

CS 405 Project 3: Scene Graph + Illumination

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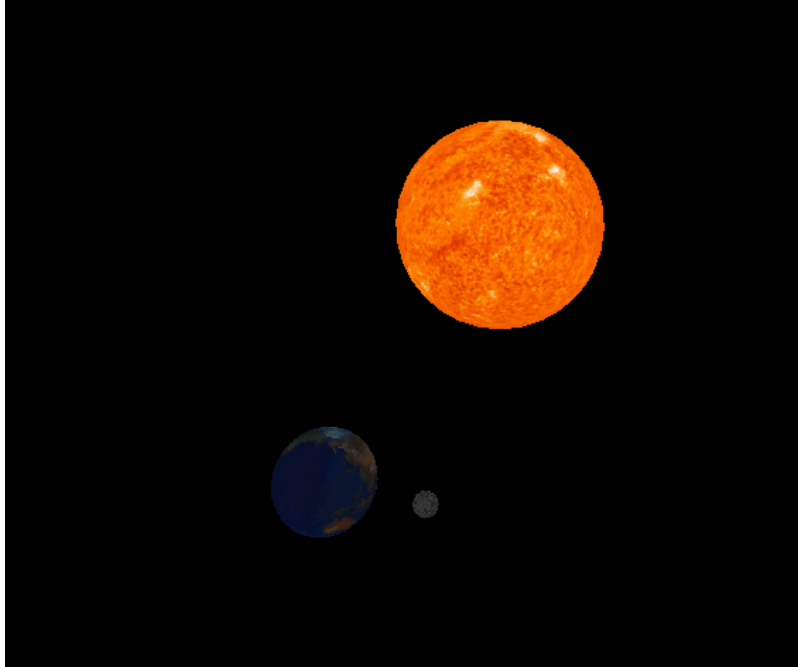
1. Introduction

The goal of the project was to implement a solar system simulation using a scene graph structure and basic lighting techniques. The project required hierarchical transformations to recursively propagate transformations from parent nodes to child nodes. Additionally, ambient, diffuse, and specular lighting was implemented to simulate realistic illumination. Committed all tasks separately after completion for ease of grading.

2. Tasks

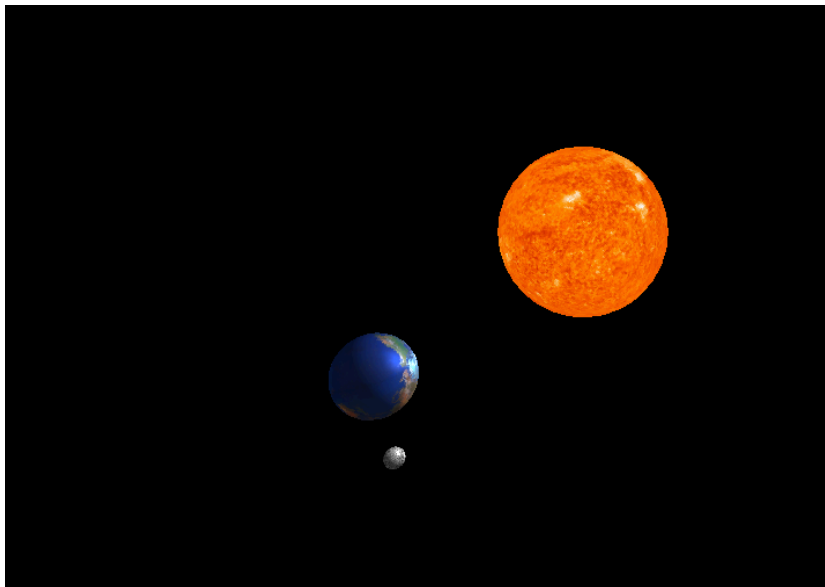
Task 1: Implement the Draw Function

- The draw function of the SceneNode class was implemented to ensure that transformations applied to parent nodes recursively propagate to their child nodes.
- Key steps included:
 1. Combining the parent's transformation matrix with the current node's TRS matrix.
 2. Calculating the Model-View-Projection (MVP) matrix, Model-View matrix, and the Normal matrix for lighting.
 3. Drawing the MeshDrawer associated with the node.
 4. Recursively propagating the transformations to all child nodes.



Task 2: Implement Diffuse and Specular Lighting

- The fragment shader was updated to calculate diffuse and specular lighting using the Phong reflection model given in class.
- Diffuse lighting was implemented based on Lambertian reflection:
- Specular lighting was calculated using the reflection vector and view direction:
- Combined with ambient light to give realistic illumination.



Task 3: Add Mars to the Solar System

- Mars was added to the scene graph as a child of the Sun node.
- Mars used the sphere mesh and had the following transformations applied:
 - Translation: (-6, 0, 0) units relative to the Sun.
 - Scaling: (0.35, 0.35, 0.35).
 - Rotation: 1.5 times the Sun's rotation around the z-axis.
- The Mars texture (<https://i.imgur.com/Mwsa16j.jpeg>) was loaded using the `setTextureImg` utility.

