TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

A Project Report

On

Realistic 3D Self-Model Creation

Submitted By:

Mukesh Pandeya [HCE081BEI023]

Submitted To:

Department of Electronics and Computer Engineering

Himalaya College of Engineering

Chyasal, Lalitpur

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Mukesh Pandeya [HCE081BEI023]

ABSTRACT

This project presents the creation of a realistic 3D model of the author using Blender. The process includes reference collection, modeling, sculpting, texturing, lighting, and rendering. The goal is to achieve a realistic digital human model and understand the workflow of 3D character creation. The report describes the methodology, tools, and results of the modeling and rendering pipeline.

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HCOE	Himalaya College of Engineering

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1. INTRODUCTION

Computer Graphics (CG) is the field that deals with generating, manipulating, and rendering visual content using computers. Modern CG techniques enable the creation of highly realistic 3D models that can be used in games, films, simulations, and virtual environments. This project presents a mini project titled **Realistic 3D Self-Model Creation and Rendering**, which demonstrates the process of 3D modeling, texturing, lighting, and rendering of a realistic human character.

1.1 Background Introduction

A typical 3D graphics pipeline involves modeling, transformation, shading, lighting, and rendering. A 3D model is constructed using vertices, edges, and faces to represent geometry, and realistic appearance is achieved through materials, textures, and lighting models. Modern tools such as Blender and game engines use physically based rendering (PBR) techniques to simulate real-world lighting and surface properties [1, 2].

1.2 Motivation

Many beginners use pre-made 3D models without understanding how realistic models are created. This project is motivated by the need to understand the complete pipeline of creating a realistic human model, including geometry design, texture mapping, rigging, and rendering. Building a personal 3D model also helps in understanding character creation workflows used in professional game and film industries.

1.3 Objectives

The main objectives of this project are:

- Create a realistic 3D model of the author using 3D modeling tools.
- Apply textures and materials to achieve realistic skin, clothing, and accessories.
- Set up lighting and camera for realistic rendering.
- Export the model for use in game engines or in real-time applications.

1.4 Scope

This project focuses on:

- 3D character modeling and mesh editing
- Texture mapping and material setup

- Lighting and rendering techniques
- Exporting models in formats such as FBX/GLB for external use

It does not cover advanced animation, motion capture, or real-time physics simulation, which are suggested as future enhancements.

2. LITERATURE REVIEW

2.1 3D Character Modeling

3D character modeling involves creating a digital mesh that represents a human body. Techniques include polygonal modeling and sculpting. Reference images are commonly used to match facial and body proportions accurately [3].

2.2 Texturing and Materials

Textures are used to add surface details, such as skin color, clothing patterns, and facial features. Physically Based Rendering (PBR) materials simulate real-world light interaction using parameters such as albedo, roughness, and metallic values [1].

2.3 Lighting and Rendering

Lighting is crucial for realism. Common lighting setups include three-point lighting, HDRI environment lighting, and ray tracing. Rendering converts the 3D scene into a 2D image using algorithms such as rasterization or ray tracing [2].

2.4 Related Tools and Frameworks

Tools such as Blender, Maya, and Unreal Engine are widely used for character creation and rendering. Blender provides modeling, sculpting, texturing, and rendering features, making it suitable for academic and learning purposes [2].

3. METHODOLOGY

3.1 System Overview

The project workflow is divided into the following modules:

- **Modeling Module:** Creation of the base mesh and detailed sculpting.
- **Texturing Module:** UV unwrapping and texture painting.
- **Material Module:** Setting up realistic materials using PBR workflow.
- **Lighting and Rendering Module:** Scene lighting and final rendering.

3.2 Modeling Process

A base human model was created using polygon modeling and sculpting techniques. Reference images were used to accurately match facial and body proportions. The process included reference collection, base mesh creation, and detailed sculpting in Blender.

3.3 Texturing and Materials

UV mapping was performed to unwrap the mesh. Textures for skin, clothing, and accessories were applied using image textures and shader nodes. PBR parameters (albedo, roughness, metallic) were adjusted to achieve a realistic look.

3.4 Lighting Setup

A three-point lighting system and environment lighting were used to simulate realistic illumination. The camera angles were adjusted to capture realistic renderings.

3.5 Exporting and Integration

The final model was exported in FBX format for use in external applications such as game engines and real-time visualization tools.

3.6 Screenshots / Figures

Figure 3.1 shows the front view of the created 3D model. Figure 3.2 shows the side view.

Figure 3.1: Front view of created 3D model.

Figure 3.2: Side view of created 3D model.

4. RESULT AND ANALYSIS

4.1 Correctness of Rendering Output

The rendered output of the 3D self-model shows correct geometry, proportions, and surface detail. Materials and textures display as intended under the chosen lighting setup. Skin, clothing, and accessories are visually consistent with the PBR workflow. Minor aliasing or noise may appear depending on sample count and resolution, which is expected in ray-traced or rasterized output.

4.2 Transformation Behavior

The 3D model supports standard transformations:

- **Translation:** The model moves correctly in 3D space without distortion.
- **Rotation:** The mesh rotates about the chosen pivot (origin or custom) as expected.
- **Scaling:** Uniform and non-uniform scaling behave correctly for export and integration.

When exported to FBX/GLB, transformation hierarchy and pivot settings are preserved for use in game engines or other DCC tools.

4.3 Performance Discussion

Rendering performance depends on mesh complexity (polygon count), texture resolution, and lighting setup. The sculpted model was kept within reasonable polygon count for real-time use after optional retopology. Final render times in Blender depend on sample count and resolution; typical still renders complete in a few minutes on moderate hardware.

4.4 Limitations

- No rigging or animation in the current scope; the model is static.
- Subsurface scattering and advanced skin shaders were not fully implemented.
- Anti-aliasing and render quality are limited by sample count and time constraints.
- Export pipeline was tested for FBX; other formats (e.g., GLB) may require additional checks.

5. CONCLUSION AND FUTURE ENHANCEMENT

5.1 Conclusion

This project demonstrates the process of creating a realistic 3D model of the author using modern computer graphics techniques. The project covers modeling, texturing, lighting, and rendering, providing insight into how realistic digital humans are created for games and visual media. The final output validates the effectiveness of the modeling and rendering pipeline.

5.2 Future Enhancements

- **Rigging and Animation:** Add a skeletal rig to enable body and facial animations.
- **Advanced Shading:** Implement subsurface scattering and skin shaders for higher realism.
- **Real-Time Integration:** Import the model into Unreal Engine or Unity for interactive applications.
- **Performance Optimization:** Perform retopology and LOD (Level of Detail) modeling for game-ready performance.

A. APPENDICES

A.1 Key Software Tools Used

- **Blender:** For modeling, texturing, and rendering.
- **Photoshop/GIMP:** For texture editing.
- **GLB/FBX Exporter:** For model export to external applications.
- **MIAXMO:** For posing the character model.

Bibliography

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[2] Blender Foundation, "Blender documentation." `https://docs.blender.org`, 2024. Accessed: 2025.

[3] E. Angel and D. Shreiner, *Interactive Computer Graphics: A Top-Down Approach with WebGL*. Pearson, 7th ed., 2012.