**Design Decisions for 3D Scene in OpenGL**

For my CS 330 final project, I developed a 3D scene that replicates a 2D image using OpenGL. This project required creating detailed 3D objects, applying realistic textures and lighting, and setting up camera navigation for user interaction. The scene includes several objects: a floor plane, a small glass vase, a water jug, a trash can, a small hand weight, and a 3DS handheld system. I chose these objects because I thought they would give a nice mixture of shapes, sizes, and textures to recreate. Below are descriptions of the shapes used for my objects:

* The vase was created using a sphere for the body, a cylinder for the neck, and two torus shapes for the top lip and bottom edge.
* The trash can was made with a tapered cylinder for the main body, a torus for the top ring, and another torus for the bottom ring.
* The jug was composed of a cylinder for the body, a tapered cylinder for the neck, a smaller cylinder for the top ring, and a torus for the lower body ring.
* The weights were assembled with a cylinder for the handle, two boxes for the weights on each side, and two prisms on each box to complete the hexagonal shape.
* The console was designed using multiple boxes for the main body and screen, cylinders for the buttons and joystick, and small boxes for the D-pad.
* The floor plane was built using a single large plane to serve as the foundation of the scene.

Textures and materials were important to enhance the visual realism of the scene. I applied high-resolution, royalty-free textures and materials to each object using the following functions: CreateGLTexture, DefineObjectMaterials, LoadSceneTextures, SetShaderTexture, SetShaderMaterial. The functions load and map the textures onto the 3D models. Key points I focused on when creating and choosing textures and materials were making sure the combination looked smooth, high definition, and made sense for the specific item at hand.

Lighting was the key to bringing the scene to life. Using the SetupSceneLights function, I added four main light sources with an extra small light for extra ambience. Each light has its own ambient, diffuse, and specular components to create a nice visual. The lights were specifically placed to recreate the photo’s setup while ensuring that all objects in the scene are well-lit from various angles. For example, one light was positioned to simulate sunlight, while others provided more focused illumination on key objects.

To make sure that users can explore the 3D scene, I added camera controls. The camera can move along the X, Y, and Z axes, controlled by the WASD and QE keys. Scrolling the mouse wheel increases and decreases the speed of the WASD QE movement key, and the mouse’s movement adjusts the camera's orientation. This setup allows users to navigate through the scene and look at the objects from different perspectives. I also included a feature to switch between perspective and orthographic views with a key press, giving users different ways to understand the spatial relationships within the scene.

In this project, I focused on a modular approach to coding, ensuring the project is organized and maintainable. I implemented key features such as GLFW controls for keyboard input and added both orthographic and perspective views. Additionally, I structured the code to handle the loading of textures, defining materials, and setting up scene lighting, making these components reusable across different parts of the project. This modular design helped with the creation of complex objects while also maintaining a cohesive and visually consistent scene.