Animation project

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In this animation, a group of giant ducks attack Brock University, crushing buses, trees, and buildings on their way to the Schmon Tower, while some Tanks try to defend it, but are unable to

Interestingly enough, I'm not the first person to feature Brock under attack in my animation project. I saw another student that included the Schmon tower burning, although I was unable to see what he/she had made.

This report outlines the creative and technical process that I went through to create the animation. To play the animation, open DuckAttack.mp4. For resource sources, they can be found in the individual folders and in sources.txt.

Creative Direction and planning

My plan was to make something that I could reasonably create with my current skill-set while still pushing myself to improve. I wanted to use this as a change to gain experience in modelling natural objects (animals, trees, terrain) and artificial objects (buildings, vehicles, etc). In the end, I enjoyed the contrast between these to sides and decided to pit nature against civilization.

When making and placing the objects in the scene, I wanted the viewers to be able to tell where things were. I used the Schmon Tower, Mackenzie Chown complex, and Cairns complex as landmarks, as well as panning from the Schmon tower to the object being focused on. The first scene was meant to introduce the setting and to give an overview of where everything was. The second introduces the 'main characters' and the forces against them.

I wanted to use the explosion effects and to make use of moving camera angles, so I decided to have the two opposing forces (the tanks and the ducks) start out far away from each other and then move closer together, allowing me to film them separately and then together. Planning the camera angles first allowed me to account for how objects would contrast with the background and obscure other objects, and also provided insight into how the background and lighting looked from multiple directions.

My original scene would have been to have a group of ducks swimming over an ocean, with giant waves crashing down. Blender does indeed have ocean simulations and fluid physics, however I believe this would be far beyond my skills, and I did not come up with any ideas on how to extend the idea of make it interesting.

Models

Modelling was entirely done in blender. For the tank and the Duck, I used reference images found online. For the bus and for other objects, I had seen them enough to make a simple model of them. I did not rely on any tutorials to make anything, however I used the tree branches texture from one of the tutorials.

Fortunately for me I had a bit of experience beforehand, but nothing that had tested me as much as this. I found myself splitting objects into groups to edit the pieces individually, and then rejoining them at the end, which helped when managing the larger and more complex objects. Polygon counts were not really an issue in this case, as I was not rendering anything in realtime, and the effects and simulations seemed to take up most of the processing power.

The modifiers were very helpful, particularly the mirror modifier to ensure symmetry, the bevel modifier to keeps corners more rounded and natural feeling, and the subdivision surface modifier to add extra geometry where a more rounded shape was needed. I avoided applying most of the modifiers, as the physics and animations work even without them being applied, and so I am able to keep them on in case I want to make changes.

Terrain modelling was done with the sculpting tool mode tools. I simply scaled up a plane, subdivided it many times, and used the brushes.

Models can be opened in the .blend files in the models folder, using blender or other 3D modelling tools.

Rigging

Rigging is the act of adding bones to a mesh or object in order to control it. Bones are collected as part of a skeleton and can have many different modifiers and constraints to help make animating and posing easier. In this project I used two rigs: one for the ducks, and one for the bus.

Rigging for the duck was fairly complicated, as I was trying to get the walk cycle to have some weight to it without being difficult to adjust the bones. Fortunately the blender rigging tools once again have a mirror modifier to ensure symetry.

In addition to mirroring the individual bones on the rig, blender is able to mirror poses. Bones with a left or right suffix/prefix such as arm.L (or LeftArm) can have their pose copied, and pasted to the same right using ctrl-shift-v to flip it, applying the same action to arm.R. Center bones simply have their local transform reversed. This is incredibly useful for animating, as I don’t have to remember the exact transformations I applied to one side and then re-apply them perfectly to the other side.

After the skeleton is made, I then parent the mesh onto the rig. Blender allows the user to give automatic weights to bones, however I wound up having to touch up some areas with the weight paint tool. For example, moving the head bones would also move the wings, and moving the ‘thigh’ bones (do ducks have thighs?) would cause the tail to deform.

The bus rig was comparatively simple, I just needed a few bones I could move for the top and bottom parts of each end, so I could deform the bus when it gets squashed under the foot of a giant duck (that is a sentence I never thought I would write). I had to be careful not to deform the front part of the mesh as it would lead to the text sign floating in the air next to a crushed bus. The solution

Materials

For the ground, I wanted to imitate the large fields of grass without introducing to heavy of a load during rendering. I knew a simple flat green colour would look unnatural, so I used noise to alternate between green and dark green, giving the appearance of depth and randomness at a relatively low cost.

Most material properties were kept as default. A few were changed, for example, I increased the roughness of the tank hull material to make it less glossy, and I increased the transparency of the bus windows to make them see-through.

Texturing

Texturing work (aside from what is mentioned before in the materials section) was done using two ways: UV unwrapping and positioning, and texture painting. Once again, blender was used for texturing, as was a search browser to find textures.

Texture painting was used for the Duck texture. Texture painting consists of creating a blank image, and then using the brushes to apply colour to the models, which are then mapped onto the texture image. Once again, symmetry is important, and I made use of the paint symetry tools. To make it more easily visible, and to contrast the green of the tanks, I chose the stereotypical white and orange (or maybe it's just because it was way easier to paint).

UV unwrapping is the process of unfolding a 3d object and aligning each individual face with that of an image. I Used UV unwraps for the buildings and for the tank. Fortunately for me, unwrapping over a continuous series of squares is relatively easy. Some buildings were more challenging than others; the Schmon tower had it's pillars, Mackenzie chown had it's pyramid-like roofs, and Thistle was irregularly shaped. Blender has a lot of options for unwrapping an object, including smart UV project, lightmap pack, follow-active-quads, cube projection, project from view, and more. To tell the truth, I mostly just tried them until I found something that wasn't completely hideous, and then manually moved parts of the Uvs around.

The Tank turned out to be relatively easy to unwrap, as the faces were all conected fairly linearly. To simplify the texturing of the tracks, I split the tank body and tank tracks into separate objects.

Blender's UV and texturing tools are good, however in future projects I may choose to use dedicated texturing software such as substance painter, mudbox, and others (if I can ever afford them).

Effects

Blender includes built in quick effects for fire smoke, and explosions (as well as a bunch of other things that I am way too bad to use). Each quick effect is a preset collection of normal modifiers, so I am able to adjust it and also learn how they are made. For the explosions, I wanted to strike a balance between cinematic and semi-realistic effects. Unfortunately, too much smoke would block out much of the scene from view (and drastically increase rendering times) so I either had to make it dissolve quickly, or keep the camera far away.

Explosion effects consist of a particle source and a particle domain. The source serves as the point and control for the creation of particles, and the domain affects the bounds and collisions for the simulation. I chose to avoid collision for explosions and smoke to save processing power. In my opinion, it's hard to tell either way if smoke is clipping into walls, so this is a useful shortcut.

Fortunately, Blender is able to bake the explosion effects to save a bit of rendering time. This is done using the cache files in the project. The downside is that this prevents changes until the cache is freed up, however the tradeoff is worth it.

Debugging the effects took a bit longer than I had hoped. This is because some issues can only be seen after all the effects are applied and calculated, making it take longer to make changes. One problem that I had not solved until the end was the explosions not appearing in the final render. As it turns out, The render system that I used had a preset distance to render volumetric effects, so I simply increased it and everything was working

Animation

Animation in 3D modelling is (typically) performed using keyframes. Objects interpolate between keyframes to make animations smooth. Keyframes can be applied to objects, bones, and other scene objects.

The duck walk cycle animation was the most complicated part, and even after spending days on it I still wish I could have done better (it's never as good as in your head). Eventually I had to focus on other parts of the project so I polished it as best as I could.

The mode of interpolation is important for accurately portraying how objects move. Natural objects such as moving creatures and bones, and vehicles slowing to a stop, start out slow, then speed up, then slow down towards the end of a movement, while artificial objects and things kept in constant motion, require constant interpolation. This can be set in the Blender animation tools for individual keyframes or for entire animations.

Interestingly enough, I was able to animate the wheels of the bus and the gears and tracks of the tank without using keyframes. The wheels were made to turn using 'Drivers', which allows a transform (scale, rotate, translate) parameter of one object to affect the transform of another. By setting a driver for the rotation a wheel to the position of the vehicle body, I can automate the turning of the wheel by moving the car. Fotunately, due to it working in local coordinates, I can have the wheels turn regardless of what direction the vehicle is facing, however this did not turn out to affect the project. To see the wheels and tracks in detail, open up the tank and bus blend files and move the body forwards or backwards.

Some animation work benefited from rendering part of the scene first, changing it, and then rendering the next part. One example was when the sign on the bus changes from '316 Glenridge' to 'Not In Service' as it was being crushed (12 seconds in). This would have been difficult to do normally, as both signs are parented to the bus, which is parented to the bus's rig, which has it's own set of keyframes. Adding keyframes for the signs to swap them out would have been messy, as it would be difficult to set them to work with the rig.

In order to try and make the duck's march feel more natural, I had to stagger the animations. I expected this to be challenging, but realized I can just copy the keyframes and move them forward or backwards in the dope-sheet keyframe editor. This would place the rig at a different point in the animation, allowing me to make each walk feel more unique. Timing the speed of the ducks to make it look like the feet had traction on the ground also took some time.

I tried to add in smaller animations in the background as well to make the scenes feel more like living areas, such as small buses on the roads in the first scene, or trees being knocked over by explosions or ducks.

Rendering

I had to redo some of the scene rendering multiple times due to not liking how the result turned out. Problems included lighting, the wheels and tracks appearing to move backwards, and noticing clipping in the background.

Rendering of the scene videos was performed by processing each frame as an image and then combining them with the video sequence editor. The advantages of rendering as a single image are that I can more easily stop and start rendering, re-render a specific part, and observe render progress of the scene. For rendering dimensions I chose 1280x720 (720p). Images were rendered as PNG files for quality, and then converted into H.264 MP4 files. It was at this point that I could have added audio using Blender's built-in tools, however I decided to do it later in Openshot.

Blender has a variety of options for rendering as video, each of which can affect the rendering time, video quality, and files ize. To save space, I used the 'perceptually lossless' video rendering preset, which trades an almost imperceptible amount of quality for drastically reduced file size. There are countless other options, but usually the default options are the best for most situations.

One of the biggest and most important aspects of rendering is the lighting. As noted by the assignment handout, light level consistency is important. I had issues with overexposure at first, with some objects being too bright and others being completely in shadow. My solution was to decrease the power of the directional sunlight, and increase the ambient light. This is probably a bit less accurate than a system with an increased number of light bounces, but allows for pleasant visuals without burning my old computer to the ground. Even after this, some objects were in shadow, and some shadows that I wanted to be more visible were hidden (for example, I wanted the shadow of the duck to creep up on the bus before it crushes it). To remedy this, I rotated the angle of the directional light per scene. This would not work in a more drawn out setting, however, with the angle changes and the fast pacing, the issue is not as apparent here, as long as I do not completely flip the angles

Rendering time was a little longer than I had expected, fortunately I was able to work on this report and on other stuff in that time. My original idea had effects that would have taken much longer to render even if I turned down the settings.

Video Editing

Video editing was done via Openshot, an Open Source video editing and sequencing tool. This part was fairly simple, just adding together the rendered scene videos and adding the sound effects.

In the end, I decided to slightly speed up one of the scenes (where the duck steps on the bus). The original speed felt too slow and unnaturally drawn out, as if the ducks were moving underwater. Speeding things up tends to work better than slowing things down in a video editor because we aren't spreading frames over a longer time, preventing the animation from being choppy.

Openshot tends to have audio issues when combining many sound effects. I had to remove a lot of them for it to not get too abrasive to listen to. Fortunately, with the new update, and an update to the sound codec libraries, it appears to have gotten a lot better.

Corners cut

This wouldn't be a true animation project of mine if I didn't skimp on a few areas and hide them behind scene elements.

The trees are all the same object, just scaled and rotated. As they look different from different angles, it allowed me to make just one tree and repeat it. To a lesser extent I did this with some of the buildings in the background, the tanks, and the ducks, giving them different rotations, vectors, and timings to add variety. I also duplicated the terrain so that the background did not cut out abruptly.

I am clearly not the best at UV editing, and it seems to show if you look at the buildings for long enough. For most of the roofs, I just scaled the UV's down until the roof looked flat and monotextured.

I did not really make Brock university accurate. It's close enough to the real thing to tell, and you can make out the Schmon Tower, Thistle, Mackenzie Chown, Plaza, and Cairns buildings, but many are missing (and to make matters worse Brock insists on adding new buildings every time I go there!) Most importantly, the massive parking lots are gone, as I didn't just want to have an empty grey plane, but also didn't have time to model a bunch of cars.

Anatomically speaking, my ducks probably could not exist even if they were scaled down to normal sizes. They would also not have the use of their wings, as I did not animate that part.

Conclusion

What worked

- Going in with a flexible idea of what to include and how to reuse the objects I had created allowed me to save time and put it towards working on other aspects of the project
- The effects and animations worked well together using the keyframe system, allowing a high degree of control.

What didn't work

- Trying to keep everything in the same scene caused a lot of performance issues as I was trying to make changes. Eventually I kept most things in their own file until needed.
- My original idea was way too ambitious, I had originally intended to have way more buildings and effects, UFO's, and other objects in the scene.
- As it turns out, ducks are hard to animate, and harder to make intimidating, especially when up against tanks.

What I learned

- I gained a ton of experience in working with the tools, as well as a lot of miscellaneous knowledge on computer graphics and on duck body parts

- The moving tracks and turning wheels of the vehicles looked really nice, but trying to show them off too much can result in angles that ruin shot composition if not done carefully. Overall, I think I have to design the scenes first, and then the objects that appear on them, rather than creating the objects, and then trying to bend everything to fit them.
- Try as I might to go through my scene carefully, I'll never have a full grasp of how things will turn out until I do a test render. This can drastically add to the time it takes to finish a scene.
- I need a new computer.

What I will do next time

- Get a new computer
- Actually plan ahead and be more reasonable
- Organize from the start
- Improve my use of tools and look for ways to speed up workflow.

Other statistics
Total number of frames: 2400 (in video sequencer)
Number of crashes during production: 5 (3 in Blender, 2 in Openshot)
Maximum number of vertices in scene: 500 000
Maximum number of triangles: 910 000
Times I said 'Duck' in this report: 22