7-1 Design Decisions

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**Conceptualization and Initial Design**

Theme and Aesthetics: The project was envisioned to demonstrate a cozy, ambient scene centered around a lamp. The goal was to evoke a sense of warmth and comfort, focusing on soft lighting and shadows to create a lifelike atmosphere.

Functionality: Interaction was a core component, allowing users to manipulate the light source (lamp) to observe changes in lighting and shadows in real-time. This required careful planning of the lighting model and user controls.

**Technical Specifications**

OpenGL for Rendering: Chosen for its flexibility and widespread support, OpenGL facilitated detailed control over 3D graphics rendering, crucial for achieving the desired lighting effects.

Shader Programming: Custom vertex and fragment shaders were developed to handle complex lighting calculations, enabling dynamic shadow casting and light attenuation for realism.

Mesh Design: The lamp and other scene objects were modeled using 3D meshes. Care was taken to balance detail with performance, ensuring smooth interactions without compromising visual quality.

Camera Implementation: A movable camera setup allowed users to explore the scene from different angles, enhancing interactivity and engagement.

**Development Approach**

Modular Architecture: The codebase was structured into modules for easier management and future scalability. This included separate modules for shader handling, mesh loading, and scene management.

Iterative Development: The project followed an iterative development cycle, starting with basic shapes and lighting before gradually adding complexity through textures, refined models, and advanced lighting techniques.

Performance Optimization: Continuous testing and optimization were performed to maintain high frame rates, particularly when implementing more demanding lighting calculations.

**Challenges and Solutions**

Realistic Lighting: Achieving lifelike lighting involved complex shader programming. The solution was to implement a Phong lighting model, augmented with ambient, diffuse, and specular components for a balanced and natural look.

User Interaction: To create a user-friendly experience, intuitive controls were implemented for both the camera and the lamp. This included keyboard and mouse event handling to rotate the camera and adjust the lamp's position and intensity.

**Conclusion and Future Directions**

The 3D lamp scene project successfully demonstrates the power of OpenGL and shader programming in creating interactive 3D scenes with realistic lighting. Future enhancements could include the introduction of multiple light sources, material properties for different objects, and perhaps even incorporating physics for more dynamic interactions. This project not only serves as a valuable learning experience but also as a foundation for more complex 3D visualization and game development projects.