 <b>Marwadi University</b>	<b>Marwadi University</b> <b>Faculty of Technology</b> <b>Department of Information and Communication Technology</b>	
<b>Subject: Capstone Project</b>	<b>Innovation and Originality</b>	
	<b>Date: 24/09/2025</b>	<b>Enrolment No: 92200133001</b>

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#### Problem Statement:

Tailors, shoppers and especially in the fashion and tailoring domains, face difficulties in visualizing how a garment will look on their own body before purchase or stitching. This results in high product return rates, customer dissatisfaction, and inefficiencies in tailoring processes due to miscommunication about design, fit, or fabric. Existing virtual try-on solutions are expensive, or fail to handle complexities such as varied body measurements, fabric textures, and occlusions like hair overlapping clothing.

**Virtual try-on system** that leverages **computer vision, pose estimation, and segmentation techniques** to realistically overlay garments on a user's image while addressing accuracy, usability, and scalability.

#### Novel Approach:

The innovation in this project can be identified in three major areas:

1. **Version-wise Evolution**
  - **V1:** Basic garment upload and try-on with segmentation-based overlay.
  - **V2:** Enabled selection of specific garment regions from model images, improving user interactivity.
  - **V3:** Optimized for female users by addressing challenges with hair occlusion during try-on, introducing post-processing adjustments to reduce unrealistic overlays.

2. **Optimized Deployment Strategy**

Unlike existing large-scale models that require high-performance servers, this project explores resource optimization by caching pre-trained AI models and deploying on Hugging Face. Although caching increases memory demands, alternative lightweight approaches were investigated to balance speed with resource availability.

3. **Focus on End-User Accessibility**

Instead of targeting only enterprise-level fashion houses, the solution is designed for tailors, small businesses, and individual users, making advanced virtual try-on technology more inclusive.


#### Comparison with Existing Solutions:

Current virtual try-on systems, such as Zalando's research-based virtual dressing platforms or Snapchat's AR try-on filters, focus heavily on AR/VR integration or e-commerce scalability. These approaches, while powerful, present several drawbacks:

- **High Resource Requirements:** Most AR-based systems require GPUs and high RAM allocations, which are impractical for smaller users.
- **Limited Flexibility:** Existing commercial solutions typically restrict customization to predefined garments and models.
- **Generic Fit:** Many systems fail to consider occlusions like hair or accessories, leading to unrealistic results.

By contrast, the proposed system:

- Uses a Flask backend for lightweight deployment.

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- Handles garment overlays with user-uploaded or partially selected outfits, adding flexibility.
- Introduces specific optimization for female users, an under-addressed problem in segmentation-based systems.

### Contribution to ICT Field

This project contributes to the **AI and Computer Vision subdomain** of ICT by introducing a scalable, accessible, and user-focused solution for fashion technology. Its contributions can be summarized as:

- **Technical Advancement:** Demonstrates how pose estimation + segmentation models can be optimized within lightweight frameworks like Flask for real-world applications.
- **Practical Impact:** Offers small businesses and tailors an affordable alternative to costly AR-based platforms, thus democratizing virtual try-on technologies.
- **Addressing ICT Gaps:** Tackles existing challenges in occlusion handling (hair vs. garment overlap), paving the way for further research in fine-grained segmentation for apparel applications.
- **Future Research Directions:** This foundation can be extended with integration of GAN-based garment fitting, 3D mesh alignment, or cloud scalability (AWS, Azure) for enterprise adoption.

By bridging gaps between research-heavy solutions and practical, lightweight deployments, this project highlights how AI-driven solutions can enhance user experience, reduce return rates in e-commerce, and empower small-scale businesses.

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