Assignment - 3

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***Abstract*—Rendering a 3d model along with lighting and material properties of model.**

I. Introduction

In this assignment we render a 3d model considering the light in the scene and material properties of the model.

II. Approach

A. Lighting

We consider three properties of light ambient, diffusion and specular. Each of these is a three dimension vector. Different values for these three properties will give different types and colors of light. lightpos is another three dimensional vector which tells about the position of light in scene. Along with these properties I consider a variable lighton which is float type takes values 0 or 1. 0 implies light is taken into consideration and 1 implies light is neglected. All these 4 properties build a struct of light. Similarly Material of object also has ambient, diffuse and specular properties along with these we consider a float value called material shineness. We compute normals for each vertex and pass to vertex shader. Glposition remains same as before, multiplying vertex position with view matrix, perspective matrix and modeltransformation matrix. But while computing GLfrag we compute effects of each lighting property on material surface and then calculating the attenuation distance by taking attenuation constants a,b,c as 1, 1, 0.1 and then finally adding them. Then we pass this final result to the glfrag. As we have multiple light sources we calculate each lighting effect and then finally adding all lighting effects.
We have two different type of models Gouraud and Phong models. Gouraud model implies all lighting calculations are implemented in vertex shader whereas phong model implies all calculations are done in fragment shader.

B. Bounding Box

As there is constraint in assignment that the light that present in 1.25 times of model bounding box should only used for calculations. I first calculate the boundingbox by taking min and max x, y,z. Then I construct a cuboid using these min and max values then I multiply this cuboid vertices with model transformation matrix so that bounding box updates regularly when some transformation occurs in model. And then I scale this bounding box to 1.25 and take all the light sources that are present in this bounding box.

C. Translation

Translation use affine transformation. When a mesh is selected and mouse is right clicked and dragged I just simply add mouse coordinates to the mesh vertices. So when mouse is dragged the mesh moves along the mouse. Similarly I update the corresponding mesh light coordinates by same amount. Hence there will be no difference in between light and corresponding mesh. As bounding box is multiplies by modeltransformation matrix it updates regularly.

D. Scaling

Scaling also uses affine transformation. When a mesh is selected and keyboard event is + then it increases its size and - decreases its size. While deceasing as bounding box updates regularly and if corresponding mesh light source is moved more than 1.25 then scaling stops.

E. Rotation

Rotation uses quaternions. I use glmatrix quat function to calculate quaternions. I get direction and angle from trackball rotation. When left clicked the mouse and dragged the trackball function computes axis and increases angle by 1 degree. I calculate x, y, z and w components before and send this to quat function which returns another quaternion and then I change it to matrix 4 and then multiply this with model transformation matrix.

F. Gouraud-Phong

To Change between these two models I use a if-else loop in shaders. I use a float variable which takes 0 or 1 where 0 implies Gouraud and 1 implies Phong. This I can switch between these models easily.

G. Light movement

To switch on or off I simply set ligon variable on each light component. In shader while caluculating lighting I use another if loop which only takes lights that have ligon as 1.
In translation of lights in 6 directions I use 6 different keys by pressing on each key the particular direction of light position is changed by some fixed value.

III. Questions

A. Q1.

The distance attenuation term simply tells the intensity of light. As we know intensity of lights decreases when distance between light and object increases and vice versa. This distance attenuation term is used to specify which lights to be passed and which not.

B. Q2.

In Gouraud model the color of each vertex is computed and then interpolated across the surface. Whereas in Phong model interpolating the vectors across the surface and computing the color for each point of interest.Phong shows specular highlights more clearly and smaller ones. Phong model prouce more shiny surface than Gouraud model. Phong gives more accurate results than gouraud.

C. Q3.

Gouraud and Phong makes difference here. In Gouraud shading I see larger specular highlights and when in Phong model I see sharper and smaller specular highlights. Also specular components of material and light also materials. But this shows a significant difference.

D. Q4.

I intially used some complex mesh object like teapot but I couldn't get the expected behaviour from this. I thought may be the normals are not coming correctly because of more curvatures. So then I used basic objects like cylinder,cube and a combination of cone and cylinder. Where I got good results. Cube ahs perfect normals, cylinder and cone have curvature but very less curvatures hence it doesn't affect the normals.