**7-1 Final Project: Design Decisions**

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**Design Decisions for 3D Scene Development**

The goal of this final project was to transform a 2D image into a functional 3D scene using OpenGL. This required combining multiple skills I learned throughout this course in each module such as creating a complex object, texturing, lighting, and implementing user interactivity through camera navigation. The scene I created resulted in a simple original image of a pencil, box with a cone on top, tapered cylinder and a pyramid. I also decided to add a ground texture and night sky background to my scene.

**Object Creation, Modeling, Texturing & Lighting**

For my final project, I created five primary 3D objects: a box with cone on top of it, a pencil, a tapered cylinder, a sphere and a pyramid. My first complex object I created was the pencil because it uses a cylinder for the main part of the pencil, a cone for pencil edge, and then another cylinder for the eraser at the end of the pencil. My second object I created using two objects was the box with a cone on top to represent a small house as I added roof texture to the cone. All my models were constructed with organized geometry and kept to a smaller scale to ensure rendering efficiency. Each object was positioned using precise X, Y, and Z coordinates to closely match their placement in my initial reference image.

**Texturing and Lighting**

My first textured item was the pencil where I used wood and pink eraser texture. I also added the night sky texture to the background of the scene and a floor texture that all the complex 3D objects are placed on. My last textured item was the cone on top of the box I textured it using a brick roofing image. I used a bright main directional light to simulate natural lighting and a secondary directional light to assist in bighting the scene. Used a third purple light and fourth green light to add more personality to the scene and this made the ball, pyramid and tapered cylinder reflect the light really nicely. I applied the Phong shading model with ambient, diffuse, and specular lighting components, resulting in realistic surface effects in the scene.

**Camera Controls and Interactivity**

Navigation in the 3D environment was implemented in my scene using the WASD and QE keys for horizontal, vertical, and depth movement. Additionally, perspective and orthographic displays in the 3D world was implemented using the P and O keys. The mouse cursor was used for changing the camera's pitch and yaw, and the scroll wheel adjusted the speed of movement. A user could use the mouse for moving the camera around to see the scene as you the WASD and QE keys for movements.

**Code Modularity and Best Practices**

Key functions, such as SetTransformations, SetShaderMaterial, and SetCameraControls, were written to handle repetitive tasks efficiently. Custom functions like these are important so you don’t write repetitive code such as when using SetShaderMaterial. This modularity improved code readability and made debugging more manageable. I also added comments throughout the codebase to explain logic and function purposes, supporting best practices in professional software development.

**Final Reflection**

Overall, I learned and grew to enjoy working on this project so much. This project also reinforced my understanding of computer graphics development from both a technical and design perspective. I changed the color of objects and the textures several times when completing this project so the design could be nice. The biggest challenge was fine-tuning lighting and texture alignment, as it felt every time one was adjusted the other would need adjusting as well. Overall, this project helped solidify my grasp of camera systems, user input handling, and allowed me to demonstrate a well-structured virtual environment that responds dynamically to user input.