Octavia

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ABSTRACT

Octavia is a 3D animated story based on experiences of Army divers in the waters of Southeast Asia. I built a strong core set of skills in end-to-end 3D animation throughout my time in the graduate program, and I wanted to incorporate them into a real story for this thesis. The myriad of stories I grew up with inspired the development of this 3D animation due to their uniqueness and their nature as a verbal history.

This thesis is based on two objectives: technical excellence in the process of 3D animation, and sharing a previously verbal history to a larger audience. I achieved these goals using a variety of technical animation tools including ZBrush, Maya, Arnold, and Premier.

Octavia itself is a modified story from my father's time diving in South Korea. The story details the interactions between an exceptionally curious octopus, Octavia, and a diver, taken from Octavia's perspective. The animation was well received during my defense for its technical difficulty and unique art styles. *Octavia* will be available online on my website.

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GENERAL AUDIENCE ABSTRACT

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Introduction

Animation has always been a love of mine, so much so that I ended up deciding to double major in it along with Art Education. This meant much more work for me, but it is what I wanted. As I went through my undergraduate program I took classes in many different disciplines of art to become well rounded with, at very least, an understanding of each subject. The disciplines I needed to have knowledge of included Drawing, Painting, Ceramics, Photography, and Sculpture. No animation or digital art to be found, and I did not think too much of it, because I was doing it myself. I graduated, got a teaching position, but not under the art department, under the Career and Technology Education (CTE) Department where I taught digital arts. Still feeling like an art teacher, I taught the same way I would have - as if I was in an art room. It was not until I attended my third Art Ed Conference and was talking to another art teacher that I realized that Technology, Digital Arts, and Animation scared many art teachers because they were so unfamiliar with them. Seeing this disconnect, I was inspired to continue my education in the digital arts to be able to bridge the gap between traditional arts and the digital. This inspiration lead me to a thesis on 3D animation, featuring Octavia the octopus and her adventures.

Inspiration

Beginning this project, I needed to determine the central themes, stories and characters, and in order to do that I looked inward to those subjects that interest me the most. I have a deep love for animals and nature, but that provided too many options. To narrow it down I looked at the parts of my life that were

Figure 1.1 Old diving suit with Mark V Helmet

unique and memorable. Some of the unique and memorable moments come from my father's many stories from his years as an Army Diver.

I remember many of the stories from my father myself, and my father is always happy to tell more, but I had a wonderful opportunity to broaden the options and collect stories from dozens of divers. Every two years a group of close-knit diver friends host a meeting at the army base to catch up, tell stories, and keep their friendships alive. This was the excellent opportunity I wanted to collect as many stories and as much inspiration as I could.

I went to the reunion with my parents, armed with a Zoom audio recorder and a camera. When I arrived, I found dozens of divers, old and young, more than happy to share their stories and boast of their accomplishments. Throughout the night I talked to many divers both retired and active duty. Many of the divers were shy to do either an audio or video recording, but some were willing to speak for the Zoom audio recorder. So for the ones that were willing, I recorded their stories. When I talked with them I allowed them to tell me any story from their time diving they wanted. Some people told me their life stories, some were afraid of cursing, and some told me silly stories. For the ones that were not afraid it was very fun to hear their stories. I even talked to and recorded the stories from one of the three attending WWII divers, who told me his life story and showed me many pictures from his time in the Army as a diver. By the

Figure 1.2 All Divers in attendance for the 2017 Diver's Reunion

end of the night, I had all of the stories I needed, but I felt as though I was missing some historical context.

I went to the Transportation Museum on Fort Eustis, in Newport News, Virginia, and talked to some people in the museum who allowed me to look at the research they had on Army Diving. Unfortunately, the data was thin. Divers do not keep a well-documented history and the most information I could find was in the form of old magazine clippings and outdated instructional books. Luckily, I was able to collect more information from my father and other divers who were also digging up their old history.

Information

After collecting both stories and history, it was time to start planning my project and deciding what exactly I wanted to do. I decided to focus in on one story for time constraints - A story about how curious octopus would come up to the divers and attach to them in the waters of South Korea. I did not want to follow the stories verbatim. The real stories end with an octopus dinner, which I did not want to animate. I decided to create a version inspired by the original stories with a slightly more kind ending for the octopus. I did want to keep some of the bits of the story the same, for example the place - South Korea. Because I decided to have the setting of the story to be in South Korea I wanted to look up the types of fish that can be found off the shores to potentially use in my project.

I began by drawing some of the sea creatures that were possibilities to make it into the final animation. After drawing the fish I decided to make some small figures of the fish to use for models before I began to create them in ZBrush (3D modeling program). To create the small figures I used Sculpty polymer clay that is baked to cure it and then painted them similarly to the

drawings I had made. In the end, I had a sketchbook of creatures, and a few small clay models to help me bring the digital versions to life.

Figure 2.1 Sketchbook drawings of different species of Octopus

Figure 2.2 Sculpy Model of an octopus

Figure 2.3 Sculpy Model of a Japanese Butterfly fish

Before I could start to make the models to animate, I had to create the story, which meant quite a few decisions needed to be made. How closely was I going to follow the stories I had collected? How much history needed to be accurate? What story did I actually want to tell? Who was the target audience? I needed to answer many questions.

Now the answer to these questions changed along the way of developing this project, and that's ok. Originally, I thought I might recreate several of the stories in a little series - and I may still do

that in the future - but I knew I would not be able to do the stories justice in such short time. I settled on one story –The story of when an octopus attached to my father's facemask and nearly pulled it off, and swam away. I was interested in telling the story from a different perspective. The story needed to be loosely based on the original. I also needed to rework the core story since I was not following the original ending. Furthermore, I needed to create a lovable character for the audience.

Unfortunately, I had not asked myself - Who is my audience? At first my answer was "everyone", but that answer was too broad and lazy. The story I picked would appeal to the older audience, but I decided to target middle and High school students for the style and artistic elements. This combination is tried and true in the industry with many blockbusters following the formula such as DreamWorks, Shrek. With the guidelines drawn and the decisions made, it was time to plan the story in detail.

I created my storyboard by drawing out each scene on small squares of paper, which I could organize, and order into the best storyline. I created 36 scenes on my storyboard to plan the story. I worked extensively with Simone Paterson to refine the details and create a unique and well-defined story. Once the story was complete, I taped the story scenes into their final
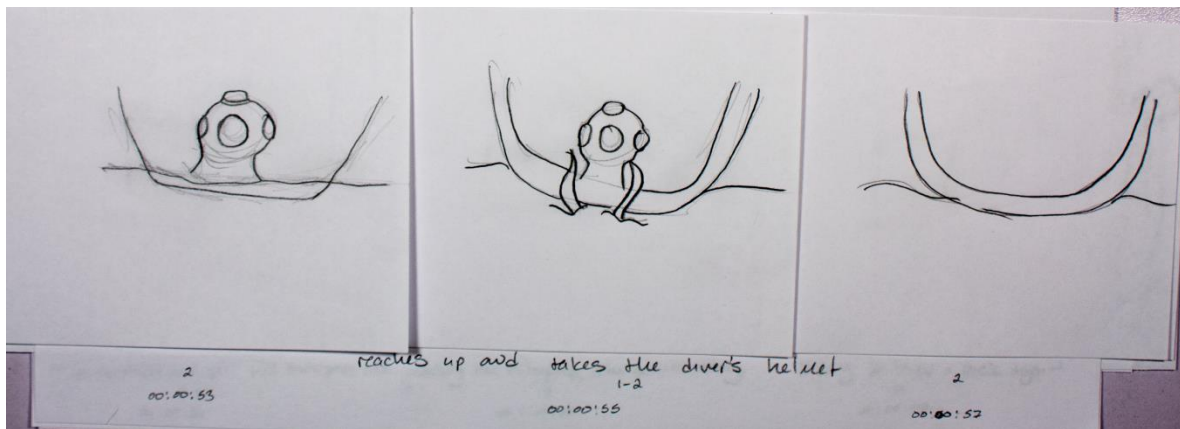

Figure 2.4 Small piece of the storyboard

ordering, and then I began the lengthy process of bringing the story to life in digital space.

Modeling

To make the characters I used a program called ZBrush to sculpt them much like I would with clay. It feels different because it is on a computer, but some of the same core concepts still apply. Other options of programs that are similar to ZBrush are Autodesk's Mudbox, 3D- Coat, 3D Paint, Sculptris, and 123D Sculpt. Of the options mentioned, 3D Paint, Sculptris, and 123D Sculpt are free to use. Despite this wide range of options I chose ZBrush because it is the industry standard, and because I have prior experience in classes in the graduate program. To model Octavia I used many different pictures and of Pacific Giant Octopus to observe shapes, proportions, texture, and anatomy. Using these resources, I sculpted Octavia to be as anatomically accurate as possible. With my main character modeled, I then looked to the secondary characters and objects I needed for my story.

Next, I needed to model the divers' helmet, but I did not want to spend the amount of

Figure 3.1 Real and scanned versions of the helmet

time I knew it would take me to model. I started looking for other options, and the main one I could think of was 3D scanning. 3D scanning is where you take an object and use a handheld 3D scanner combined with a spinning table to scan object into digital space. The scans then must be stitched together to make a model. My father owns a small, but very accurate, replica divers helmet, which I borrowed for the scan. When you scan an object it must not be shiny, black, clear, or any combination of those. The helmet I had was shiny, so I expected a very poor scan, but it actually came out pretty well. When you scan something it is never perfect, there are holes or little extra floating bits you must repair. I brought the rough model into ZBrush and Maya. I used Maya to fix holes and missing parts of the scan, and I used ZBrush to smooth out the scan and add small details that were lost in the scan. Overall, the 3D scanning process was a resounding success and cut a significant portion of time off when compared to traditional modeling. However, I still had more models to create.

I continued my modeling of objects using ZBrush. I created two different boats – one tiny toy boat, and one large and real boat. Next, as part of the storyboard, Octavia would create a diver out of small stones, which I would have to model. Due to the nature of modeling rocks, Brendan Casey, a fellow student at Virginia Tech, offered to let me use some of his rocks he had previously modeled to help speed up the process. I happily accepted, and moved on to the long and tedious task of creating the rock-diver. In the process of creating the rock diver, I used hundreds of the rocks to balance and build the shape of a human. Finally, I needed a diver. After scoping out the time, difficulty, and complexity of creating a diver model from scratch, I made the decision to use a premade model, purchased online, instead of creating my own. I made this decision for a few reasons. Firstly, the diver is not the main character, and I would only use it as supporting cast. Secondly, the modeling and rigging of the diver was not possible under the time

constraints. Finally, I do not like modeling humanoid figures. With all of the models created, it was time to move on to the next step of texturing.

Texturing

From modeling the characters, I already had to make some decisions on how the characters would look, but I needed to put thought into the rest of the appearance of the characters as well as the overall look of the final project. I decided from looking at some other artists that I wanted to try printing the UVs of the characters and objects and painting them with real paint, and then transferring those paintings back into the computer to go on the models. In order to be able to apply what is known as a texture (color) to a model a UV map needs to exist. A UV map is similar to the foil that is around candy with a design to make it look like Santa or a bunny. It looks like Santa when it is all wrapped around the chocolate, but when you unwrap it the foil looks strange and stretched out. That is exactly what a UV map does, it is a flattened version of the model, that can be wrapped back around to give the model its appearance.

Figure 4.1 Example of a how a UV map works

That is what I tried. I printed the UVs large 2k by 2k on printer paper, so I had to piece the things back together, I traced the outline to make it darker for when I transferred it to watercolor paper. I realized I had one major problem. I did not know what was what on the UV set. Meaning I did not know for the octopus where all the suckers were because I could only tell where the outline was. I realized I needed to go back if this was

Figure 4.2 UV Map of Octopus with colour coded sections to indicate locations of details

going to work. I went back to ZBrush where I had the option to paint directly on the model I had made so I chose a few colors and painted in different features - suckers, underside, top, beak, and eyes - and printed the map again. Now with things roughly painted I could see where each part was located.

Figure 4.3 Outlined Octopus head on watercolour paper

Using a light box, I traced everything onto sheets of 11 by 17 watercolor paper, so the paper would not warp much. After doing this, I chose to use acrylic paint, mostly because I am not patient enough for watercolor, and because I knew I could get the look I wanted. After the UVs were painted I had to get them back into the computer, I photographed them as straight as I could and put them

into Photoshop to alter and make fit back to the original. Now it could appear on the model itself as the texture.
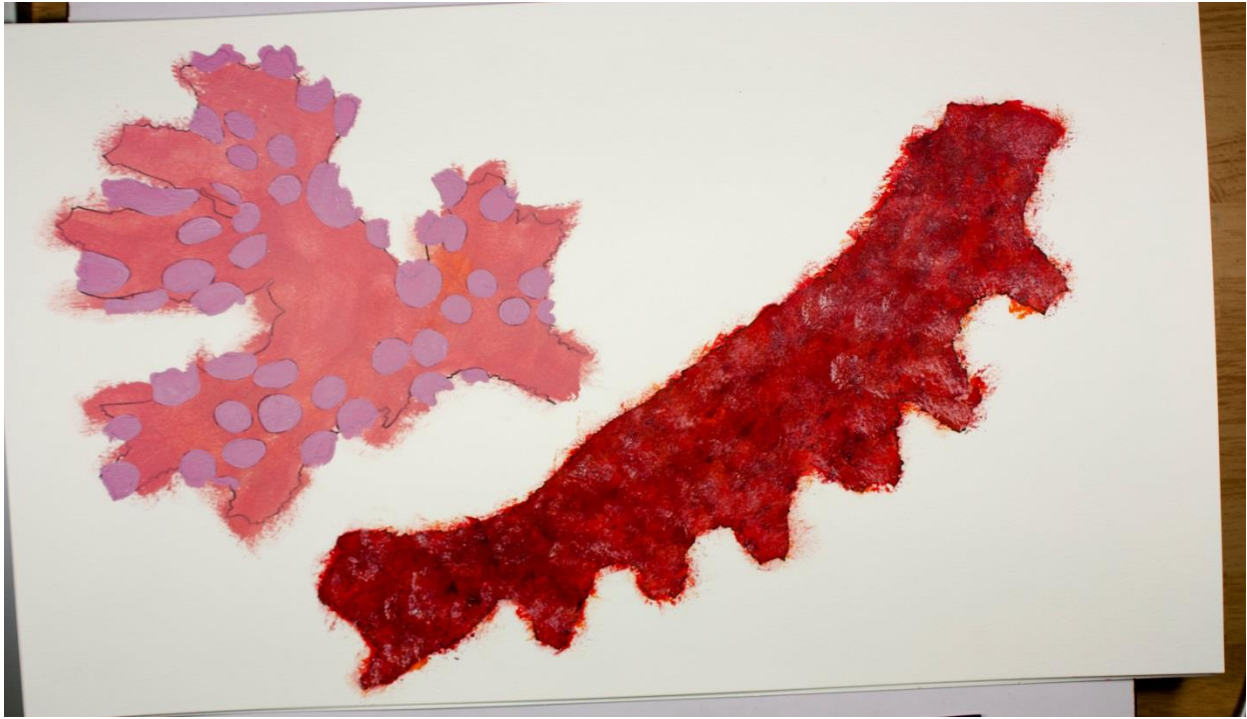
To take the textures one-step further it was suggested that I use another program called Substance Painter, which is kind of a Photoshop for 3D models, so I could see the changes being made on the model itself. I could also create the many different types of maps that can be layered to create interesting and unique effect when rendering the final product. With Octavia and the other models fully textured, I took the next step to Rigging.

Rigging

After creating the characters, I had to get them prepared for animation. I seriously considered how they would move and how much control I wanted for that movement. In order for these models to be able to move, a process called Rigging must take place. Rigging is adding a skeleton to the model and this skeleton is what allows one to be able to move the character.

More specifically, there are three main parts to a rig, the joints, the skin, and the controllers. The joints are the literal skeleton, like bones in your own body. The skin is the model and it must be bound to the skeleton, and then weighted. This means attaching the skin and then telling the joints what part
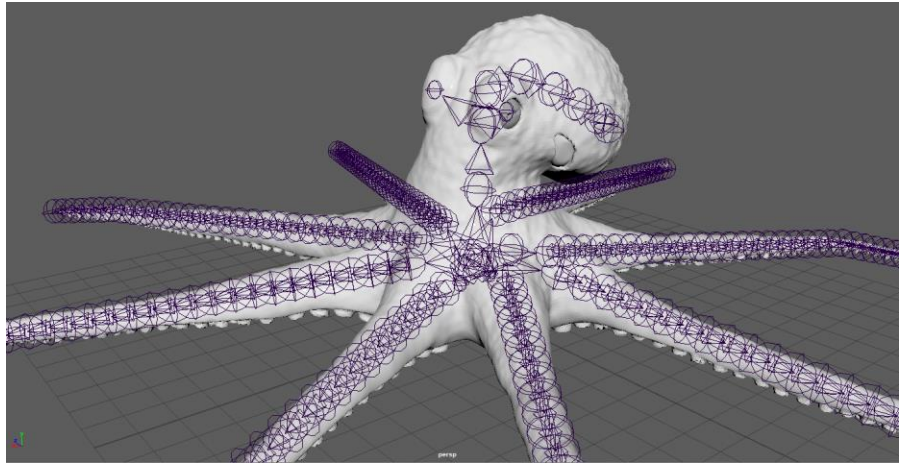
Figure 5.1 Showing the Skeleton created for controllers to attach

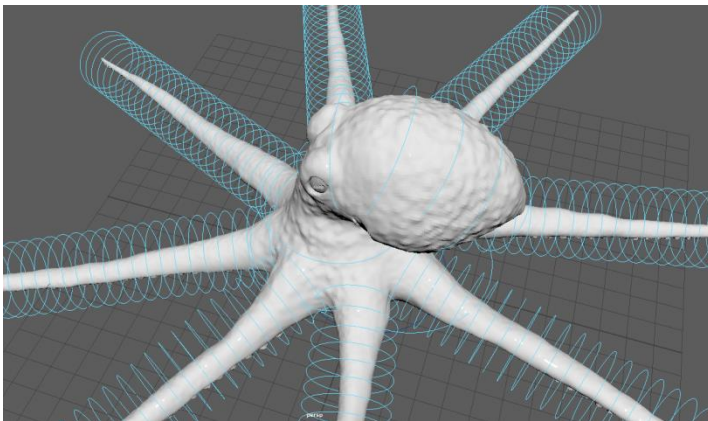of the skin they can move and how much it can move. The controllers are attached to the joints and are like strings attached to puppets, these allow the animator to work without having to move the joints themselves. These controllers can also allow the animator to move multiple joints at the same time in different ways.

Figure 5.2 Showing the Controllers used to manipulate the skeleton

I created the rig for my octopus using a plug-in for Maya called Advanced Skeleton 5. This handy little plug-in makes rigging process take about 4-5 hours if you are creating a complex rig, which is vastly better than creating a rig the traditional way, which can take weeks. So how this tool works is you input some information in the beginning like what type of creature you are creating; biped (human-like), cat, bird, etc. and it gives you a starting half of a bone structure that you use to fit to your own model. When you have the bone structure to fit, you can build the rig and it does it for you

and makes all the components. The main thing you may have to fix is the weight painting, which tells the bones how much and the location they effect on the skin. This plug-in sometimes does a great job, though sometimes it does not, so it just depends on your model.

As mentioned previously, each tentacle has about 30 controllers/ joints in it, which gives me a great range of movement on them but it is many things to move for each tentacle. Because of the way I also chose to make the rig, I did not have IK set up. IK means inverse kinematics. It allows you to move a hand or a foot, which will also move the elbow or knee accordingly, without moving the shoulder or hips. The other method works from the shoulder or hip down, after moving the hip or shoulder, then the elbow or knee would be moved then finally the hand or foot. That method is called forward kinematics. This is how my rig works it is a top down approach. With Octavia fully rigged, it was time to move onto Animation.

Animation

Animation is my favorite part of the whole process because it is when I get to see everything come alive. As well, I am the one making it come alive. Animating is a long process that requires a lot of attention to detail to make the movements believable. The process of animating Octavia was no exception, and the other characters and object had their own challenges.

Animating Octavia was one of the more challenging experiences of my 3D animation career. Each of the 8 tentacles had 30 bones and the head had more, leading to a total of almost 300 different points to move and manipulate. In order to move Octavia in a swimming motion, I controlled each tentacle to move in a lifelike pattern, and all at the same time. The effect is a lifelike swimming motion, which conveys a sense of movement simply by the motion of the

tentacles. I faced further difficulty as I created numerous facial animations for expressing emotion and making small gestures such as heavy breathing. Beyond these expected issues during animation, I also saw some unexpected software issues as well.

Throughout the animation process, I saw numerous instances of software crashes due to mistakes in rigging. These types of issues are common in the 3D animation world due to the known unstable state of many of the 3D tools, such as Maya, which I used. Even with an auto save function enabled, such software crashes can severely affect the success of the project. This issue caused a delay in my schedule, but thanks to proper planning the animation there was only minor delay. The next step lighting caused less crashes.

Lighting

My creation of proper lighting was a critical step in the success of Octavia. Since my scenes were entirely underwater, I needed to focus lighting from the top of the scene to simulate the natural lighting of the ocean from the sun. I achieved this using a series of different lighting types. I started with a dome light to cover the entire scene. This light provided the basic ambient light to illuminate the entire scene. I
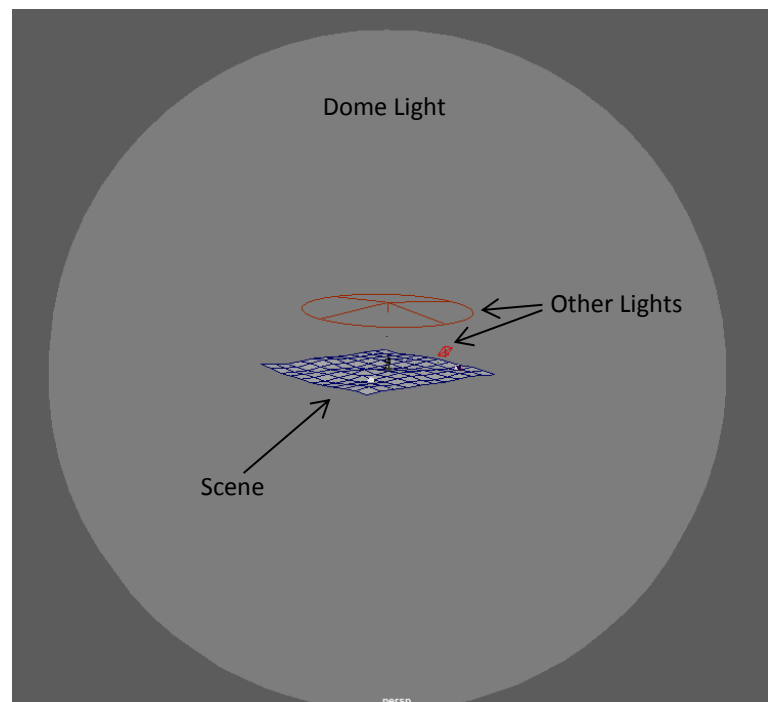

Figure 6.1 Dome light around the scene with other lights

also needed to add spotlights and rectangle lights to properly light the scene. Both spotlights and rectangles provide a large quantity of light onto a specified location. The primary difference is in the shape.

I used the spotlight to cover my scene from above so I could achieve the way light appears underwater, and used to rectangle lights in order to brighten up specific areas that remained too dark. With both animation and lighting complete, I moved onto Rendering.

Rendering

In the best-case scenario, rendering can be a nearly painless waiting game, but during the creation of Octavia, rendering caused significant delays. I originally chose Renderman as my rendering software. I chose Renderman because it is an industry standard, it works well, and we have a farm to rapidly render using it. Initially Renderman was working well. After some intense work, I was able to get the renders in Renderman looking great. Renderman, however, had other plans for me.

Renderman quickly lost its value when I needed to upgrade to the latest version. Rendering, by nature, is a slow process and to improve the speed of my machine I did a fresh wipe of the software. Regrettably, the old version of Renderman, which was working great, was no longer available. I upgraded to the latest Renderman. The upgrade caused my copy of Maya to crash repeatedly, and made rendering impossible. I lost a couple days attempting to salvage the situation, but after repeated failure, I had to reassess my options. With the my schedule being delayed, I made the only choice I had – Learn an entirely new render software, Arnold.

Arnold is rendering software owned by Autodesk which works similar to Renderman with some differences. Luckily, Arnold is similar enough to Renderman that it only took me about a week and a half of learning to be able to use it at the same level as Renderman. This delay came in time for Thanksgiving, which I was able to work to my advantage. Beginning my rendering, I was observing a render time of around 5 minutes per frame. Combined with the 24 frames per second in an animation around 2 and a half minutes, the total time to render came to around 300 hours. Though this number seemed insurmountable, I was able to use almost the entire DAAS of PCs during Thanksgiving to render out the animation at 10x speed. This opportunity to utilize the computing power of DAAS brought me back onto schedule.

Figure 7.1 Early test render with Renderman

Unfortunately, during rendering I saw many noteworthy complications. The most noteworthy complication was that Arnold was unable to render the above-water water scenes correctly. Sadly, due to the tight timeline, you can see this issue in the final cut of Octavia. Another complication I observed was due to the nature of Arnold as licensed software. Due to the licensing requirements of Arnold, I was locked out of the best rendering process and was forced to use the "Render Sequence" tool, which works significantly slower. Despite all of the rendering bumps, I was able to get the renders completed over Thanksgiving, and I was back on track.

Post-processing

The next step in the production of Octavia was post-processing. I made the decision early in the rendering to remove as much of the processor intensive work from the rendering as possible. Rendering in all of the aspects that I added in post-processing would have easily doubled or tripled the time to render, which was not an option. To do the post processing, I, with help from Anthony Liparulo, used Adobe After Effects, and Adobe Premier Pro. Specifically the additions to the animation added in post-processing were particles, light rays, and color correction.

My choice to add particles in After Effects was one of the best time saving decisions I made. In post-process I only needed to make two different particle effect layers. Those layers are responsible for the small floating dots you can see in the underwater scenes. The effect is actually a snow effect that I reversed to go upward and set to extremely slow and randomly moving particles. The results appears to be floating particles in the water. This effect took a relatively short amount of time, and adding it in post processing was quick – Taking only 3 hours to completely re-render the animation. This process was further improved when I upgraded my RAM, HDD, and GPU in my PC bringing the render time down to 45 minutes. These particles brought a more realistic watery feel to the scenes and so made a major difference in the overall quality of the animation.

The next additions in After Effects and Premiere were Light Rays and Color Correction. I added light rays by adding a curtain shaped mask of light to the water when I was doing scenes close to the surface such as the one of Octavia arriving at the boat. This change was simple in After Effects and added a sense of depth to the scenes. In deep water, the light rays would be nearly nonexistent, but when near the surface they were bright and obvious. With light rays now

improving the quality of the near to the surface scenes, it was time to Color Correct. I used color

correction in Premiere normalize the color and lighting from scene to scene. Any minor

differences in color or light in each scene were easily fixed to a standard look by adding coloring

masks to the scenes in question.

The result was a vast improvement to the color continuity of the animation, which united the

separate scenes into a continuous story. I completed the post processing using particles, light

rays, and color correction, and then moved on to adding audio.

I added audio using a combination of Adobe Premier Pro and Audacity, and

Freesound.org. I originally wanted to add a music track to Octavia. I searched though many

different songs and eventually found one that matched up closely enough to cut into the

animation. Unfortunately, the soundtrack failed to match up well enough to my animation, and I

decided to start from scratch using sound effects instead of music. I downloaded numerous

sounds off FreeSound.org and used Audacity to edit them to fit into the animation. One example

of this is the underwater ambience heard in all of the underwater scenes. That background is a

combination of three different sounds, which I edited to smooth out repeats and sound

contiguous. In the end, the audio editing portion of the process was relatively painless and added

a much-needed layer of depth to the animation. With both the visual and the audio portions of the project complete, I submitted my thesis for review.

Throughout this project, I learned a more about the process myself. I also started to experiment and see where in this normally completely computer-based process, pieces could be done away from the computer. I would like to expand this project into a small series of stories based on army divers, and trying something different for each one.

Being a teacher myself, going forward, I hope to share the information I have learned from this project with others to do two things. First, to help expose Art Teachers to animation and the possibilities it can bring. Second, to help others that are unfamiliar with 3D animation, understand the general process.

Bibliography

Blake, O. (n.d.). Olly Blake: Illustrator/Animator. Retrieved March 18, 2018, from
https://ollyblake.wordpress.com/

Documentation of the making of the short animation Buoy.

Gardner, R. (2017, March 17). Dock 45 [Web log post]. Retrieved November 12, 2017, from
https://www.facebook.com/100004307597326/videos/869357416551170/

A history of Dock 45 in South Korea.

Williams, R. (2012). The Animators Survival Kit. London: Faber and Faber

The basics of animation and an in depth explanation of how it works.

U.S. Navy diving manual. (2008).
doi:http://www.navsea.navy.mil/Portals/103/Documents/SUPSALV/Diving/US DIVING
MANUAL_REV7.pdf?ver=2017-01-11-102354-393

Current US diving manual.