I set out to replicate a two-dimensional image as a three-dimensional scene using OpenGL. The main objective was to demonstrate my ability to construct objects with primitive shapes, apply textures, integrate multiple light sources, and implement camera navigation. I approached the task with efficiency in mind, making choices that balanced realism with the project’s requirement to use low-polygon models. The process of translating a flat reference into a functional 3D environment pushed me to think critically about how geometry, lighting, and user interaction come together in computer graphics.

When deciding how to represent the objects in my scene, I focused on breaking them down into their simplest forms. The reference image I chose featured items like a desk, candles, a yoga block, and a yoga mat, which could be represented effectively with basic geometry. For example, the candles were built from cylinders with caps to create a realistic profile, while the yoga block was modeled as a box mesh. The mat was designed as a long, slightly rotated cylinder to capture its rolled appearance. I also created a decorative clover-like shape using three half-tori arranged around a center, which demonstrated how combining primitives can yield more complex forms. By keeping each object under 1,000 triangles, I ensured that the rendering remained efficient while still producing recognizable forms.

Applying textures was another major part of my design decisions. Since polygons alone would not have captured the realism I wanted, I used high-resolution, royalty-free textures to bring life to the objects. The desk used a wood grain texture that was scaled with UV coordinates to give the impression of a natural surface. The candles were assigned a glossy material to simulate porcelain or glass, while the yoga block and mat had distinct images mapped onto them to better match their real-world look. This approach allowed me to create details without increasing the polygon count, which reinforced the idea that texturing and shading can often achieve more than adding unnecessary geometry.

Lighting was equally important in building a believable scene. I implemented multiple light sources to create depth and highlight different material qualities. A directional light served as the main source of illumination, simulating general room lighting, while four-point lights were placed strategically to brighten specific objects. I also added a spotlight attached to the camera to function like a flashlight, giving the user direct control over focused illumination. To fulfill the rubric’s requirement for colored light, I tinted one of the point lights slightly. Using the Phong shading model with ambient, diffuse, and specular components allowed me to show differences between surfaces, such as the subtle reflections on the candles compared to the matte yoga mat.

To make the scene interactive, I built in a flexible camera navigation system. Users can move around the environment with the WASD keys, while Q and E adjust vertical movement. The mouse controls yaw and pitch to look around naturally, and the scroll wheel modifies movement speed. Additionally, I implemented a feature that lets the user toggle between perspective and orthographic projections with the P and O keys. This not only enhanced the user experience but also demonstrated my ability to apply different projection techniques within one project.

Reflecting on this project, I feel my design decisions showcase a practical application of computational graphics principles. By combining low-polygon primitives, textures, and thoughtful lighting, I was able to produce a scene that was both efficient and visually convincing. Navigation controls and projection toggles added to the interactivity, while the modular structure ensured maintainability. Overall, the project not only met the rubric requirements but also gave me confidence in my ability to design, implement, and refine a complete 3D environment.