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Building and Using a Character in 3D Space

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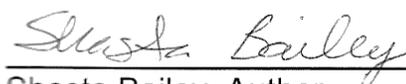
Building and Using a Character in 3D Space

Thesis submitted in partial fulfillment of Honors

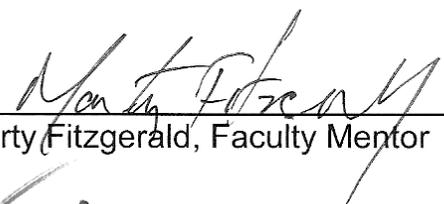
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Introduction

Characters, whether in books, movies, or video games, are one of the most important factors to consider when trying to create media that people can connect to. By undertaking this particular project in which I created a character and took it from conception all the way through the 3D creation and animation process, I was attempting to bring to life a character that I could connect to, and maybe others could, too.

Video games and animated media have been a huge part of my life since I was very young. As an only child I spent the majority of my time entertaining myself, something made easier when I was introduced to the Nintendo Entertainment System. At the age of seven I got a Sega Saturn and my first introduction to 3D generated games. At the time I enjoyed video games, but didn't think much about how they were made. Around the same time I was also watching animated series like Sailor Moon in the afternoons and was inspired to start drawing in earnest due to my desire to emulate the characters I was seeing.

An arguably life changing event occurred at the age of ten when I saw a commercial for a soon to be released game called Kingdom Hearts. The game contained beloved Disney characters combined with other characters whom I found to be well designed and aesthetically pleasing. I was enthralled and desperate to play. When I got the game I found myself enchanted by the graphics and the story line and for the first time I found myself thinking "this is what I want to do with my life."

From that point onward I started to take art more seriously and began designing and drawing my own characters with their own worlds and stories. I had determined that nothing would make me happier than being able to work on videogames and bring

characters to life. Since then I have been working with that goal in mind. In many forms of media: books, movies, and video games, there are a lot of things that go into creating something that people will enjoy; it needs to be relatable. When I engage with media I tend to relate strongly with characters, so I have a great desire to create characters that I and other people can relate to. Relatability comes mostly from personality, but an aesthetically pleasing design doesn't hurt either.

The Project Outline

For this project, I designed a character in 2D using a couple of different art programs and then took the character to 3D. The initial design for the character was created in a free art program called Alchemy, which is basically a random shape generating program. I then took the design into a digital painting program called PaintToolSAI and fleshed out the features that I wanted to keep. A free program called MakeHuman and two Autodesk programs, Maya and Mudbox, were used for the 3D modeling, texturing, rigging and animating. I worked on this project for a span of around 7 months, a few hours per week. The 3D part of the process took much longer than creating the initial designs, but for me, the design process was the most enjoyable and least stressful part of the project.

The Design

Since I was young I've been creating characters, trying to design things that were aesthetically pleasing to my own eyes. Over the years I've come to be familiar with many different ways of designing characters, like using design prompts or looking at

photos for inspiration. More recently I've begun using the free program Alchemy to create random shapes and silhouettes that I can then pick out features from. This method of design is kind of like throwing splatters of paint against a canvas until you see something within the random shapes. People have a tendency to pick out the familiar, which is why you can look at the clouds and see images in them. Using Alchemy I went through a number of random silhouette shapes (see fig. 1) before finding one to work with (see fig. 2).



Figure 1: Example of silhouette



Figure 2: Chosen Design from Alchemy

I fleshed out some of the figure that I could see within Alchemy using more controllable shape creators, then exported the image as a .png and opened it in PaintToolSAI. In SAI I painted over the figure, mostly the face, in order to better render the features (see fig. 3). I then used layer options and more painting tools to add color to the grayscale image (see fig. 4).

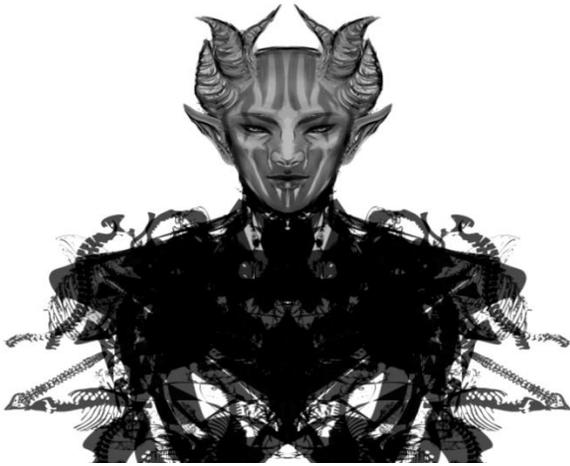


Figure 3: Grayscale Painting

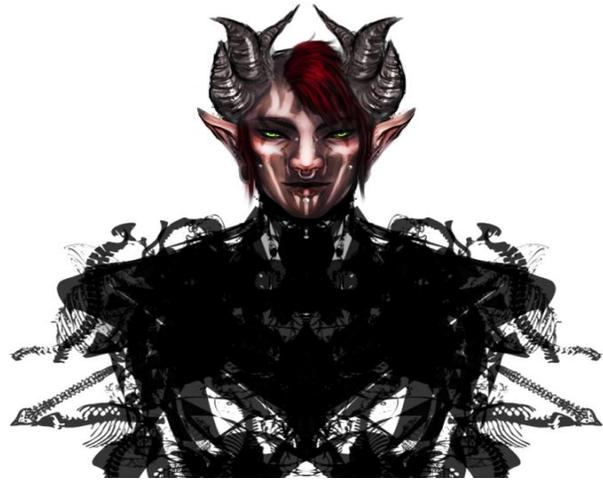


Figure 4: Color Painting

Finding the initial design to be a bit cluttered and perhaps overly detailed for what I felt comfortable doing for this project, I worked to simplify it a bit and came up with a final look for the character (see fig 5). The world space he is meant to live in is sort of modern era with supernatural creatures inhabiting the same spaces as humans, similar to the world of *Hellboy* (movie-verse). I admit to being enamored with almost all of Guillermo del Toro's works, so it's safe to say that I find inspiration for many of my designs from him.

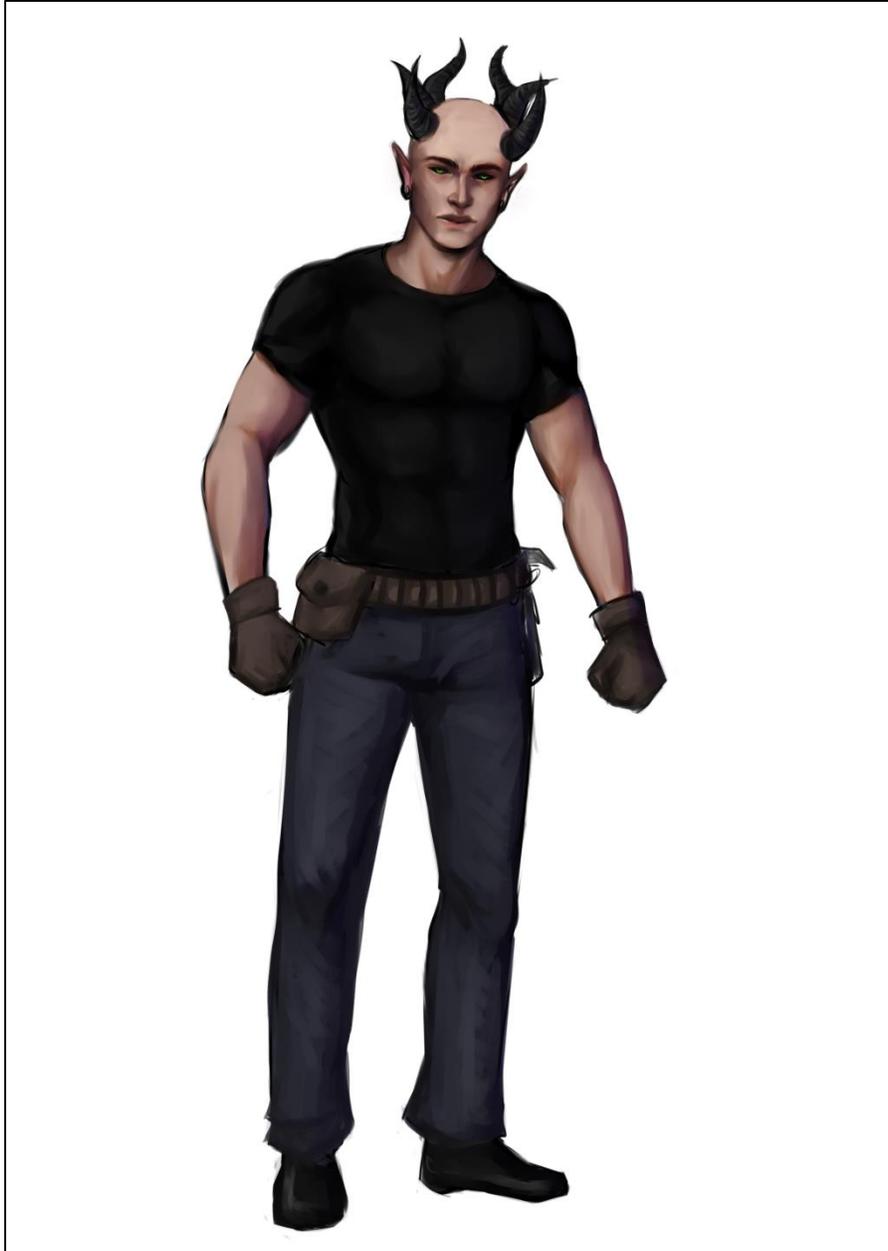


Figure 5: Finalized 2D Design

3D Modeling

Once I had a design hammered down, I was ready to take the character into Maya and start the 3D Modeling process. To save time and to ensure I ended up with a proportionally correct model, I started off with a model from the free program

“MakeHuman”, which allows you to create human models and customize their characteristics, like face shape, body type, et cetera. I tried to get the body type and, to a lesser extent, the basic facial features that I felt suited the character (fig 6). Once I felt I had exhausted the options for customization within the program, I pulled the model into Autodesk Maya, a 3D modeling software, and started working on modeling and fixing things that were off with the base mesh.

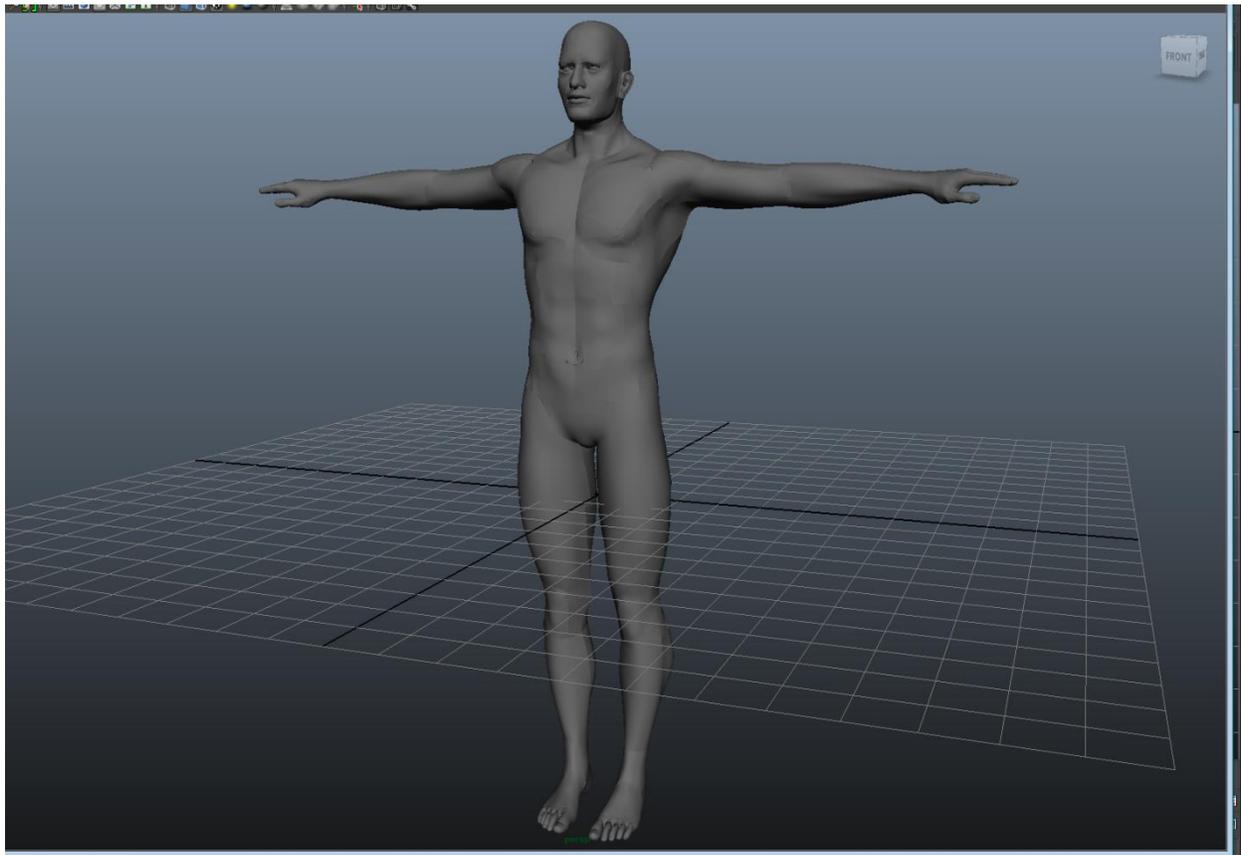


Figure 6: Base mesh exported from MakeHuman

The mesh exported from “MakeHuman” was in pieces so I had to combine all the meshes shapes to create one piece of geometry to work with. After that I had to go about fixing some of the errors in the geometry that aren’t good for modeling, like shapes with less or more than four sides, as modeling in Maya is mainly quad based. I

found myself having to delete a number of faces and rebuilding some of the mesh before I actually began modeling in earnest.

Once the mesh appeared to be in a fit enough state to work with, I started shaping the model to more accurately reflect the character that I wanted. I adjusted facial features, bulked up on some of the muscles in the body, and began working on the ears (see fig 7.)



Figure 7: Basic Modeling

After this, I deleted half the mesh and started working on just one side of the model so that I could later reflect the mesh and get a completely symmetrical figure. It's easier to work this way in Maya than to attempt to model both sides of something the same way. I finished modeling the shape of the horns and ear, and then reflected the mesh to work

on the face a bit more. Once I was happy with the basic geometry I smoothed the mesh in Maya and did a bit of sculpting on the face and body to bring out features that I felt were important to the character, like the deep-set eyes and angular nose (see fig 8). Once I had the body the way I wanted, I went back in and modeled the clothes. Initially I had thought to use a cloth simulation in Maya that would make realistically simulated clothing, but realized that the simulation was a bit too much to work with for this project. Instead I decided to just model the clothes from the mesh I already had to keep a simpler model (see fig. 8).



Figure 8: Mesh with clothing modeled

UV Mapping

After I finished modeling, I had to UV the model to prepare it for texturing. UV Mapping is kind of like cutting the model apart and folding the pieces out flat so that a 2 dimensional texture can be applied to them. For me, UVing is probably the least enjoyable part of making a model. It's tedious, but it's one of those things you have to get past in order to texture it. I used a combination of planar UV mapping and spherical UV mapping to get the model's UVs to an acceptable state for texturing. After a few hours of work I finished the UV map and was ready to apply textures (see fig. 10).

Texturing

For texturing I went into another Autodesk Program called Mudbox. Mudbox is typically used to add details to a premade mesh through sculpting and painting on top of it. Textures from Mudbox can then be exported and applied to the model in Maya.

To begin, I focused mainly on painting the texture of the skin. I started off with undertones of reds, blues and yellows; colors that are found in light toned skin (fig.11).



Figure 11: Base Painting on Skin

After the initial colors were laid down I went back in and added some details like veins and deeper areas of color. After that, I went back over with a lighter tone; overlaying the colors I had already put down to make them a lot less intense and give the skin a more even tone. I finished texturing the skin and painted the horns, and I also put flat tones down on all the clothing (see fig. 12).



Figure 12: Completed Mudbox texturing

I then exported the texture map and pulled it into Photoshop where I could add some more detailed textures to the clothes. I downloaded some cloth textures off of a free texture website called “CGTextures.com” and I overlaid cloth patterns on the jeans and the t-shirt to give them a better look when it was time to render the 3D model.

I saved the edited texture map and imported it into maya, and applied it to my character model (fig 13).

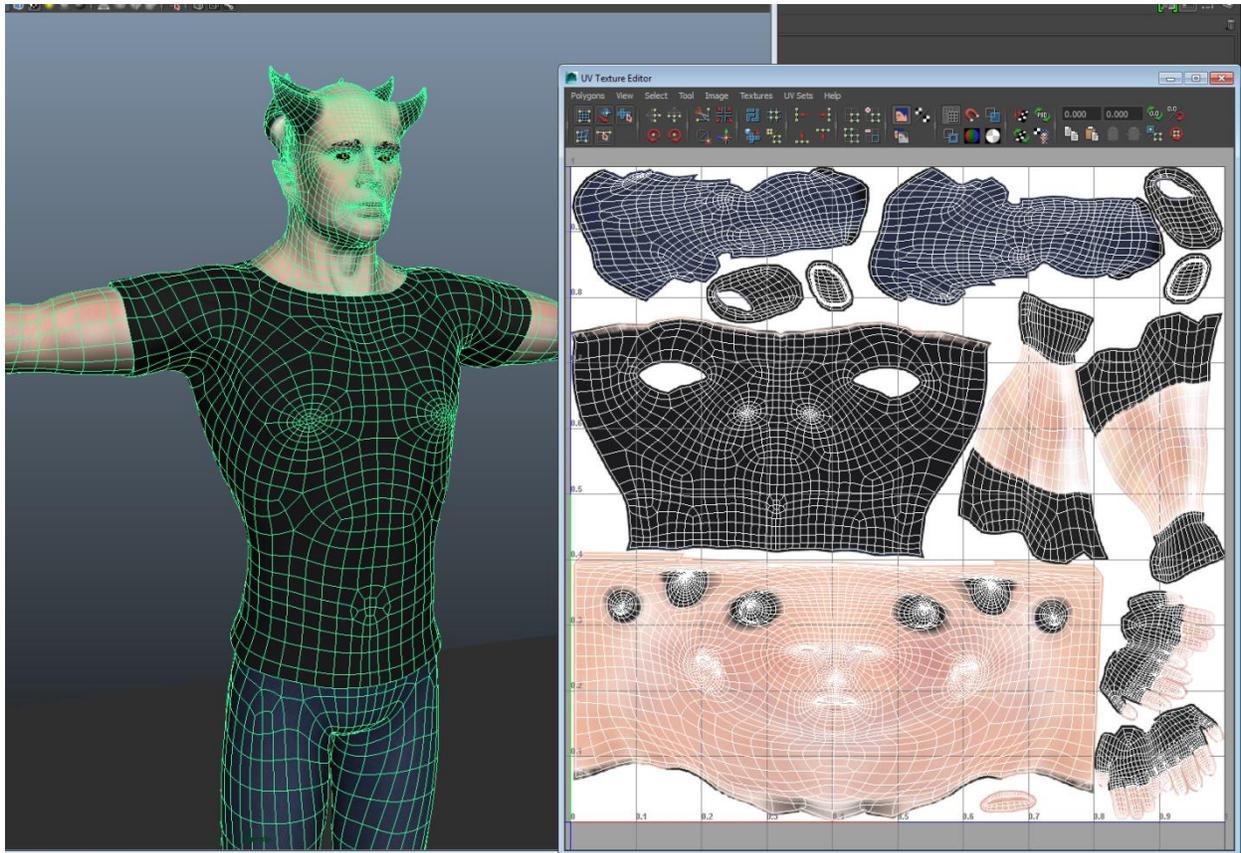


Figure 13: Character model with applied texture

Rigging

With the model and texturing finished, I was ready to rig the character so it could be animated. Rigging is arguably one of the most difficult parts of creating a character as there are many ways to go about doing it, but it's extremely obvious if it's done the wrong way. Body parts aren't going to move the way that they're supposed to if the character isn't rigged correctly. With the help of my thesis mentor and a number of online tutorials I was able to overcome a number of rigging problems.

Rigging is basically building a skeleton for a model that can then be used to move the model. Maya comes equipped with tools to help with rigging. I started off creating the joints that would be needed for the character to move properly, the same joints that are in the human body. Generally one starts rigging from the bottom and builds up, so I began with the feet. I used what is commonly known as a reverse-foot rig to rig the legs and feet and ensure that they worked properly.

After creating the feet, I moved onto the spine. The spine is somewhat complicated to rig due to its need to be twistable. Most other joints in the body simply bend, but the spine also twists and so requires a bit of extra work to get it working properly. Above the spine I made the neck and head joints using the same process as with the spine so that the neck could twist.

Once finished with the spine and neck, I went to work making the arms, starting with joints for the collarbones and working outwards, down to the wrist. I created the joints for the hands separately and later connected them to special bones called Bind bones, which are basically duplicates of existing bones created to ensure smooth transitions from FK to IK and vice versa. FK means “forward kinematics,” while IK is “inverse kinematics.” FK and IK are two ways of articulating joints to be controlled. Generally legs are done in IK while arms are most often animated in FK as FK controls allow for more freedom of motion.

After creating the bones and joints for the character, I was ready to create controllers for those joints to make the character easier to animate. Controllers are most commonly made using curves, part of Maya hardware that shows on the screen but is not geometry. Once created, controllers can be connected to the various attributes of

the rig's joints, like rotation and translation (linear movement up, down, or to the side).

There are also controls that affect other things, like FK/IK switches for blending between the two modes.

The controllers for the arms and torso were fairly straight forward, but more complicated were the hands. Rather than created separate controls for every finger joint like is done with the other joints in the body, it's better to create one control that can control all the finger joints separately. I achieved this through the use of "set driven keys," a process which allows you to create attributes with whole number states, and connect these attributes to different number states on the rotation attribute (or any attribute of your choice) of the finger joints. This allowed me to basically say "when the controller attribute of the first joint in the index finger is at ten, the first joint of the index finger will rotate forty-five degrees in the Y(up/down) direction," or something similar. I had to create these keys for each finger joint in both hands.

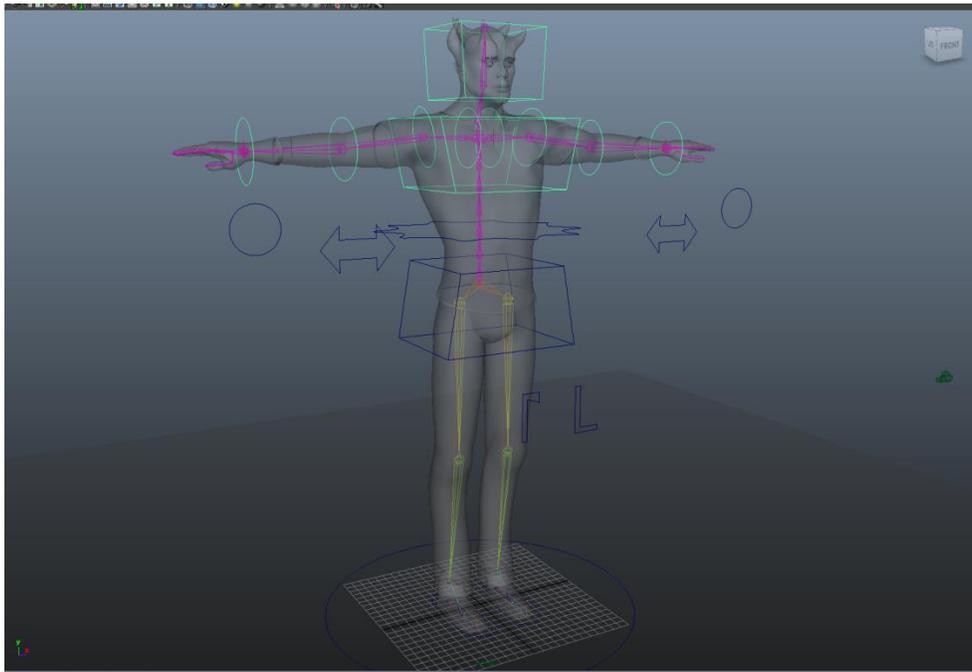


Figure 14: Finished rig

Skinning

Once I had the rig built (see fig. 14), I could take the character mesh and use a process called skinning to connect it to the rig and be able to move it. Skinning basically connects sections of mesh to the joints nearest to them, and allows moving the joints to affect and move the mesh. A computer program is only so smart and skinning rarely goes perfectly the first time, though, so I had to go in and tell the program which parts of the mesh should be affected by which joints. Maya makes this easier with a process called “paint skin weights,” which allows you to color in the areas affected by a single joint.

I tested the rig, moving the controllers so that the joints and by association the “skin” would move in order to see what problems needed to be fixed. There are sometimes points that get connected to joints they needn’t be connected to, so I went in and selected these points and removed the controls of joints that didn’t need to be controlling them. I also painted quite a few weights onto the areas affected by the spine and hip bones to allow for smoother motion when moving the legs and arms.

Once I felt like the skinning was finished, I took the mesh for the eyes and eyelashes/brows that were as of yet not connected with the main mesh and combined them. I then parented the combined mesh under the head control of the rig so that they would move with the head when it moved. At this point I felt like I was ready to begin animating the character.

Animation

I decided to animate a walk cycle as being able to create cycling animations is important for working on videogames, as that is how game characters are typically

animated for the bulk of the game outside of cut scenes. Animation is done through the use of key frames, which take the selected attributes of the rig controllers and “key” them, or save them at a certain point in time. I started off with a blocking pass and only a few key frames of animation on the arms, legs and feet. A blocking pass allows you to get the basic motion and timing down, like the foot falls and the swing of the arms.

After the blocking pass, I went back in and added more detailed key frames to the animation. Things like the sway of the hips, the bob of the head, and the rotation of the ball and toes on the feet were all worked on during this stage. Once I had all the motions that I felt the animation needed put into the key frames, I went into Maya’s graph editor and began to offset some keys so that the motion wasn’t completely uniform and robotic looking. Offsetting keys is the one of the most important things to make an animated character seem less stiff.

Most creative pursuits end in results that can be called “finished” and yet can always be improved upon. Animation is no different, and so once I reached a point where I was pleased enough with the animation to call it complete, I did so, even though I know given more time the animation could certainly be improved upon.

Rendering

Once I finished the animation I was ready to render it. Rendering is the process of turning all the work done in Maya into something tangible like a finished image or, in this case, a video of my animated character. I chose to render using mental ray rendering software. Mental ray has many options that allow for more photorealistic looking renders. I used the “physical sun and sky” present in mental ray to create the lighting for my character then rendered out the animation sequence from three different

views as a way to showcase the animation. From there it was easy to composite the three views together in a video editing software and end up with one final video that showed all the work put into the project, from the design of the character to the modeling, texturing, rigging and animating that I had done (see fig. 16).



Figure 16: Screenshot of 3-View walk cycle animation

Conclusion

For the time I've been at ETSU, I've often wondered if I should have gone for an art degree rather than degree in digital media that I've worked towards, simply because it would be easier. While working on my thesis however, I came to realize that everything I was creating wouldn't have been possible for me without the classes and professors in the digital media department, and to be cliché, I really loved being able to bring something that I had created to life.

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