CS 6366 Computer Graphics

Final Project Proposal

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1. **Title：** *Environment Mapping*

   In our final project, we decide to choose a topic that we are interested in and would like to challenge in the field of Computer Graphics to research and study on it. After considering, we think the topic Environment Mapping is challengeable and interesting for us.

2. **Name:**

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3. **General Description of Environment Mapping**

   When we are doing with the graphics objects, we have following issues:

   a. Many objects are glossy or transparent
   b. Glossy/Transparent objects reflect the external world
   c. The world is refracted through transparent objects

   Thus, it is important to make the scene appear realistic. Because the precisely simulating of such phenomena is computationally costly and very comprehensive, it requires us to track the rays, find out where they collide and do some extra lighting computations.

   Under this background, we have environment mapping, which is a very simple and powerful method to generate reflections. It assumes that everything surrounding an object is infinitely distant from the object, so it simulates reflections by using the reflection vector to index a texture map infinitively. Environment mapping also gives rendered objects a chrome-like appearance.

   There are some specified procedures of the technique in the field of Environment mapping. We can divide it into 4 sections respectively:

a. Environment Mapping: Simulates an object reflecting its surroundings.
b. Reflective Environment Mapping: Simulate reflective materials with environment mapping. Also, creates a chrome-like reflective object. During this procedure, the most calculations will be doing.
c. Refractive Environment Mapping: After knowing how to implement basic environment mapping, we need to simulate some related physical phenomena. With this, we know how to illustrate within different phenomena like air, glass and water.
d. Chromatic Dispersion: Refraction depends on the wavelength of the incident light, like red light gets refracted more than blue light. This must be considered in the computations.

4. Description of Problem

Although we have learned some basic techniques in Computer Graphics, we know some basic shading techniques like how to light, transform, texture, and animate objects. However, the renderings are probably not quite what we envisioned. With the technique of Environment mapping, we can dramatically improve the images.

But, when we are mapping the objects, as descripted above, different forms of objects have different illustrations. Like a sphere and a cube, they will illustrate different envisions apparently.
Besides, the material influences the Environment Mapping as well. Even when we use two different objects with same form and size, with the difference of the materials, the mapping will also be different.
In addition to the above two factors, the environment factor decides the mapping as well. With different environments surrounding the object, we will also have different illustration mappings.

5. Plan to do

During our project, we will try to divide our works in some small parts and use the Control Variant Method to do different tests, so that we can control our tests easily. Then make them comprehensive.

We will firstly try to illustrate the Environment Mapping with different forms of objects.

a. Cubic Environment Mapping (CEM): Place the camera in the center of the environment and project it to 6 sides of cube (Top, Bottom, Left, Right, Front, and Back). With the reflection vector (x, y, z), find the major component and then get the corresponding plane.

b. Spherical Environment Mapping (SEM): SEM is a fast way to fake the specular term of the lighting equation, and for specific cases, to fake lighting altogether. It uses special texture maps called “lit spheres” or “matcaps”. To access this, we need to do some extra computations. Besides the reflection vector as usual, we also need to compute the sphere normal in local space.

After that, we will try to test the Environment Mapping with different materials, with the change of the material, all the factors will be changed, so does the mapping effect. As we know the reflection factors of materials like plastic and glass, we could simulate the Environment Mapping of these materials based on the parameters of these materials.

Then, we will try to implement our tests within different environments. The changing of external environment will also influence the illustration of the Environment Mapping.

6. Goals

Based on the design and implementation of our project, we will realize the Environment Mapping under different circumstances and also design it as a integrated program. We will design the GUI of the project and have the Mini-GUI in our testing window to change the parameters, so that the testing will be much easier tested.

We will also try to fully implement the functions and tests like descripted above.

a. Using different forms

b. Using different materials
c. Testing different environments

7. Additional Goals

We will try to make our project more usable, we will try to set the Environment Mapping under different models. With the changing of different model like water, vacuum, air, plastic, glass, diamond and so on. We could illustrate different visions with one button click. Thus, this will be a very useful program.