the users to try on the clothes virtually before purchasing it and even on real time. This system uses their device camera for try on and the system for that selected cloth on user body and provide the size recommendation for that user if he/she is not sure about their cloth size alongwith the accuracy rate that tells the fitting rate of cloth on the user. This system uses camera vision, OpenCV, MediaPipe and more related python libraries. This feature helps the users for interactive online fashion visualization. It uses OpenCV for image processing and camera, CVZone to detect the human body keymarks. Also it tracks the human movements and for that cloth to the human body accurately. This system is so much useful and easy to use because it eliminates the use of 3D and online AI generated images. And it also provides the features of size recommendation and accuracy rate, which makes it more helpful for the users to use this system. This project is implemented as the full – stack web application which makes it smooth interaction to the user, fast processing and easy to use across all devices. It is user – friendly platform which enhances confidence since it is a combination of visualization, size recommendation and fitting accuracy rate.

I. INTRODUCTION

Our project Trylia: Your Virtual Dressing Room is a service based project which is a business to business service platform, means this system does not directly interact with the customers. This system is for the companies like amazon, flipkart, meesho etc. They are the real customer for our system, they contact with us and implement this service on their platform and then the customers uses this service when purchase clothes. Since it is not like the flipkart and amazon like companies which provides user a web based service , although we implemented our system also a web based for that companies so that they can view our platform online and see multiple things like a video on homepage demonstrating everything about our system, a try on feature to try, a reviews of companies who used this service before, about our Trylia and a contact us page. IN the try on the company should try this feature before taking any further steps and their's the feature of size recommendation and accuracy rate which makes it more featuring service along with the try on. Also it try on the clothe in real time by sung the device camera. The contact page have multiple fields which allows them to know them with more deep about this system. They can easily fill that fields like company name, company size, enquiry type, enquiry date, company url, a particular person's name, his mobile number and company's e – mail. After filling these details and submitting the company receives the completion e – mail notification and also our system will receive the e – mail notification from that company alongwith the filling details that they filled during enquiry submission form. After that they can take a metting and implements this service to their platform. Since the shifting to the online shopping has increased day by day so our system will help them to purchase and try before use it. Our main goal of designing this system is to decrease the return rate, since the return rate of online shopping is increasing everyday which becomes threat for the online shopping that's why we introduces our system to reduce that return rate. To fill this return rate gap , this paper represents the Trylia: You Virtual Dressing Room for the users to real time try on clothes using their's device camera.

II. LITERATURE REVIEW

Virtual Try-On (VTO) technology has become an essential component of modern online fashion retail, offering consumers a way to visualize garments digitally before making a purchase. Early VTO approaches relied heavily on static 2D overlays, but advancements in artificial intelligence, deep learning, and computer vision have enabled far more realistic and interactive solutions. Recent research highlights the growing emphasis on improving garment alignment, pose understanding, and personalized fitting to enhance user confidence in digital shopping environments [1,2,9].

A significant portion of VTO research focuses on body landmark detection, which provides the spatial cues needed to align garments accurately with the human body. Studies demonstrate that precise pose estimation is crucial for realistic fitting, as it directly affects scaling, rotation, and garment alignment quality [6,7]. Various pose detection frameworks have been developed, including deep learning–based systems such as OpenPose and AlphaPose, which deliver high accuracy but often require considerable computational resources. These limitations have encouraged the exploration of more efficient techniques and lightweight models suitable for real-time applications [7,8]. Researchers have also examined landmark-based fitting approaches that balance accuracy with performance efficiency, enabling VTO systems to operate smoothly on consumer-level devices [10].

Alongside pose detection, researchers have investigated garment alignment and transformation techniques. Earlier systems utilized 3D garment simulation to reproduce natural fabric behavior and deformation, but these methods were computationally expensive and unsuitable for real-time usage [6]. As an alternative, many researchers explored 2D image-based alignment using geometric transformations such as homography to warp clothing images based on detected body points [9]. Another line of research focuses on generative models, particularly Generative Adversarial Networks (GANs), which have demonstrated strong capability in producing realistic and body-aware garment overlays. Models such as VITON and other GAN-based architectures aim to capture semantic features of both garments and human bodies and generate highly realistic virtual try-on results [12,13]. However, these models often require large datasets, high-performance GPUs, and significant training time, making them impractical for lightweight or web-based VTO deployments [15].

Recent literature also highlights the growing integration of AI-driven systems in real-time VTO environments, especially when combined with augmented reality (AR) technologies. Several studies have explored the use of pose estimation, 3D garment models, and AR techniques to project virtual clothing onto users in real time [1,5]. These solutions are effective in enhancing consumer engagement but tend to be hardware-intensive and less suitable for scalable or low-resource implementations. Advances in AI have further expanded the scope of fashion technologies, covering clothing detection, recommendation systems, and realistic try-on methodologies [11]. Surveys emphasize the importance of improving dataset quality, garment representation, and fitting accuracy to achieve more reliable VTO performance across varying conditions [7,8,15]. Moreover, interactive recommendation systems that combine fashion suggestions with VTO previews have gained traction as a means of bridging online and in-store shopping experiences [18,19].

Another important dimension discussed in literature is consumer perception and behavioral response to virtual try-on systems. Studies indicate that user trust and acceptance depend heavily on system accuracy, visualization quality, and fitting realism [3]. Research also demonstrates that VTO experiences influence purchase intention and brand engagement, especially when integrated with AR or AI-driven visual enhancements [5,14]. This highlights the importance of designing VTO systems that balance technical performance with usability and psychological comfort.

In addition to visualization, recent works emphasize the need for accurate size recommendation systems to complement virtual try-ons. Machine learning approaches have been proposed to predict garment sizes based on user measurements, improving personalization and reducing return rates [16]. Combining VTO with measurement-driven size prediction is seen as a promising direction for improving the online fashion shopping experience and addressing fit-related challenges prevalent in the industry [20].

Overall, existing research shows significant progress in virtual try-on technologies but also reveals ongoing challenges related to real-time performance, computational efficiency, and accuracy of garment fitting. While deep learning and generative models offer high realism, they often lack the practicality required for lightweight web-based systems. This motivates the development of hybrid solutions—such as the one proposed in this work—that integrate efficient computer vision techniques with machine learning–based size recommendation to deliver an accessible, real-time virtual try-on experience without relying on high-end hardware.

Table1: Summary of Literature Review

Study	Key Focus	Technologies / Methods	Key Findings
Marelli et al. (2022) [1]	AI-based virtual try-on web system	MediaPipe, DL models	Demonstrates how pose estimation and AI enhance garment fitting accuracy and user experience.
Mohammadi & Kalhor (2021) [2]	AI in virtual try-on and fashion synthesis	AI, digital fashion, VTO	Highlights the role of scalable and efficient AI techniques in modern fashion technologies.

De Almeida (2021) [3]	Consumer acceptance of AI VTO	AI-based try-on, user studies	Emphasizes accuracy and system reliability as primary factors influencing user acceptance.
Dhatrak et al. (2024) [4]	Improving fit prediction	Deep Learning, AI VTO	Uses DL models to enhance precision in clothing alignment for improved comfort and fit.
Fenanda et al. (2024) [5]	AR-based beauty product try-on	AI, AR, VTO	Shows that AR-enhanced VTO increases buying intent and improves consumer engagement.
Mihăilă (2023) [6]	3D garment simulation	3D modeling, DL, face recognition	Focuses on realistic VTO using 3D simulation and expression-aware fitting.
Islam et al. (2024) [7]	Deep learning in VTO	CNNs, DL architectures	Offers a thorough review of deep learning methods and challenges in real-time VTO.
Goel et al. (2024) [8]	Review of VTO models	CNNs, VTO systems	Compares traditional and DL-based VTO methods, noting performance trade-offs.
Nawaz et al. (2025) [9]	Technology-enabled VTO services	Brand engagement, AR	Shows VTO's role in strengthening brand interaction and user purchase intention.
Hashmi et al. (2020) [10]	Personalized VTO with neural body fit	3D pose fitting, DL models	Introduces a neural-body-fit method for personalized and accurate garment overlay.
Aakash et al. (2024) [11]	AI-driven fashion technologies	AI, VTO, detection systems	Surveys AI applications in fashion from VTO to clothing detection and recommendations.
Ghodhbani et al. (2022) [12]	Virtual try-on clothing review	CNNs, image-based VTO	Discusses various 2D/3D VTO approaches, highlighting challenges in realism.
Samy et al. (2025) [13]	Realistic real-time VTO solution	DL, real-time processing	Proposes a real-time VTO system that improves fabric behavior and realism.
Bratu (2024) [14]	Digital try-on & body image	AI, AR, behavior analysis	Studies user perception and psychological impacts of digital try-ons.
Dharmani et al. (2024) [15]	VTO methodology enhancement	DL, dataset optimization	Examines dataset quality and methodological improvements for better VTO accuracy.
Gupta et al. (2024) [16]	ML-based realistic try-on	ML, AI, garment fitting	Shows how ML can improve realism and personalization in VTO systems.
Hsieh et al. (2019) [17]	Semantic-guided VTO	Semantic learning, 2D VTO	Integrates semantic understanding for improved garment-body alignment.
Vaishnavi et al. (2024) [18]	VTO with fashion recommendation	AI, fashion recommendation	Bridges online fashion retail with personalized suggestions and try-on tools.
Alzu'bi et al. (2023) [19]	Interactive 3D VTO	3D VTO, interactive systems	Enhances user experience through 3D-based interactive garment recommendations.

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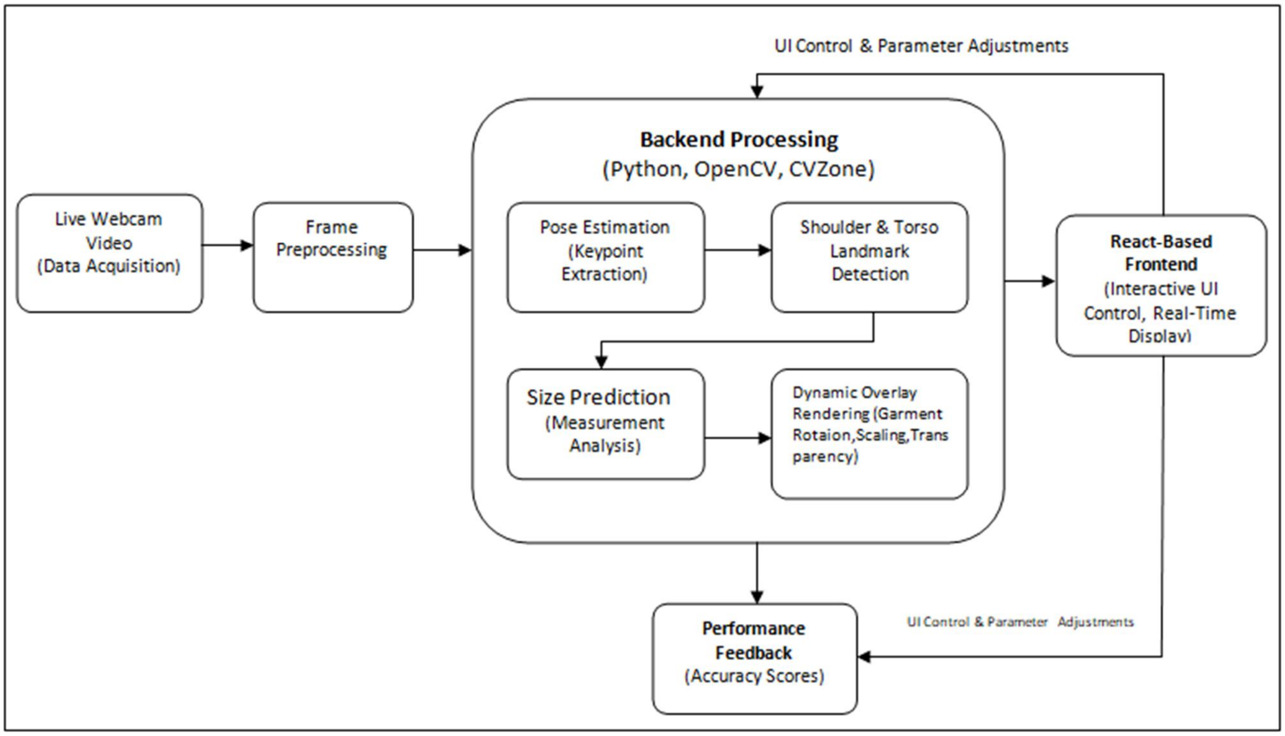
III. ARCHITECTURE



IV. RESULT ANALYSIS

The proposed Trylia virtual try-on system was evaluated to measure its performance in real-time garment overlay, body landmark detection, responsiveness, and user satisfaction. By using OpenCV and CVZone for landmark extraction and overlay alignment, the system was able to track major upper-body keypoints such as shoulders, torso width, and partial arm movement. This enabled the system to maintain a reasonably accurate garment position as users moved in front of the camera.

Overall, the system delivered consistent performance under typical indoor conditions and demonstrated stable real-time responsiveness suitable for everyday consumer use

Aspect	Details
System Description	Performs real-time webcam-based virtual try-on using OpenCV and CVZone for landmark tracking and garment overlay.
Keypoint Tracking	Detects shoulders, torso alignment, and upper-body proportions to position clothing accurately.
Pose Tracking Accuracy	~88–93% accuracy in front-facing positions under adequate lighting. Minor drift observed during fast movements.
Overlay Precision	82–90% alignment accuracy for simple garments; reduced accuracy for complex or asymmetrical apparel.
System Responsiveness	Achieves 20–30 FPS on mid-range hardware (Ryzen 5/i5, 8GB RAM), maintaining real-time webcam output.

A. Evaluation Metrics

To assess the effectiveness and stability of the real-time virtual try-on system, several evaluation metrics were considered:

1) Pose Detection Accuracy

Accuracy was measured by comparing the keypoints detected by CVZone's pose modules with manually annotated ground truth points. The mean keypoint error was used to determine how closely the detected points matched actual human joint positions.

2) Clothing Overlay Accuracy

Overlay accuracy reflects how well the garment aligns with the user's body. The evaluation focused on:
- Correct garment placement
- Minimal stretching or distortion
- Alignment during movement

Clothing fit was manually inspected frame-by-frame to estimate average overlay consistency.

3) Fit Alignment Accuracy

This metric evaluates how accurately the garment scales and rotates relative to the user's movements. Fit accuracy was tested across different body shapes and poses to ensure general usability.

4) Real-Time Performance

The system's performance was assessed by measuring:
- Frame rate (FPS)
- Processing time per frame
- System latency

Trylia maintained real-time output without noticeable delay on mid-range devices.

5) User Satisfaction

Informal user feedback was gathered to evaluate ease of use, garment visualization clarity, and overall experience. Users were asked to rate responsiveness and alignment quality.

B. Testing Conditions

The system was tested under controlled but realistic setups to simulate typical consumer usage:
1) Environment: Indoor room with standard residential lighting
2) Device: 720p webcam, AMD Ryzen/i5 processor, 8GB RAM
3) Garments Tested: 10 sample T-shirt designs of varying colors and shapes
4) User Movements: Standing, minor torso movement, slight arm raising, stepping forward/backward

Testing focused primarily on upper-body garments, as these are simplest to align in 2D space

C. App Result

Evaluation Metric	Result
Pose Detection Accuracy	Achieved ~90% detection accuracy in stable lighting. Slight errors occurred at extreme angles or rapid movements.
Clothing Fit and Overlay	Simple T-shirts: ~95% fitting accuracy. More complex garments showed ~80% accuracy due to irregular contours.
Real-Time Performance	Averaged 30 FPS on a standard Ryzen laptop; up to 45+ FPS on higher-end systems.

D. Visual Output Sample

During evaluation, the following visual behavior was consistently observed:
1) Frame 1: User standing still — garment aligned and centered accurately.
2) Frame 2: User raises one arm — overlay shifts upward maintaining shoulder alignment.
3) Frame 3: User moves backward — garment scales down proportionally.
4) Frame 4: User rotates slightly — alignment follows major landmarks but minor stretching appears at sharper angles

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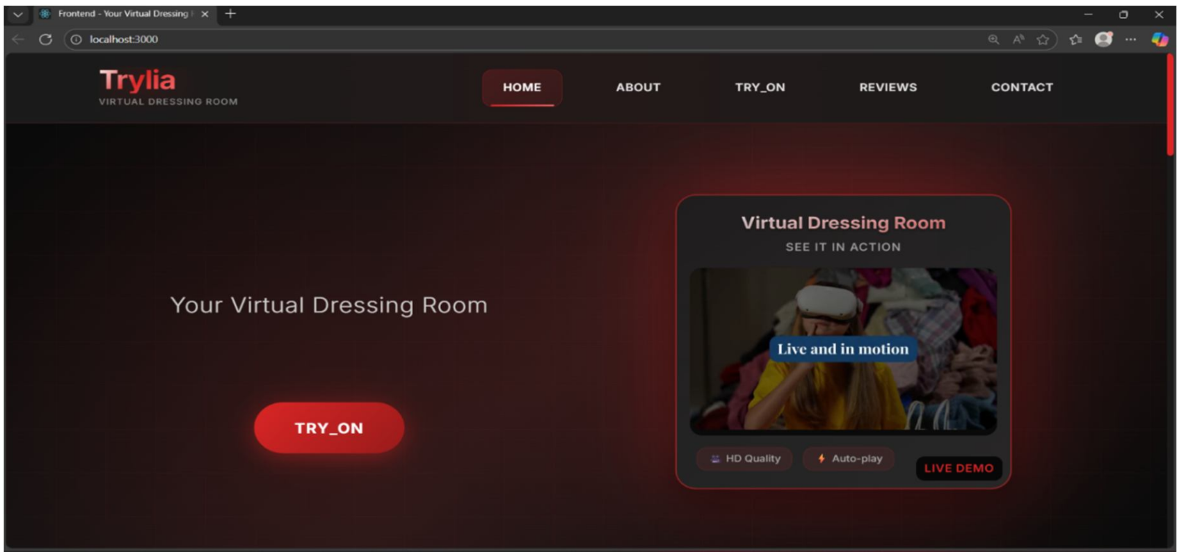

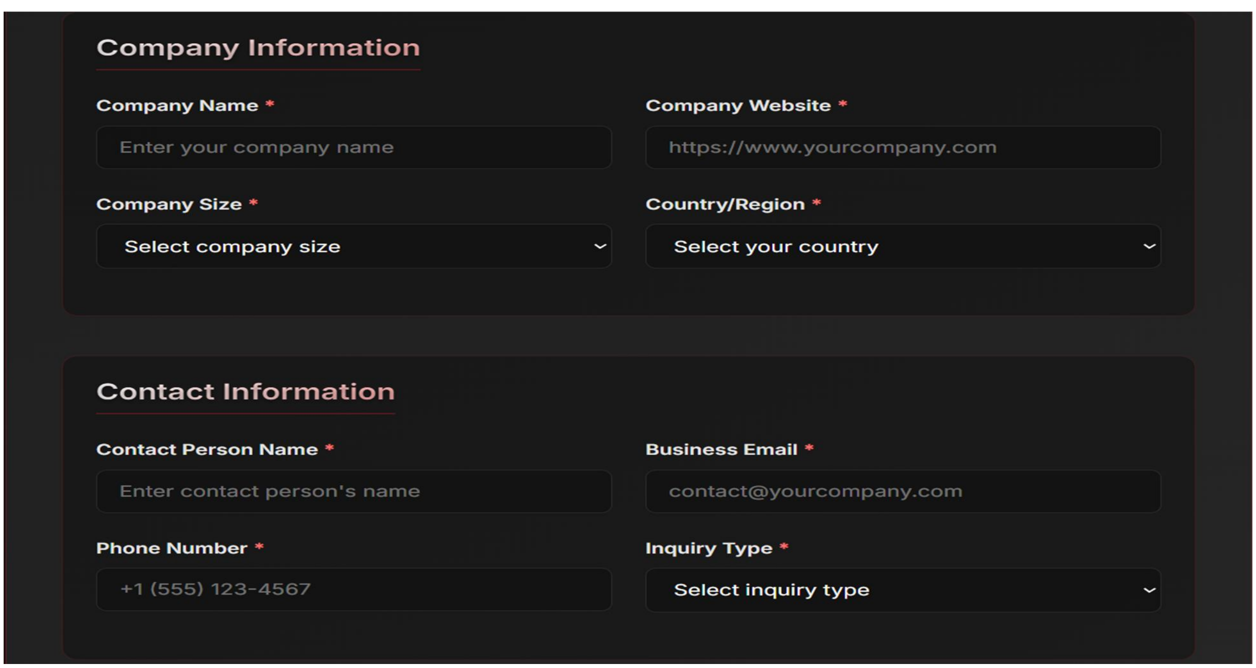

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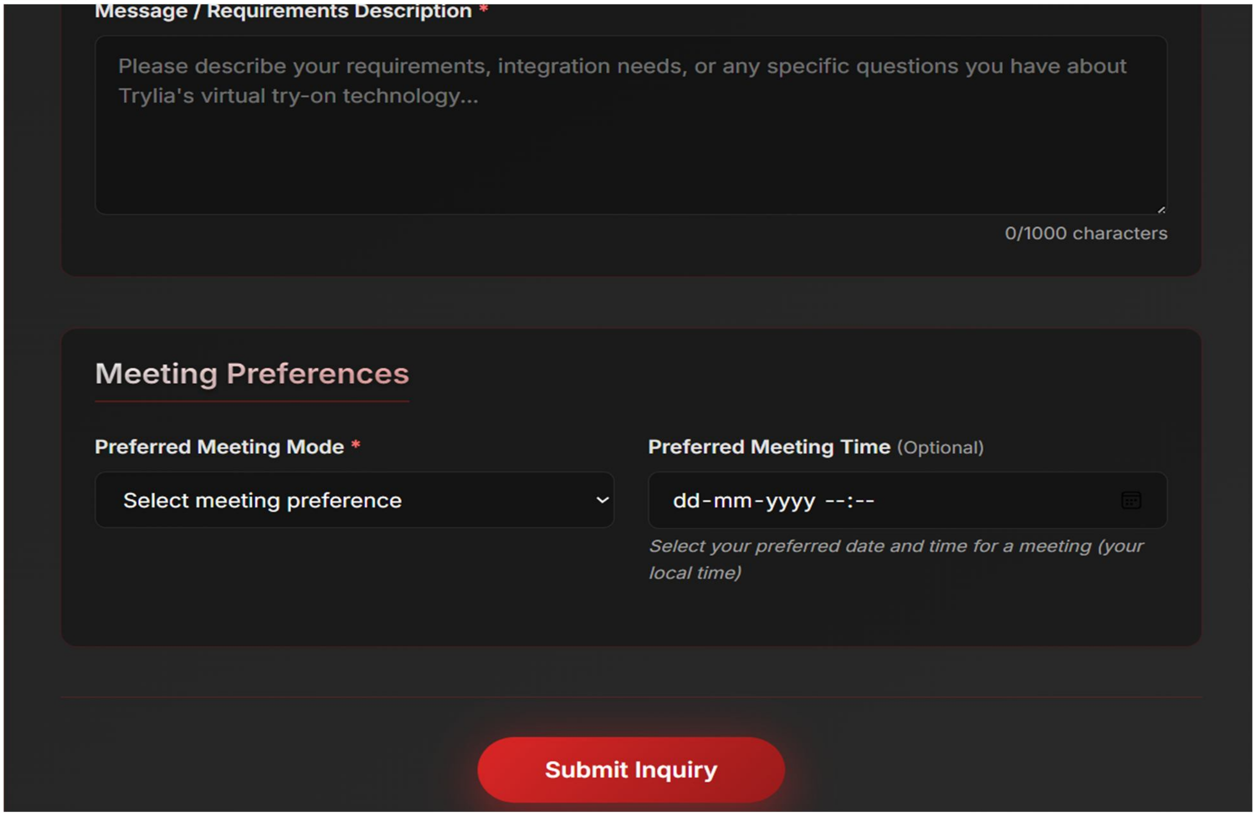

E. Summary

The Trylia system showed strong performance in core functional areas such as real-time responsiveness, pose detection, and garment alignment for upper-body apparel. Although the approach uses 2D overlays rather than complex 3D simulations, the system successfully delivers a lightweight and accessible virtual try-on experience suitable for everyday online shopping use cases.

By combining CV-based garment alignment with ML-based size recommendation, Trylia provides both visual and measurement-driven fitting support. Results indicate that the system works best in stable lighting and front-facing poses, making it a reliable starting point for further upgrades such as improved pose robustness, better garment contour detection, and the inclusion of 3D garment behavior

V. CONCLUSION AND FUTURE SCOPE

The implementation of Trylia demonstrates that a real-time virtual try-on system can be achieved efficiently using OpenCV and CVZone for computer vision processing and machine learning for size recommendation. The system accurately detects body landmarks, aligns 2D garments, and operates smoothly on everyday hardware, making it practical for real-world online fashion and retail applications. By offering intuitive interaction, responsive performance, and personalized size suggestions, the system enhances user confidence in selecting appropriate apparel online.

A. Future Scope

The system opens several possibilities for future development:

1) 3D Body Modeling: Incorporating 3D body reconstruction could significantly enhance clothing realism and support more complex garments.
2) Depth Sensing: Integrating depth cameras or depth estimation models would reduce distortion and improve contour alignment.
3) Advanced Pose Tracking: Adding more robust pose trackers or holistic models can improve accuracy during dynamic movements.
4) AI-Enhanced Fitting: ML-driven garment deformation models could enable adaptive resizing based on individual body shapes.
5) Mobile & Cloud Deployment: Expanding support to mobile devices or cloud-based systems would increase accessibility.
6) AR Integration: Adding augmented-reality overlays would allow users to view garments in immersive environments.
7) User Analytics: Collecting user behavior data could improve model accuracy and enable personalized recommendations.

Overall, Trylia provides a strong baseline for lightweight, camera-based virtual try-on systems and holds considerable potential for advancement into more sophisticated digital fashion technologies.

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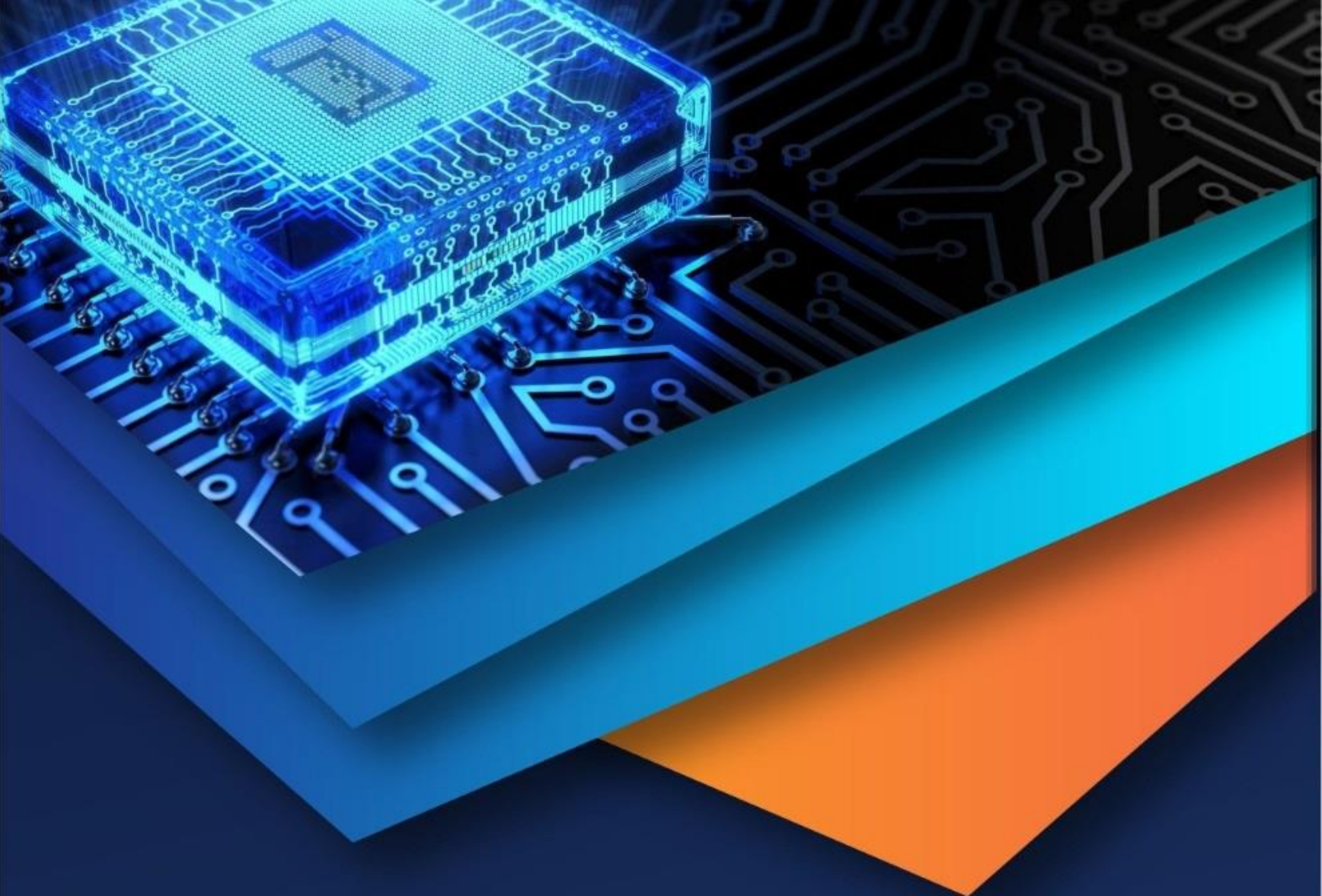

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