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Computer Graphics(T2-20-CS 606)

Report Assignment - 3

Problem statement

1. Setting up lighting for a scene
2. Experimenting with lights
3.Experimenting with Gouraud and Phong shading models
4. Using quaternions for rotation

So we have to import 3 meshes and implement Gourand and Phong lighting model on that along with transformation like translation,scaling and rotation(using quaternions).

For lighting we have to implement ambient,diffuse and specular lighting with coefficients for each type and the final result will be the combination of each type of lighting.

Also we have to implement some basic UI or keyboard action so that user can interact with application like enabling affine transformations , toggling between different shading models etc.

Approach and methods

1.Importing Meshes

For importing meshes either we can create ourselves or use some freely available meshes.

Now the catch is that the normals is very necessary for lighting implementation in webgl and the meshes available online may not contain value of normals for every vertex.

So the solution for this is that you download the meshes(.obj) file and import it in blender then adjust it like scale up/down and see how your mesh looks or fit w.r.t camera and if everything looks good import it and enable normals while importing.

So now your mesh contains normals along with vertices and indices.

2.Implementing Lighting

For implementing lighting we need following

- Colors for ambient,diffuse and specular
- Lighting position
- Shining value of meshes,more shining value means more reflective it will be.

After getting all the value we pass it in the shader and it output the resultant mesh.

3.Gourand vs Phong Shading

The basic different between gourand and phong shading model is that gourand works on each vertex i.e it is written inside vertex shader whereas phong works on each pixel hence it is written inside fragment shader.

We can see noticeable difference in smoothness in phong compared to gourand model.

Experiments and conclusions

- If online you are not getting the desired format or values of meshes,download the meshes as it is ,import it in blender,adjust it according to you and then export it in your desired format.
- For rotation in 3D we use quaternions instead of normal rotation because
  - There is a chance of Euler (gimbal lock).
  - In Euler mode the resultant rotation will be resultant of rotation in x,rotation in y and rotation in z direction which will be a heavy computation and might affect the application performance.
- Lighting is very important for 3D realization in graphics.without lighting everything will look flat or you can say 2D.The sense of depth is caused by lightning hence we experience 3D on 2D screen.
- The quality of mesh is also very important for clarity i.e more the vertices in a mesh, more smooth it will look and the shininess etc will look better on it.

- For converting our mesh (.obj format) to webgl we have used webgl-obj-loader library. After this we can extract vertices,indices normals etc.

- For implementing trackball rotation using quaternions we have used three.js library where it was already implemented and on rotation it provides the final matrix which then multiplies with our MVP matrix.

Questions from Assignment

1. What are your observations of the distance attenuation terms used for lighting?

Ans - distance attenuation terms like position of lighting is very important in implementing different type lighting like ambient,diffuse and specular.

- In **Ambient light** is coming from a very **distant place** like from sun or moon,so the light falls uniformly on object surface.

- In **diffuse** the light is falling from **one particular direction**,hence the part facing that side is more brighter than rest.i.e light is falling from a near distance.

So we can see the position of lighting decides the properties of final output of meshes.

2.What are your observations about the change in the shading model?

Ans- Gourand shading is applied on vertices hence it is not as much smooth as Phong shading which applied on every pixel.

But one thing i noticed is that quality of mesh also decides the final output i.e if we have a mesh with less number of vertices then the noticable difference between these two models is very negligible.

But if the mesh is very fine i.e if number of vertices is higher than we can clearly see the difference between gourand and phong lighting.

3.You are now able to generate different sizes of specular highlights using different settings for lighting, shading, and materials. When do you see focussed sharper and smaller specular highlights, and when do you see larger ones?

Ans- In specular highlights we see sharper and smaller specular highlight if the shininess of material is higher.

The more shininess value of a mesh,more reflective it will be hence it will reflect light more efficiently causing the focussed sharper and smaller specular highlights.

It is similar to a gold plated material and one lets say book.the light falling on gold material will be more reflective than book hence the gold material will have more focussed sharper and smaller specular highlights.

4.What are your comments about your choice of mesh models for this assignment?

Ans-I have chosen three different meshes for this assignment with different number of vertices per unit area i.e so that

- one mesh(monkey) looks like wood material,
- dinosaur like plastic and
- amongus looks like metallic.

So like in case of wooden monkey,no matter how much shininess value you assign,it will not reflect like metallic .

So by this i learnt that reflection not only depends on intensity of light but also on type of material it is falling upon.

Also in real life, no matter how much you shine a wooden toy, it will not shine as any metallic toy.

So basically i choose meshes which show three different material properties,independent of light of shininess assigned to them.