**Virtual Try-On Integration for 3D Body Mesh**

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**Submission Note**

While the task was submitted slightly beyond the recommended timeline, I prioritized achieving a high-quality and realistic virtual try-on result. Extra time was taken to fine-tune the mesh fitting and ensure the garment aligned naturally with the body models, minimizing artifacts and visual inconsistencies.

**1. Approach**

The solution was divided into two phases:

**1. Script-Based Fitting (Python + Open3D):**

* I developed a Python script using Open3D to fit the provided t-shirt mesh onto the female body mesh.
* The process included:
  + Aligning the center of mass (COM) of the t-shirt and body meshes.
  + Applying translation and uniform scaling adjustments to match the body proportions.
  + Using vertex normals to slightly sink the shirt onto the body for a more natural look.
* Minor deformations were avoided to preserve mesh quality.

**2. Manual Refinement (Blender):**

* For additional body meshes, I used Blender to manually adjust the t-shirt fit.
* Blender's **Proportional Editing** and **Sculpting** tools were used to:
  + Scale, position, and lightly deform the shirt mesh for better body conformity.
  + Correct any remaining minor clipping artifacts.
* This hybrid method allowed for faster and more visually accurate results across varying body types.

**2. Assumptions**

* The t-shirt model provided is neutral and scalable to the human body mesh without drastic topological modifications.
* Minor deformations are acceptable for initial prototype demonstration, given the lack of integrated cloth simulation.
* Uniform scaling was used initially, assuming proportional differences across body types could be manually corrected.

**3. Challenges and Solutions**

| **Challenge** | **Solution** |
| --- | --- |
| **Different body proportions** (across male/female meshes) | Used Blender's manual proportional editing for realistic adjustment after initial COM alignment |
| **Clipping and minor penetrations** | Applied normal-based vertex offset and manual corrections in Blender |
| **Lack of cloth physics** | Focused on static fitting, and adjusted manually for better visual plausibility |

**4. Suggestions for Future Improvements**

* **Integrate Physics-Based Cloth Simulation**:  
  Using Blender’s Cloth Simulation or PyBullet to simulate natural draping behavior under gravity and collision constraints.
* **Parameterize Fitting Process**:  
  Develop a fully automated pipeline where scaling and deformation parameters adjust dynamically based on body mesh measurements.
* **Texture Mapping**:  
  Apply UV mapping and material textures to the shirt to enhance visual realism.
* **Collision Handling Automation**:  
  Integrate a collision detection system to prevent shirt-body intersections during fitting.
* **Use of SMPL-X Body Parameters**:  
  Modify fitting dynamically based on SMPL-X parameters like pose, shape, and expression for diverse datasets.

**5. Rendered Screenshots:**  
A computer screen shot of a mannequin

AI-generated content may be incorrect.

**A computer screen shot of a mannequin

AI-generated content may be incorrect.**

**A computer screen shot of a person wearing a black shirt

AI-generated content may be incorrect.**

**A computer screen shot of a person

AI-generated content may be incorrect.**