Render An Earth Model

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Outline

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Plan

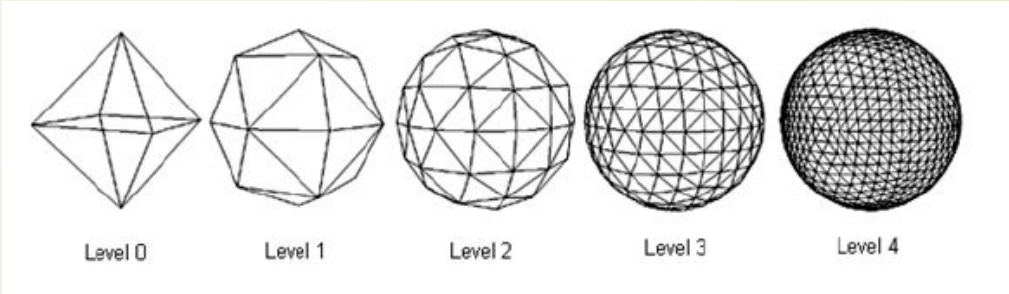
This Project is divided in two stages to carry on:

- The first stage is sphere tessellation, which is used to model the earth. I apply triangle mesh to tessellate it.
- The second stage is texture mapping. First, I use bump mapping with an earth elevation map to adjust sphere surface location. After that, I do the texture mapping of this sphere with an earth map. Then I use reflection map and night light map to make the rendered surface look more realistic.

Related Technologies

Sphere Tessellation Algorithms

- A tessellation of a flat surface is the tiling of a plane using one or more geometric shapes, called tiles, with no overlaps and no gaps. Iterative Sphere tessellation algorithms begins with triangle-based Platonic solids and each time we can split one triangle into 4 triangles. As shown in the figure below.



Bump Mapping

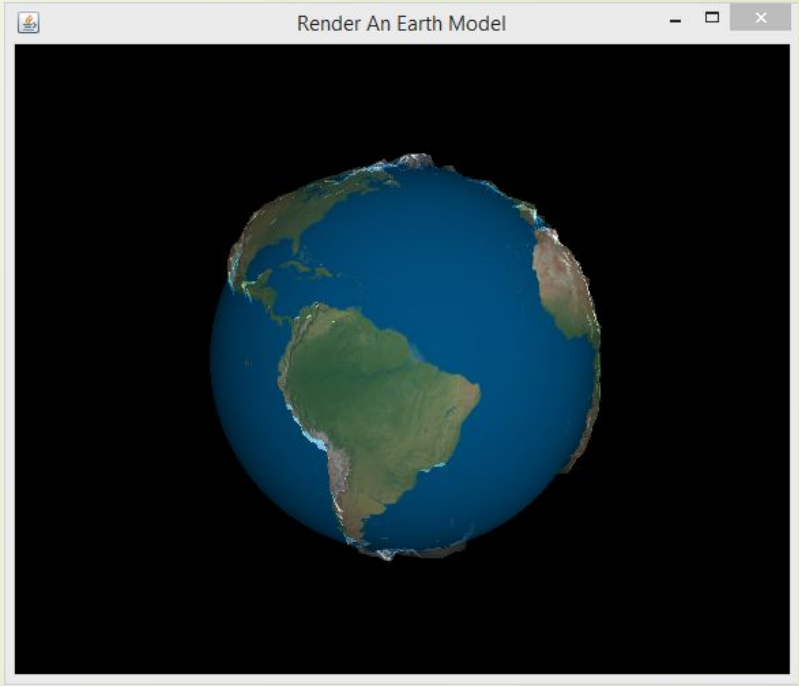
- Simulate bumps by perturbing the surface normals of the object and using the perturbed normal. The result looks bumpy rather than smooth. However, the surface of the object is not actually bumpy. This is a vision illusion. The lighter the pixel is, the more curving outward it looks.
- In summary, The bump map stores the light information.

ADS shading model

- ADS shading, is referred to as the Phong reflection model or Phong shading model, which is used to replicate the interaction of a light with a surface by taking into consideration three components. The ADS model represents the sum of the three components: ambient, diffuse, and specular.
- Ambient - It can be modeled by multiplying the intensity of the light source by the surface reflectivity: I1 = Ka * Ld
- Diffuse - The intensity of the light that being reflected is calculated using the angle between the surface normal and the vector defining the light source: I2 = Kd * Ld * dot(s,n)
- Specular - The specular component models the mirror like reflectivity of the light in a scene. The reflection vector is computed using the following equation: r = -s + 2*dot(s, n)*n, then calculated the intensity of reflected light use equation which is dependent on the position of the viewer : I3 = Ls*Ks * dot(r , v) ^ f
- We can add them together and set the color of the current vertex.

Current Work

- Currently, I tessellated the sphere which started with Octahedron. I did texture mapping with an earth elevation map and an high-resolution earth map as sources.
- During the elevation texture procedure, I computed the longitude and latitude for each vertex on its 3d coordinate.
- Besides, I have transferred camera to screen, then to raster coordinate that the earth will be displayed based on viewport.



Future Work

- To enhance the result, I will consider to use light source(The sun) and a shading model. That could make the model earth be shaded that the earth facing the sun is day and opposite side is night. Meanwhile, reflection strength of ocean and land is different too. Using night light map to simulate night on earth, which is supposed to make the effect more reliable.
- ADS shading(ambient, diffuse, and specular) model will be used. Meanwhile, The rendering pipeline, which is implemented the default light system in Java OpenGL(JOGL) may be used.