

Graphics Mini-Project

“Runaway Train”

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1. Introduction

This graphics mini-project aims at displaying some of the varied and complex features of the Open Source 3D Modelling package Blender. The project takes the form of a one minute video rendered at 25fps and aims to encompass as many of the various features of Blender as possible.

“Runaway Train” is a video made up of four separate scenes each of which provides differing examples of techniques and methods employed in modern computer graphics. Each scene and the methods and techniques used for each are explained below. The main emphasis of the video is a tunnel sequence which has been modelled to reflect an underground mine shaft. The methods and inspiration for this sequence are derived from an online Blender tutorial which discusses a procedural approach to Blender animation through the use of paths and duplicate frames [1].

2. Scenes

2.1 Space Scene

Description:

This scene serves as a basic introductory sequence where the camera waits for some text to pan in front of it before rotating towards a model of the earth and zooming in on that model.

Techniques:

- **Texture Mapping**

The model of the earth used in this scene is textured using a simple earth texture as well as an overlapping specular highlights map of the earth. This allows for the correct placement of specular highlights across the model. A third layer to the texture, height mapping was also introduced however this layer is disabled as the level of detail required by the model does not warrant the use of the bump mapping.

- **Keyframe Animation**

Another simple technique utilised by this scene is that of keyframe animation, specifically the animation of the text and the rotation and movement of the camera were generated by setting up the scene at various key time intervals and then creating keyframes. This simple and easy method of animation was then extended through the manipulation of the resultant IPO curves resulting in a smoother animation.

- **Environmental Textures**

The final technique employed in this scene is that of environmental textures. This scene uses the built in feature of stars within Blender coupled with a black background in order to easily simulate space. This method is useful for noting as a comparison to the image based texture map employed by the subsequent scenes.

2.2 Desert Landscape

Description:

The desert scene is used in this animation to reflect one possible method of terrain generation as well as the use of repeated textures on surfaces. The scene is also meant simply as a filler between space and the tunnel. Specifically the scene depicts a desert landscape with hilly terrain. The camera simply pans across this landscape and moves into the tunnel on the side of the hill.

Techniques:

- **Fractal Based Terrain**

The landscape used in this scene was generated using fractal subdivision and simple smoothing. A plane was initially created as the basis for the landscape, this was then subdivided to provide more vertices and faces. A fractal subdivision was then applied which divided each face into four further faces and then adjusted these faces using a fractal algorithm. This process of subdivision followed by fractal subdivision can be repeated various times to allow for terrains of increasing complexity,

however for this scene the process was only applied twice. The mesh was then smoothed and various vertices and faces were raised to allow for the creation of a hill. Smoothed falloff was also employed during the raising of the hill in order to maintain the consistency of the curves in the terrain.

- **Environmental Textures – Image Mapping**

As a contrast to the previous method of environmental texturing, this scene uses an image applied as a texture map in order to simulate clouds in a blue sky. This was achieved with the use of a sky and clouds texture image and the blending of that image with the relevant shade of blue for the scene. This environmental texture is used throughout the rest of the animation.

- **Repeated Textures:**

The texture used on the desert floor is a sand texture which is repeated five times across both the U and V planes of the terrain.

2.3 Tunnel Sequence

Description:

This sequence forms the basis for the animation, it involves the use of simple curves extrapolated down paths to create a realistic mine shaft. The animation in the scene involves the simulation of a runaway mine cart which flies through a twisting and turning mine shaft.

Techniques:

- **Complex Geometry with Curves**

Both the railway rails and the surrounding rock tunnel used in this scene are derived from curve objects. In both cases the outline or silhouette of the object was modelled using a Bezier curve. A path was laid using a NURBS curve and subsequently edited to create twists and turns for the shaft. The path was then duplicated to allow for both object to be extrapolated down the same pathway. Finally the curve objects were applied to their respective

paths as bevel objects and thus the complex shape of the tunnel was formed.

- **Pathways**

The same path that was used to create the rails was then also used as an animation path for both the camera and a two lights. The camera simply points down the tunnel and follows the same path as the rails. A simple point light was also implemented with low energy levels in order to allow for small amounts of ambient light within the tunnel.

- **Animation offset and empties**

In order to create the best headlight effect from the spotlight, an animation offset was used. Specifically an empty was created as an object which the spot light could follow which would not be rendered and thus impede on the rest of the scene. This empty was then locked to the original path of the railway and was edited to have an animation offset of -4 frames. This allowed the empty and thus the focus of the spotlight to always be four frames ahead of the rest of the animation allowing for the light to remain ahead of the camera and for it to illuminate around corners briefly before the camera turns that corner.

- **Duplicate Frames**

The wooden railway ties and the overhead wooden struts were created through the use of duplicate frames. A single railway tie and a single strut were created and locked onto the railway path. This meant that they followed the camera and the light through the entire animation. Duplicate frames were then however applied which allowed each object to be duplicated in the model for each frame. The Duplicate Off value was then increased to decrease the number of copies of the ties and struts. This allowed for each tie to be repeated every 5th frame and each strut to be repeated every 15th frame.

2.4 Billboard Scene

Description:

This final scene of the animation attempts rather unsuccessfully at present to highlight the use of particle physics within the Blender package. The scene involves the mine cart flying out of the mine entrance in a new landscape and crashing into a signboard advertising Afrigraph 2007.

Techniques:

- **Particle Physics**

This scene attempts to simulate the collision and subsequent destruction of the mine cart with the billboard. In order to achieve this a simple cone object was added to the scene and used as a particle generation object. Thus as the mine cart crashes with the signboard, the cone begins to generate particles to represent wood chips. The realism of this feature was not however successfully achieved and remains as a further extension and improvement of this project.

3. Sequence Editor

Once all of the various scenes had been modelled and their respective animations set up, the sequence editor was used in order to string all of the various animations together.

4. Acknowledgements

Tutorial

The tunnel sequence which forms the central part of this animation is as mentioned previously based upon the tutorial from Blendernation called “A Ride Through the Mines.”

<http://www.blendernation.com/tutorials/blender-3d-beginner-tutorial-a-ride-through-the-mines/>

Textures

Various sources were used to gather textures for this animation, each of which is listed below:

Planet Earth Textures:

<http://planetpixelemporium.com/earth.html>

Grass Texture:

<http://www.vectordepot.com/downloads/KATextureLib/grass4.JPG>

Sand Texture:

<http://mr-32587.mr.valuehost.co.uk/lessons/lesson5/images/sand03.jpg>

Wood Texture:

http://www.planit3d.com/source/texture_files/wood/wood50.jpg

Afrigraph Logo:

<http://www.afrigraph.org/conf2007/gallery.php>

Cloud Texture:

<http://mayang.com/textures/Nature/html/Clouds/index.html>