Assignment - 3

[1]Arjun Verma : IMT2017008
T2-20-CS 606: Computer Graphics
Course Instructors : Prof. Jaya Sreevalsan Nair
Prof. T.K Srikanth

Illuminator

Abstract. *This technical report contains a brief overview of the methodology involved in solving the given problem statement along with the solutions to the questions posted with the problem statement.*

1. Problem Statement

The given problem statement deals with lighting and shading in 3D rendering. It also involves implementing rotation using quaternions. Abstractly, the problem statement requires setting up a scene consisting of 3D models. These models are rendered by assigning different material properties to each of them. Each model also has its own light source which is constricted to movement within a region that is 1.25 times the bounding box of the object. The models can then undergo various manipulations such as translations, rotations and scaling. The individual light sources of each object can also be translated along either of the three principal axes. The individual light sources can be toggled on or off. Additionally, one can choose whether one wishes to use Gourad or Phong Shading on each of the individual meshes.

2. Methodology

In this section, we discuss the distinct characteristics of the approaches involved in designing the application.

2.1. General Design and Application Instructions

The application has been designed such that it has two modes : Mode 0 and Mode 1. Mode 0 deals with setting up the scene and shader selection while Mode 1 deals with model manipulation and illumination. A user can toggle between the different modes by pressing the 'm' key. A user can try out the different features by enabling that feature action in it's respective mode by pressing the appropriate key. The application also throws out occasional instructions and messages in the browser console for the ease of use of user. These are simple console.log messages and a sample of it has been included in a separate folder consisting of screenshots.

2.2. Model Design

The models have been designed and imported from Blender. All models were created manually and then imported as .obj files and read into the application using webgl-obj-loader. The models are essentially designed to represent the different kinds of trees found in three different seasons : Spring, Winter and Autumn.

2.3. Mode 0

This is the Scene Setting and Shader Selection Mode of the application. In this mode a user can draw Models on the screen by pressing 'C'. A user can also select one of Spring, Winter or Autumn models by pressing the keys 7, 8 or 9. After selecting a model, the user can press 's' to toggle between Gourad or Phong shader. Separate vertex and fragment shader files have been made for each of the shader. When an object is initialized along with its material and light sources, the respective values are set up in one instance each of the two different kinds of shaders. Based on user selection, the appropriate shader is then used.

2.4. Mode 1

This is the Model Manipulation and Illumination Mode. The model transformations have been implemented as per the previous assignment. Although, it does have a new addition in the form of trackball rotation. The mapping of the distances between delta time periods has been somewhat similar to the camera rotation that we implemented in the previous assignment. Mapping these to a trackball and using quaternions was the modification that was required and was done as per [1]. These are realized by clicking and dragging across the selected mesh. One can move the object intuitively with arrow keys and using $<$ and $>$ for the z direction. The objects can also be scaled using '+' and '-' if they don't violate the constraint mentioned in the assignment. This has been done by always recomputing the bounding box before the scaling and proceeding with the transformation only if the condition holds.

The individual light sources can be toggled on or off using '1' and '0' respectively. They can also be moved individually along the x, y and z axis by using the key pairs ('q', 'w'), ('a', 's') and ('z', 'x') respectively.

2.5. Quitting the Application

A user can choose to quit the application at any time by pressing the 'Esc' key. On doing this, the screen is rendered clear and an exit message is displayed on the browser console.

3. Questions

The following section addresses the questions posted in the problem statement.

***(1)** What are your observations of the distance attenuation terms used for lighting?*
Answer. We observe that setting the linear and quadratic terms to 0, give us somewhat bright objects, irrespective of the distance between an object and its light source. However, on increasing the values of these terms, the objects become somewhat darker with an increasing distance from its source. Moreover, it is observed that an increasing quadratic term somewhat dominates over an increasing linear term.

***(2)** What are your observations about the change in shading models?*
Answer. I believe that the changing of shaders from Gourad to Phong makes the object somewhat smoother. The difference however seems slightly insignificant due to the choice of meshes which are highly coarse meshes modeled in Blender. I believe that refining these meshes with an increased triangulation would result in much noticable

differences when one switches shaders.

(3) *You are now able to generate different sizes of specular highlights using different settings for lighting, shading, and materials. When do you see focused sharper and smaller specular highlights and when do you see larger ones?*
Answer. Having a combination of low K_d and high K_s for a material helps us in noticing a highly predominant specular highlight. Keeping the shininess value of an object low allows us to observe small focused specular highlights. Increasing it, results in seeing a larger highlight that covers almost the entire object. The highlights also become focused and sharper when the light source is moved towards the object. On moving it away from the object, the highlights become less intense.

(4) *What are your comments about your choice of mesh models?*
Answer. As mentioned briefly earlier, I believe that the meshes imported are highly coarse. These are meshes that I manually modeled for Assignment 2 and proceeded to use them for this assignment as well. I feel further subdividing these meshes to have finer triangulation would result in observing much noticable differences on switching shaders.

4. Conclusion

In conclusion, the report has elaborated on all the required deliverables. The methodology section briefly discusses the approaches behind the implementation of the application. The sample images for the same have been submitted in a separate folder. All the questions entailed in the problem statement have also been addressed.

5. References

1. Trackball Rotation