

CS475: Assignment 3

FMX Rendering and Animation

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1 Setting up cameras

We set up three cameras, which were as follows:

- The first camera is a perspective camera that overlooks the scene and does not move with any changes in the scene. This camera is positioned in a manner such that it can see the entire scene.
- The second camera is a perspective camera that looks at the rider and follows him as he moves. This is the third-person camera.
- The third camera is a perspective camera that is attached to the head of the rider and views the scene from point-of-view of the rider. This is the first person camera.

We can toggle between the three cameras by pressing the **Key V**. The static camera can be manipulated using the mouse for better views. Left click and moving the mouse translates the camera, right click and moving the mouse rotates the camera and scrolling is used for zoom.

2 Setting up lighting

We used Phong Shading (implemented in the fragment shader) and the Blinn-Phong model of illumination. Two point lights have been set up in the scene which can be switched on/off using **Key J**. One point light is at the top of the scene and one at the right side (when the track is viewed from the top). In addition to these, two other lights, namely the headlight of the bike and a spotlight on the rider have also been set up which can be turned on/off. The spotlight can be switched on/off using **Key H** and the headlight using **Key K**. The headlight and the spotlight are modelled to illuminate a conical region, with the axis of the cone being the direction of the light and the half angle of the cone determining the area around the axis being illuminated.

To determine whether a point is being illuminated by the conical light source, we compute the dot product between the light vector (the vector from the point on the surface to the light source) and the negative of the light direction, after normalizing these two vectors. If the value obtained is greater than $\cos(\theta)$ where θ is the half angle of the cone, we conclude that the light from the source will reach this point.

3 Setting up texturing

The textures are present in a folder called 'textures' in the root directory.

3.1 Skybox

The skybox was set up by first building a bounding cube around the entire scene and then texture mapping all the faces of the cube with the appropriate textures. A panoramic view was converted to six images for the

3.2 Track

We have mapped a road texture to the flat stretches of the track. To the obstacles, we have mapped the texture of a dirt track.

3.3 Rider

We have mapped the texture of a blue sweater to the torso of the man.

3.4 Bike

We have mapped a grey leather texture to the seat of the bike.

4 Animation

The frames have been created by manipulating the hierarchy using the same key bindings described in the last report.

4.1 Saving and Loading Keyframes

Key S is used for saving a keyframe. The state corresponding to a keyframe is saved in the keyframes.txt file. The state contains a timestamp and information about the translation and rotation of all the objects present in the scene in a hierarchical order. In addition to this, the state also contains the lighting information of the scene.

Key L is used to load the states into memory from the keyframes.txt file. This allows us to save the keyframes, manually make adjustments in the keyframes.txt file (if required) and then load the edited set of keyframes into the memory. Once this is done, playback can be started by pressing **Key P**.

4.2 Plot

In a dystopian future in the outer space, a levitating FMX track is present where our rider will cross several obstacles before finally executing a flip after jumping off from a slope. The rider starts off and navigates the obstacles well before finally arriving at the dreaded jump. The rider is suddenly in mid-air and pulls the handle back executing the flip. The flip being successfully completed, he pushes the bike off and jumps onto the track, landing to safety.

4.3 Link to Video

<https://youtu.be/0Gc89sVKpaQ>

5 References

- <http://www.songho.ca/opengl/>
- <https://github.com/paragchaudhuri/cs475-tutorials>
- <https://github.com/nothings/stb>
- <https://pxhere.com/en/photo/706161>
- <https://github.com/open-source-parsers/jsoncpp>
- <http://elemisfreebies.com/08/20/wool-texture-with-3-colors/>
- <https://www.everypixel.com/image-1948630222725838955>
- <https://www.artstation.com/artwork/k4wEXz>
- <https://github.com/denivip/panorama>