Intermediate Computer Graphics Midterm

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Results:
7+1+2=10
EVEN

Game and Description:
We will be recreating Pac-Man, so to recreate the game we will need Pac-man the character the player controls, ghosts, pellets, and walls as objects. As for objectives the player must clear out the stage of any pellets to win and steer away from ghosts to avoid losing.

Responsibilities:
Mark will be programming basic functionality, texturing, lighting, and shaders.

Riyaz will be doing the portion that explains the concepts.

Emmanuel will be explaining how to implement the use of a dynamic lighting system and creating the video.

Together we are shifting focus to help each other in areas with problems we can't fix individually. Parts of the document will also be written by each member of the team.

Explain the concepts of:

Select the playable character and use it to explain the graphics pipeline stages associated with Vertex shader, Geometry Shader, and fragment shader.

Firstly, the player's mesh is created as a sequence of vertices. These vertices all have a position, textureUV, normal, and color. Each vertex is then given to the vertex shader which will put each vertex in the worldspace and calculate which pixels are affected using a rasterizer. For every pixel the object affects on screen, the fragment shader will run once. The fragment shader takes in parameters from the vertex shader (such as texture coordinates) in order to draw the object in 3D space.

Explain how the Phong lighting model allows you to create a metallic feel for objects within the game.

The Phong lighting model consists of 3 components: ambient, diffuse, and specular. These three components combined is what gives the metallic feel to objects when light hits the object's surface. The ambient component will capture light from the environment and reflect

whatever comes in contact giving the object the lighting to match the environment. The diffuse component works to spread light across the object. This would be from a direct light source and will most likely provide a matte finish lighting on the object. The specular component is where the majority of this feeling comes from as it provides the object with a mirror like lighting. The shininess comes when specular is added into the mix thus giving objects a metallic feeling.

Explain what approach allows you to create a winter feel using shaders.

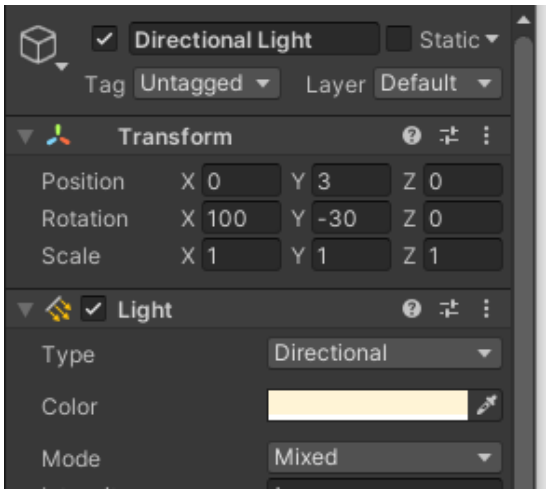
An approach that would lead to a winter feel is to change the light colors to a white or blue color. This will make it so that all objects in the world are lit as if it was wintertime. There could also be a post processing effect to tint the entire screen white or blue in order to make the world feel colder. With post processing a LUT could be used for the scene to give the desired output. To use the LUT we will need to make sure our engine is able to handle the color correction. Since the color correction will be applied to everything in the scene, we will make sure that our scene class is changed and has a separate texture for the LUT. We also have other separate shaders such as the fragment shader that we will have to implement the color correction into.

Explain how to implement:

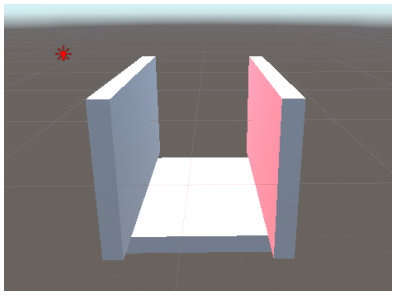
A dynamic light that gives the effect of changing the scene (e.g., day passing, seasonal changes, etc.). This includes proper light behavior when moving away or closer to objects

A dynamic light is lighting that prefers to be moving or changing. It is always reacting to the main objects in the scene. A background lighting that supports the other moving parts within that scene.

In Unity/Blender and many other softwares, opening a basic scene will provide the user with some sort of dynamic light that shows exactly what the question is asking. The image below shows the settings that Unity has to offer for dynamic lighting in a scene. Adjusting the x-value of the lighting changes the “time” in the scene and changing the y-value results in changing the angle of lighting.



To implement these in Pac Man while taking notes from the softwares we will create a simple point light object and assign both position and a value to the point light object. Our game has a square-like enclosure. We will not have the rotation feature because the position will be the thing determining what “time” it is. If the point light is close and on the left side that means it is day, and if it is under the map it will be “night” and little to no dynamic light will be affecting the player or other game objects. The problem will be intensity because if the point light is on the right side of the board it will be the same as the other side just hitting the board at a different angle. To fix this, the value mentioned before will be adjusted during runtime by set conditions mentioned before compiling.



Example of approach

Explain how you implemented the shader for this Midterm and indicate why this choice was made.

The shader was implemented by taking notes from the previous semester’s lectures on Blinn-Phong lighting, and how to implement ambient and diffuse lighting.

Firstly, the normal of the fragment is calculated using the Blinn-Phong method. Using the normal, the ambient and diffuse lighting is calculated using Lambertian shading. Lambertian shading calculates the cosine between the lightsource and the normal of the fragment. This is then used to calculate how much shadow is on the fragment. After that, the specular is calculated using the dot product between the camera and direction of the light from the normal.

This is then used as the specular highlight. Finally, the texture is sampled according to the UV's passed from the vertex shader, and the texture color is multiplied by the sum of the ambient, diffuse, and specular values. Blinn-Phong lighting was used to give the game a shiner look to it.

In order to have parts of the shader be toggled on or off, a uniform was created in order to pass data through into the shader. This data was in the form of an integer indicating which mode of operation the shader should use. Depending on what value the integer is, certain parts of the shader will be skipped, or have their values modified.

The day and night effect was done by linearly interpolating between a daytime color and a nighttime light color. This was done to cast different colored light on the objects in the game in order to mimic the feeling of daytime and nighttime.