CPT205 Assessment 2

3D Project REPORT

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Dec. 16, 2023

Introduction

This project employs computer graphics techniques and leverages OpenGL functions to create a 3-dimensional representation of a daily life scenario centered around the theme of "Reading Books." Developed within the MS VC++ and OpenGL environments, the project aligns with the emerging Digital Twin concept, transforming real-world entities into interactive cyber objects.

Design & Features

The scene encompasses a desk, a bookshelf, interactive books, decorative elements, and a lamp, each meticulously designed to enhance the overall immersive experience. This project delves into the application of computer graphics, OpenGL, and the Digital Twin paradigm to recreate a dynamic scene. It serves as an educational exploration of advanced rendering techniques, texture mapping, and animation within the context of real-world scenarios. The attention to detail in modeling elements like the desk, bookshelf, and interactive books emphasizes a commitment to realism and immersion.

Desk:
Representation: Modeled after a traditional wooden desk, a substantial plane serves as its visual manifestation.

Bookshelf:
Representation: Simulating a classic wooden bookshelf, the two-tier structure combines wooden boards with rows of books.

Decoration:
Representation: Emulating a plant positioned behind the desk, this element is realized through transformed spheres.

Books:
Representation: Mirroring the real-world experience of searching and perusing books, the animation unfolds as follows:
Initial Placement: Books are orderly arranged.
Exploration Phase: Books are taken out and examined, revealing covers and textured pages. Each book holds unique content for exploration.

Lamp:
Representation: Modeled as an L-shaped 3D object with a cubic base, the lamp incorporates a top light source to enhance the reading experience.

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3D OpenGL Techniques

3D OpenGL Techniques Applied in the Assignment:

1. Creation of Geometry

Extensive utilization of geometry primitives such as quads in 2D and three-dimensional constructs like cylinders and cubes. This encompasses the fundamental building blocks for crafting the visual elements within the scene.

2. Transformations

Application of various geometric transformations including scaling, translation, and rotation. Specifically, the judicious use of glPushMatrix() and glPopMatrix() encapsulates objects' adjustments, ensuring harmonious integration within the overall visual composition.

3. Hierarchical Modelling

Implementation of hierarchical modelling techniques, where geometry primitives are instantiated through instance transformations. Notably, the animation sequences for books involve hierarchical structuring to achieve the nuanced actions of taking out and putting back. The lamp modelling also embraces hierarchical techniques for the transformation of a basic cuboid into a realistic lamp.

4. **Lighting and Materials**

Incorporation of two distinct light effects along with corresponding materials. The first is the ambient environment light, crucial for overall scene visibility during initialization. The second is a focused spot light positioned atop the lamp to optimize the reading experience. The program applies a variety of materials when rendering different objects to enhance visual realism.

5. **Texture Mapping**
Extensive use of texture mapping to bind textures to predefined geometric primitives, contributing to the intricate detailing of objects such as books and the desk. This technique adds a layer of realism by introducing texture and visual depth to surfaces.

6. **Viewing and Projection**
Application of perspective projection from three fixed positions, providing a realistic viewing experience. The fixed positions offer convenience, and the program additionally allows users to dynamically alter viewing positions and directions for enhanced flexibility.

7. **Animation and Interactions**
Integration of diverse animation sequences and interactive features controlled via mouse and keyboard inputs. For detailed instructions which outlines the specific commands for manipulating the scene interactively, the commands are listed below:

Keyboard Input:

The keyboard function:
'l' or 'L' toggles the lamp light.
'1', '2', and '3' switch between different prefixed view aspects.
't' triggers the read mode, which take out the books (In some condition).
'r' triggers the read mode, which look through and search for the books (In some condition).
(The prefixed view aspect is well adjusted)
'x' and 'X' adjust the view position along the x-axis.
'y' and 'Y' adjust the view position along the y-axis.
'z' and 'Z' adjust the view position along the z-axis.

Mouse Input:
Left click press pull the books.
Right click press push the books.

Tips:
Expected order: Left Click-> press ‘t’ -> press ‘1’ -> press ‘r’ -> Right Click
Please use lower case alphabet.

Sample Pictures

1. Start Scene

2. After open the light (Press L)

3. When reading books

4. After reading books