Ensemble

3D Animated Short Film

Digital Media & Design, Master of Fine Arts Thesis Document

By Hongju “Hannah” Lim

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Introduction

Abstract

My goal as a character animator is to create an animation that delights both children and adults through character animation. In order to achieve this, I felt it was necessary to know the overall process for making a 3D animated film. I wanted to learn and explore 3D animation as much as possible in my MFA studies, and that is why I decided to make a short 3D animated film as my thesis project.

For my first animation, I tried to be silly and crazy, and to not limit myself when coming up with ideas and a story for the animation. I also challenged myself by using unfamiliar software and crafted the film nearly entirely by myself. There were many changes and troubles during the development of *Ensemble*. However, I learned a lot from it, and I am happy with how *Ensemble* ended up as a funny and sweet story.

Artist Biography

Hongju Lim is a South Korean filmmaker and a character animator who focuses on telling stories for young adults and children. She graduated from Chung-Ang University in Seoul, South Korea (2019) with a B.A. in Film Studies and a minor in Game and Interactive Media. She is currently a second-year M.F.A. candidate and graduate assistant studying 3D animation in the Digital Media & Design Department at the University of Connecticut, with a focus on character animation. In addition to her M.F.A. thesis, the animated short film, “Ensemble,” she has directed two live-action short films, “Akmong” and “ON Time,” and has collaborated on numerous other short films as a synchronous recordist.

Artist Statement (Ensemble)

The competitiveness of society often isolates young adults from their surroundings and can easily cause them to forget that the value of life comes from real interactions with others. *Ensemble* is a 3D animated short film that tells the story of the struggles of a young producer who tries to compose music. However, he learns that the answer to making powerful music is found not in his isolation, but through his interactions with neighbors.

This story reflects my own experience as an international student. I used to block myself off from my surroundings because I thought they would distract me from having success in my career. However, moving to a different country has made me come out of my comfort zone, and I have learned to observe and interact with the people, places, and culture that surround me.

Ensemble shows that the more you disconnect yourself from reality, the more likely you will be to miss out on valuable interactions. I concentrated on character animation, with humor, in order to share my personal epiphany in an entertaining way.

Unreal Engine 4 real-time rendering was used in this production. *Ensemble* is my first of what I anticipate will be many future productions using game engines for real-time rendering.

Animation Plot (Ensemble)

In a contemporary house, a young composer is in his music studio listening to music that he has composed. Twin kids from the neighborhood knock on his window, which annoys him. The kids show him a party invitation they have made, but the composer shows no interest and goes back to his work station. The composer focuses on producing music, and his mind sends him into a dark virtual world full of his instruments.

As the composer acts as a conductor and gives a cue sign, a spotlight shines sequentially on a drum set, bass guitar, piano, and an electric guitar. As the music builds up, he hears someone knocking on his front door. The twins and their dad are waiting at the door to share a hotdog with the composer. They want him to join them in their party. However, the composer is still not interested in having any interaction with them at this time.

The composer goes back to producing music in his mental virtual world. However, he is not satisfied with the music and feels like something is missing. As he tries to figure out the missing part, chaotic music comes from the neighbors' yard. The composer stomps his way to the yard where the children are playing their instruments, and he furiously takes the tambourine away from the kids' dad. However, the kids are happy to finally have the composer at their party and the composer becomes interested in the instruments they are playing.

The composer helps the twins' family play their instruments, who make wonderful harmony as he conducts. He finds joy in this harmony and also finds the answer to the missing parts in his own music. He adds the tambourine and recorder (flute) to his composition and invites the neighbors to his studio to hear the new music. The neighbors love it, and the composer is also very satisfied with his new composition which would not have been possible without his neighbors' input.

Concept Development in Script Writing

Personal Background

While there have been several script revisions which led to the final version of *Ensemble*, there is one unchanging theme that runs through all of the iterations of the script, which is that people need to break out from any self-defeating mindsets. The protagonists in my prior versions of the script were trapped in their own self-limiting routines, obsessed with their work, and refused to break their routines. The characters are a reflection of myself in my early 20's.

Looking back at my life, I noticed that my inner growth and solutions to problems mostly came when I broke out of my self-absorbed mindset and interacted with others. For many years I had been so concerned with my academic studies that I didn't spend enough time with other people. I missed many chances to learn from the people around me. Yet during this time, I also gradually began to learn to look around at the people, places, and the cultures that surrounded me. As I did this, I learned more about the world and also more about myself. This was in stark contrast to the "academics-only" mentality that had previously been drilled into me.

The South Korean educational method is well-known for its rote style of learning. Korean students are taught to just listen and memorize what the instructors teach. This environment makes it hard to speak out and ask questions during class. Unfortunately, this continued to affect me even when I studied film at Chung-Ang University. Where I should have been creative and genuine to myself in exploring new ideas and new ways to express my thoughts, I instead thought that everything had only one answer - the one that the teacher gave. Unknowingly, this has limited the way I study, write and even how I ask questions. As a result, I couldn't be myself even when I was writing the script for my senior film. I felt like I wasn't writing my story, but I instead was trying to write something that feels like what my teacher would expect in a good story. I was more concerned with meeting other people's expectations than in expressing my own ideas. When I was in Korea, I didn't speak up in my classes because I was afraid I might make a mistake and do or say something that was not correct. I was very surprised during my first week of classes at UConn, in that students felt very free to express their thoughts and opinions and no one thought that it was wrong or bad. It has been a new experience for me to feel free to speak up and be part of a conversation in class. If I were not here, I would have not had a chance to find out that it is possible for me to openly express my thoughts in public.

This personal epiphany was something that I wanted to express in the storyline for my MFA thesis project. With this as the theme of the project, I believe I could finally tell the story of my own personal journey and perhaps encourage others to also break free from any behavioral patterns that are unknowingly limiting their potential in their career and personal life.

Prior Versions of the Script

“Coffee Elf” Script

I wanted to make an animated film that both children and adults can enjoy and therefore tell a story about something that young adults can easily identify with. I tried to begin with things that we use every day and that make us feel good. And so I thought of coffee. Claudia, one of my MFA colleagues, gave me an idea of a creature that uses magic to make caffeine in coffee, which makes people stay awake. So with that idea, I came up with the Logline.

Logline

“A passionate coffee elf encounters a human on whom his magic won’t work.”

Who would be the human? I thought about a job where people really need coffee and the first thing that came to my mind were medical workers. My sister is a nurse, and she works very hard, and often cannot get enough sleep. I also heard a lot of news reports about doctors who say that 24 hours is not enough time in a day. In particular, I see many medical workers around the world working so hard through the COVID-19 pandemic. They need to get more rest. They need to sleep, but that is not possible because of the current dire situation. So I would tell a story about a surgeon who can’t even get a sip of coffee.

As I tried to develop the script, I noticed that the story was too serious and was going far from the humorous script I intended. The most critical problem with this script was that there was no obvious conflict. This was because I couldn’t clearly explain this imaginary world where an elf lives in a human society, and I also wasn’t clear about the goal of the character. So I abandoned this script. Even though I didn’t develop the script further, I learned the importance of

developing the personality and background of a character and also the world in which the character lives.

Coffee Elf Script

S#1
INT. NIGHT. HALL

Two suspicious men carry a coffee machine and place it next to a bench.

S#2
INT. DAY. HALL.

A man walks by the coffee machine. He is interested in the new machine, looks for coins in his pocket and inserts coins into the machine.
The red light on top of the pickup box turns green.
The man sips on the coffee and his eyes open wide. (ZOOM IN)

INSIDE COFFEE MACHINE (ICM)

(ZOOM OUT) Eyes are monitored by a magical screen.
And in front of it is a silhouette, the ELF.
ELF gives his signature smile.

Coins clink(New order). Time ticks.
ELF moves in front of a boiling pot and takes out a blue ball with a tool. He inserts the ball into a hole. Pushes a button. The ball transfers through a tube and cracks open. A blue magic spreads into the coffee.
A human hand grabs the coffee. Eyes appear on the monitor. Eyes open wide.
The ELF makes a smile.

Coins Clink. Time ticks. Pushes a button. Cracks open.
ELF waits in front of the monitor to see the eyes.
EYES WITH GLASSES appear which look very tired.

HALL
A mouth takes a sip of the coffee.

I.C.M.
(Monitor) Eyes stay tired.

HALL
A mouth gulps the coffee. The eyes open a little, but then close.

I.C.M.
Elf gets shocked.

S#3
INT. INSIDE A COFFEE MACHINE(ICM). DAY

The ELF is reading a magic book. In the book, there is information about making more powerful magic.

Coins Clink. Time ticks.
ELF checks the periscope. It's HUMAN.
With a fast speed, ELF makes the dark blue ball and pushes the button. Elf makes a sigh of relief and heads to the monitor.
However, the eyes would not appear.
ELF checks the Periscope and there is no one out there. Elf waits for the human.

Time passes.
Elf takes the cup back up to the machine.

S#4
INT. INSIDE A COFFEE MACHINE(ICM). NIGHT
ELF is in bed sleeping.
Coins Clink. Time ticks. ELF wakes up.
The ELF notice it’s the HUMAN and quickly makes the coffee.
Once again the eyes do not appear on the screen.
The ELF grunts and pulls up the cup. Then suddenly a hand grabs the cup.
ELF falls into the cup. The HUMAN accidentally drops the cup.
The ELF crawls out of the cup. A napkin falls on the ground.
Beeping sound. The human runs away.
ELF finds a footstep made with coffee.

S#5
INT. ICM. NIGHT

The ELF’s uniform is stained with coffee.
ELF searches through the book and finds something on a page and makes an evil smile.
The ELF makes a dark red ball with deep sleep magic.

Coin Clink.
The ELF checks the periscope. It's the human.
ELF pushes a button and deep red magic spreads in the coffee.
The human grabs the coffee. The eye appears on the monitor.

HALL
The human tries to take a sip.
Beeping sound.
The human hands over the coffee to the other hand.

ICM
Eyes on the monitor change to another eye. ELF is surprised.
He gets the dark blue ball and comes out of the machine to look for the coffee.

S#6
EXT. OUTSIDE THE HOSPITAL

The ELF flies around and the hallways are empty.

ELF goes out of the building.
A siren rings. Ambulance passes. People running.
ELF dodges through them and finds coffee-stained pants.
ELF looks up and it's the HUMAN, a surgeon.
She is on a moving gurney doing CPR on a patient.
The ELF chases the SURGEON.

S#7
INT. OPERATION ROOM

The ELF arrives in the operation room and finds the SURGEON over glasses on window, washing her hand.
An intern comes in with coffee and the SURGEON tries to take a sip.
The ELF panics and flies toward the coffee.
As soon as the SURGEON tries to take a sip, the ELF absorbs all the red magic into his mouth and cracks the dark blue ball.
Because of the speed, the ELF hits the wall.

The ELF gets up straight to see the SURGEON.
The SURGEON is standing in front of the table. Her drowning eye pops open.
With a professional pose, the SURGEON grabs the mass.
The ELF gives his signature smile and falls asleep smiling.

“Box Apartment” Script

I wanted to preserve the story of a coffee-making elf and tried to think of what other environments would be interesting to show in an animated film. After UConn closed its campus because of the pandemic in March 2020, I spent most of my time in front of my computer. Classes and meetings were all done online, and I really missed interacting with others in person. I was afraid that if this pandemic situation continued for very long, we might get too used to doing all of our interactions online, and I would miss the value that comes from meeting people face-to-face. I wanted to write a story about the joy and preciousness of having time with others.

I thought about the moments when I had the most fun with people, and that was when I played board games with my friends. Board games seemed to contrast well with digital entertainment. Jenga is a game that has simple and clear rules, and I thought I could tell a story with it.

The next script that I wrote was about a barista named Toto, who lives in a fantasy city, on the top floor of his apartment building. Every day Toto works hard in his home selling coffee. However, one day his entire apartment is suddenly moved to the ground floor, by a flying robot crane, in order to restore electricity after an emergency blackout. In this story, he discovers the joy of interacting with others after playing Jenga with some kids in the apartment residents’ waiting room on the ground floor.

My committee gave me the idea of making Toto’s apartment resemble a Jenga set. It was a visually interesting concept, and I enjoyed building a world where an apartment can be easily moved, like a Jenga block. I loved the way the script was going and was satisfied with the concept, but it was too complicated for me to make as a solo animator/filmmaker. It had too many characters, more than three different environments, and was too long for a 3D animated short. Someday in the future, I would still love to create this animation with a team of artists and a lot more time.

Box Apartment Treatment (Nov 08)

Initial Style Frame of *Box Apartment* Opening Scene

1. An autumn leaf that is on one of the drones inside the apartment, falls and lands on Toto’s head. Toto is an elf who is living in the highest box apartment and also uses it as a shop to produce and sell drinks. Toto works hard making drinks. On the public balloon screen there is a ranking chart. Toto is first place in the ranking in terms of sales (Most Sold Drinks). You can see that the drone moves faster in front of Toto’s apartment than the apartment below. The apartment is so high that the only thing you can see is clouds. Drones are taking drinks from the dropbox that is outside Toto’s box.

   Coffee making Reference
   https://www.youtube.com/watch?v=6PMB_PtGGbs

2. Toto’s ranking falls to second place. Toto is surprised and runs to the speed controller and sets it at max speed which is dangerous. A red alarm rings, but Toto ignores it.

3. Toto succeeds in moving back into first place but, because of the relentless speed, the machines crash and break and cause a blackout (only in Toto's apartment). The red alarms die off and

all machines stop. A coffee sign outside of Toto's box also turns off and drones start flying away. Toto sees the drones. He is anxious and panics.

4. Toto panics and tries to open the door, but the door is locked because of the blackout. Toto looks out the window and checks the ranking. He has fallen again into second place. Toto tries to come out through the window in order to reach the generator. It looks very dangerous. While Toto is working, a big shadow appears. Toto tries to quickly get inside his apartment. A big flying robot comes to take Toto's box apartment. Toto is frustrated and bangs the window. Then, through a reflection in the window, he finds a leaf on his hair. He examines it and smiles. He puts it in his pocket. The box starts moving. Toto walks slowly to the side window to see the ranking balloon. He puts his forehead against the glass and looks up. The box starts moving down.

5. The box arrives in the fixing station. Little robots start examining the apartment. Toto comes out of the apartment still very mad and walks into the apartment resident waiting room. There are others in the room. Toto looks out to see the ranking balloon. (He is in third place) Toto crosses his arms and starts tapping his foot. Then a young kid hands him a piece from a *Jenga* game. Toto ignores it.

6. Kids are playing Jenga. The game gets intense and one kid makes an awesome move. Everyone cheers and Toto screams with excitement. Everyone looks at Toto. The kid gives Toto the block and when Toto tries to build the block up, the stack falls apart. Toto turns around in frustration, but the kids laugh with joy and others cheer him up.

7. Everyone starts playing Jenga. The atmosphere is bright and filled with laughter. Toto looks very happy. (https://www.youtube.com/watch?v=I2gzPVvIeVw)

8. Everything is fixed. Toto sees the ranking and he is still in third place. A robot shows a sheet of paper and it shows the option of the height at which the apartment can be placed. Toto, feeling no doubt, chooses the top and takes a pen out from his chest pocket. Then the autumn leaf comes out from his pocket, too. When Toto tries to sign the paper, he finds the leaf. Toto looks around and there are lots of beautiful autumn leaves. We can see others still enjoying the games in the

waiting room. Toto looks up on the ranking balloon and back at the bottom of the paper where the apartment is on the ground. He signs the paper.

9. Toto's ranking is not on the screen anymore. We can see the rankings for first, second, third place keep changing. The scene zooms out and the camera is in Toto’s apartment.We can hear the sound of him making a drink. Toto takes the drink and serves it to the elves at a table. Toto also takes orders for the takeout. We can see elves sitting around Toto’s apartment hanging out with each other and there are autumn leaves around the box apartment.

Final Script “Ensemble”

As a film student, I was accustomed to writing scripts for live-action short films that are 12-20 minutes long. It was challenging to write a script that is under four minutes and also to be animated. I didn’t want to make a story that could be made easily into a live-action film. I wanted to make the best use of the animation genre, and to create a fantasy environment with non-human characters and situations.

I originally wrote the script for “Ensemble” using all young adult characters. However, this made the script too long since I had to create an acceptable reason for all of their actions. Therefore, I instead added children as side characters, and the story became lighter and more meaningful. Adding children to my film really conveyed what I wanted to say through the animation. They are genuine and innocent, so their silly actions are more easily accepted. I believe the protagonist decided to spend time with the children because he instinctively doesn’t want to hurt their feelings.

Animation still showing the twins

To make the story simple, I rethought the occupation of the protagonist. The job should be something that can be explained with actions and that is easy to become passionate about. A job related to music seemed like an answer. Music is something that can be very personal, but it is also something that you can collaborate on with others, and it fits perfectly with the theme I wanted to share. That is how the main character came to be a composer.

The main character is not only a composer, but an influencer on an online music distribution platform. He is obsessed with making music in order to get more followers online. Young adults today often are closely connected online. All of them have their own avatarson the internet, and those characters often can be somewhat more influenced and recognized by others than their real selves in the real world. The main character is the kind of person who puts more importance on his online world.

I wanted to keep the “Box Apartment” story format in “Ensemble,” where the main character learns a lesson when he comes out of his mental “comfort zone” and interacts with others. I wanted to create a simple transition from the protagonist’s “comfort zone” to when he interacts with others. However, a transition from his music studio room to the neighbor's yard seemed too boring and not attractive enough. I thought that maybe this zone could be an imaginary world. That is how I came up with the virtual music world inside the main character's mind. I decided to make the protagonist a conductor in this imaginary world because it had so much potential to get a funny and active action from it, and would really challenge my character animation skills. Also, the fact that the instruments play on their own while under colorful spotlights made this world unique and interesting, meeting my goal of a fantasy environment best created via animation. I also created this imaginary music world to represent the main character in his online world.

This story shows how both our real and virtual worlds are important to our life. They are interconnected and so can affect each other. The answer to a problem in one world sometimes can be found in the other world. The main character grows to become a better neighbor to the kids while he also grows as a composer to create a better music piece. His comfort zone expands beyond his room and into his neighborhood, while his music repertoire expands by incorporating new instrumentation.

Animation still of the music world of the composer’s mind

Pre-Production

Character Development

I wanted to tell this story with an interesting character. The concept I had for the “Box Apartment” character was an elf in a fantasy world. He had pointed ears and purple skin, but dressed as a normal human. I imagined characters from the Pixar film, *ONWARD*.

Box Apartment Toto’s Concept

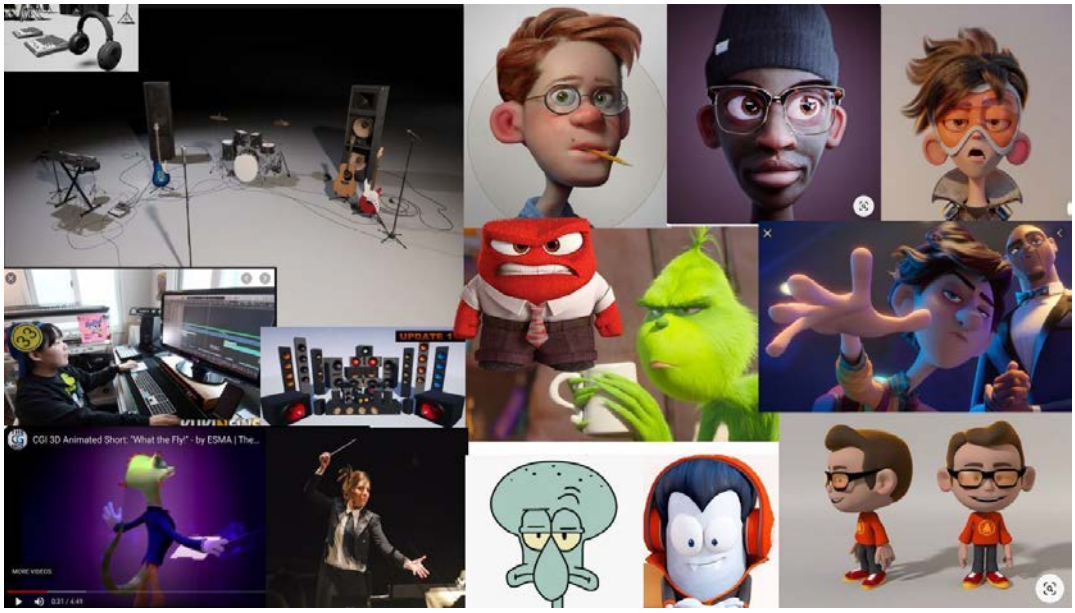
External Feature

- Very neat and clean.
- Long and skinny.
- Wears trouser and polo shirt
- Speedy and always busy

Internal Feature

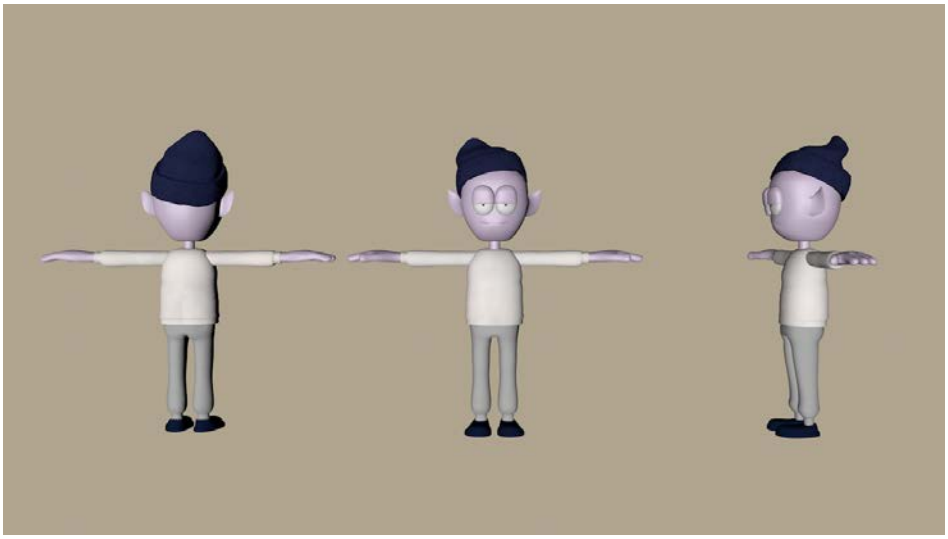
- Wants to be the best
- Very proud of himself
- Mostly feels anxious about losing his top position
- If a problem occurs, he tries his best to find alternative solution

As I moved on to the “Ensemble” script, I kept the external features and just changed the clothes to look more like a music producer. I gathered reference images to make the mood board for the character. It helped me build and understand the personality and characteristics of the main character.



The main character mood board

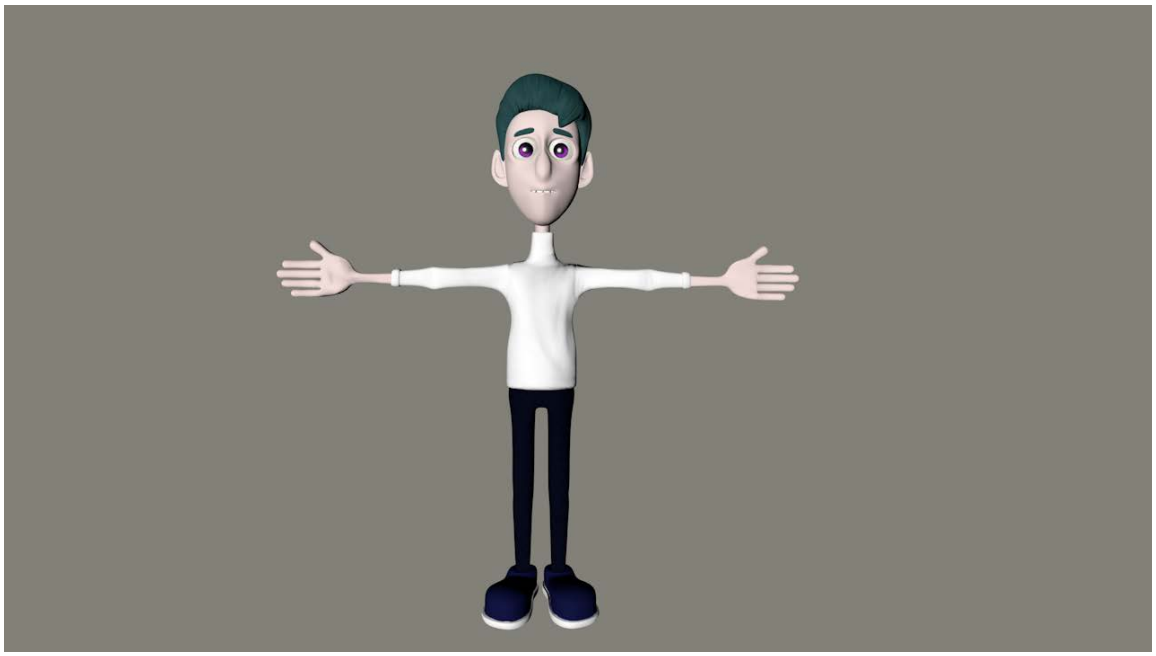
The personality of the main character that I imagined closely resembled Squidward, from *Spongebob SquarePants,* who is grumpy, cynical, educated and artistic. From the moodboard, I modeled the first version of the character. I imagined the animation would be in a “cartoony” style. So I made the character as low-poly and simple as possible.



The main character model, first version

As I gathered my assets and tried out rendering in Unreal Engine 4, I discovered that the overall feeling was very realistic. The game assets provided by Unreal Engines were close to photo-realistic. I thought the model that I made might feel different from the environment, so I tried to redesign the character model with more detail. Since the assets I am using are very

realistic, the fantasy character concept did not seem ideal. So I changed the skin color to be similar to human skin color.

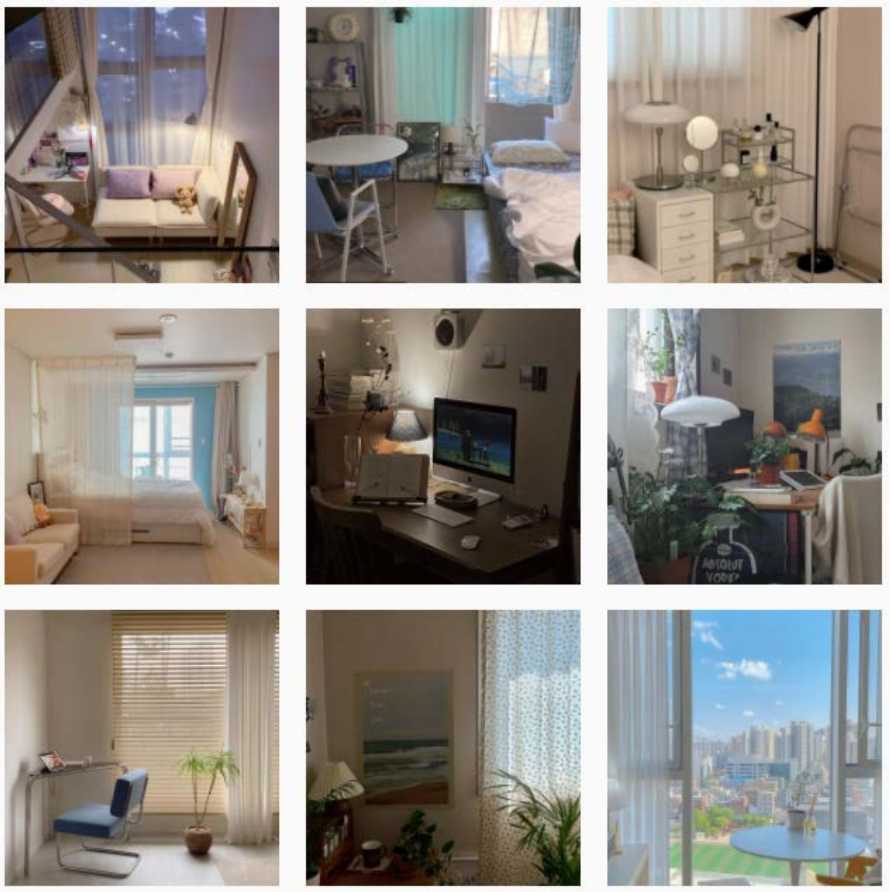


Main character model, second version

Environment Concept

The Main Character's Room

I referred to my Korean friends when building concepts for the main character and his environment. Korean millennials are sensitive to trends in social media. Living in a simple, white studio apartment has become a trend among us. I thought about why young people are interested in interior design. Since most of the job opportunities are in Seoul, many young people leave their family's house and move to Seoul. Living alone and finding a place to live in a large city can be very hard and exhausting. I think people sometimes get interested in interior design in order to find a way to forget about their weary situations. They try to fill their lonely spaces with modern fancy objects.



Instagram Feed of #원룸인테리어 (studio apartment)

The main character is like those young people, since he lives alone in a house and he works hard to become a better musician. His music studio's overall color is monotonous with no strong saturated colors. He keeps only the supplies and furniture that are necessary. His house is square and simple with white walls and a black roof. I tried to make a contrast with the twin's house which is built of wood and feels more like a family home.

Music World

One of my favorite scenes from all movies is the “Greatest Show Ensemble” in *The Greatest Showman*. The music, lighting, action and camera movements are so perfect that it is astonishing and overwhelming. I was excited to have music in my script and the “Greatest Show Ensemble” scene inspired me in imagining how the music world could be created.

The Greatest Showman Ensemble

My first idea was to use spotlights in a dark room. Each instrument would be a musician on a round stage. I imagined that when the main character is adding and playing instruments in the MIDI sequencer software, in his mind he would be directing the instrument to play. So when the main character gives a cue sign to an instrument, a spotlight will light up, and the instrument will start playing on its own. I had to think of entertaining ways to show this instrument playing on its own. One way was giving different colors to the spotlights. I animated the instruments to make it look like an invisible person is playing each one. However, that didn’t seem to be enough. So I added a luminance light strip on each instrument to make it feel like it’s playing its own keys.

It was a challenge to create interesting scenes composed of just instruments. I tried to use a variety of different shots and angles to make it entertaining, such as transitioning from a full-shot to a medium-shot, one-shot to a full-shot, and zoom in and zoom out.

For the character animation, I searched for maestro references. I thought I could create a fun feeling if the main character conducted energetically with the band instruments. Conductor Gustavo Dudamel's video was a great reference. The crazy action of the main character really made these silly ideas of instrument animations and spotlights feel like a small concert.

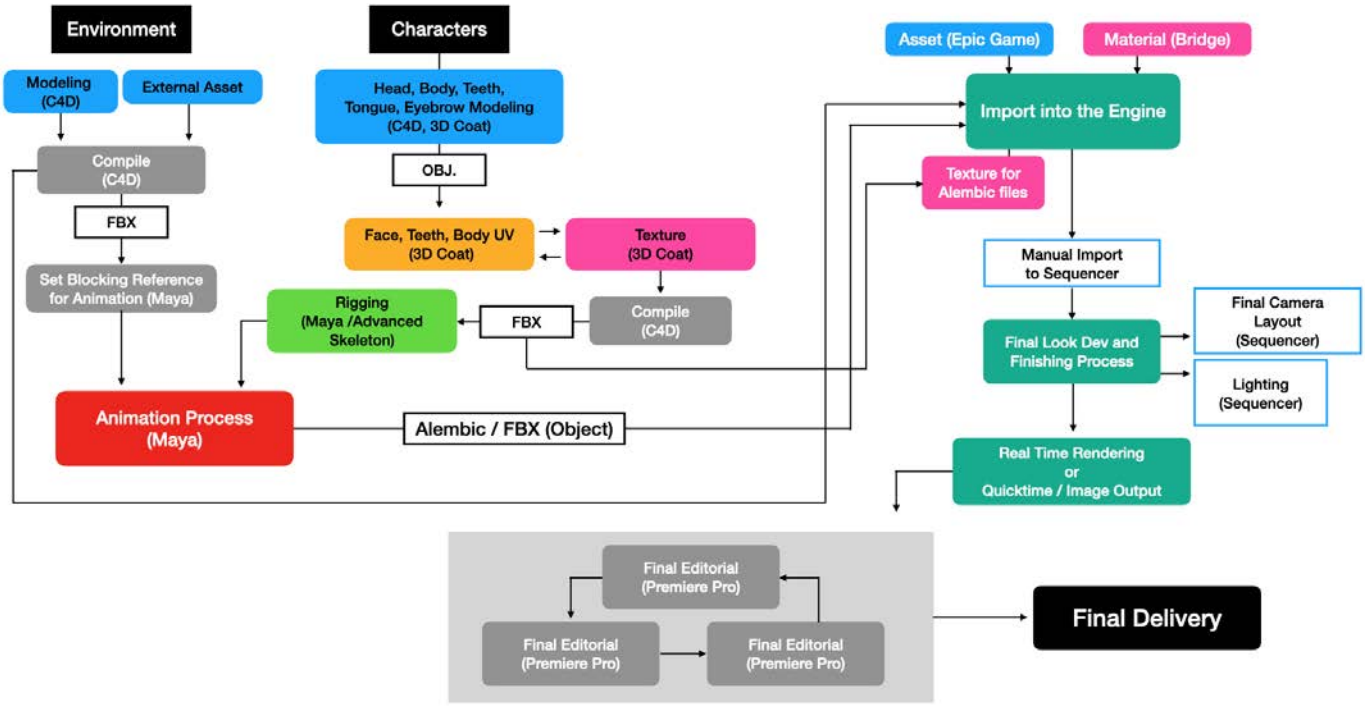
Storyboard and Animatic

A storyboard is a graphic representation of how the animation will unfold shot-by-shot. It contains information such as the composition, camera size and angle, and direction of the movement. Since I made a major change to the *Ensemble* script at the end of Fall 2020, I made a storyboard as soon as possible to visualize my ideas. The storyboard helped me to understand what is going on in each shot. However, since I had never made a 3D animated film, I wasn't sure about the process and also how long it would take to realize each shot. My biggest concern was that the duration of the story might take too long for me to complete the animation in time for the exhibition. My committee suggested that I make an animatic to help me figure out the appropriate length. When I first made an animatic, it was seven minutes long. I changed the script to make things simpler, but it was still too long which made me think that I was going in the wrong direction. I considered switching to a different script, but Professor Elliott-Famularo encouraged me to continue with the *Ensemble* script. With my committee members' help, I was able to develop the animatic into a short and strong four-minute story.

*See Appendix B for the *Ensemble* Final Storyboard

Production

When I was an undergraduate, I took a course that taught me how to make a third-person shooter game in Unreal Engine 4. At that time, I had little experience with 3D programs. However, in a short time I was able to make a good quality rendering output and there were lots of interesting features such as visual effects, sequencer, assets, and lighting built into the software. I searched more about Unreal Engine 4 and I found that many studios are starting to use it for the final render. It is free to use, has the ability to check the final quality of the animation in real-time, and there are good quality assets available in the marketplace to use in production. The best reason for using Unreal Engine 4 as a renderer is that you can easily make changes during the production stage. It is also easy to check shots and change the order of them through the sequencer, and it's flexible in moving files from Maya and Cinema 4D. Due to these many strengths, I wanted to explore the production pipeline using Unreal Engine 4 with my thesis project.



Ensemble Pipeline

It may have been a simpler process to do all the modeling, rigging and animating in one 3D software program. I had been using Maya for character animation, since this was an industry standard software for animating. However, other than character animating, I was more familiar and comfortable using Cinema 4D, so I had to find ways to work with it. There was much information online about using 3Ds Max and Maya with Unreal Engine 4, but not much about C4D. So I followed Maya tutorials in using C4D, since the functions are similar. Fortunately, in December 2020, there was an update in Unreal Engine of a plug-in, "C4D Datasmith," which made it possible to import a C4D file directly into Unreal Engine. This made it easy for me to make the environment set and work from C4D to Unreal Engine. Winbush's YouTube videos were a great help to me in building the pipeline using C4D.

Character Rigging (Advanced Skeleton)

I discovered that Advanced Skeleton (AS), an open-source plug-in to rig characters in Maya, allowed me to rig my characters quickly and easily, and it also has advanced controls. . Since I feel more comfortable using Maya to animate, I thought it could be more efficient for me to use this plugin instead of rigging directly in Cinema 4D. There were many good tutorials about AS, but I had to do a lot of trouble shooting since I was not comfortable using the Maya rigging tools.

1) Initial Setup

When using AS, there are some elements you should check before you begin in order to make an efficient rig.

First, keep the topology in low resolution. While moving my character object between several software programs (Cinema 4D, 3D Coat, and Maya), I had the subdivision baked into the object. This animation process requires a large amount of computer processing capability. So I had to change the model into low-resolution again for rigging.

Second, have a separate model for the head and body. You can make an advanced rig just for the face in AS. However, if the body is merged with the head, the system acknowledges the whole body as a head and requires much more processing time. Having separate head and body models makes it more efficient to work with. It is also good to have a separate model for hair, eyebrows, tongue, and teeth so you can use the advanced controls.

Third, make sure there are no N-gons in the polygon, only triangles or quads. This won't be a problem in Maya, but it creates trouble when importing the alembic file into Unreal Engine 4.

Fourth, the model should be symmetrical.

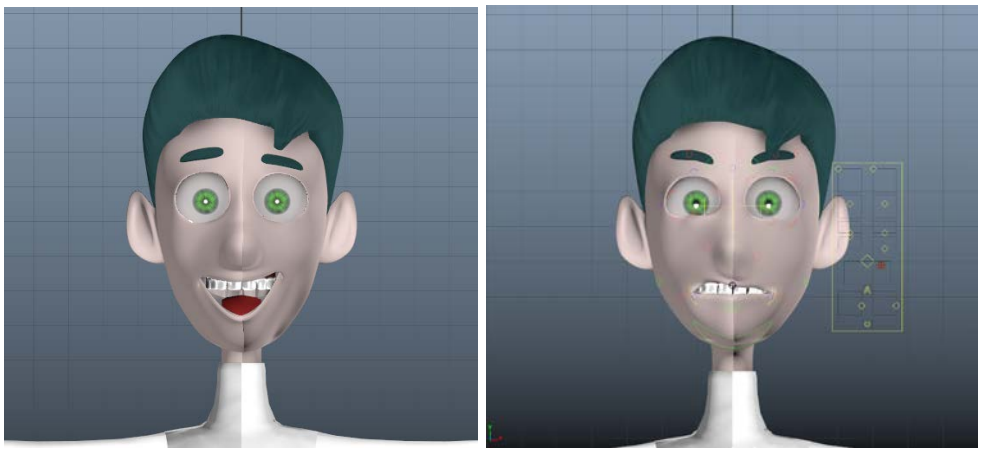
2) Building the Skeleton

I had quite a bit of trouble building the skeleton. AS provides a default biped joint frame, so I used it to set the joints for my model. During the process of adjusting the model's joints, I had to use Key-D to move the anchor point of the joints. Several times, I accidentally selected Key-S, which made keyframes in the timeline. This created errors when I tried to build the joints into the skeleton.

3) Corrective Shapes

The set-up and process of rigging the face in AS is pretty simple. If you select the vertex, as it says in the guide, it automatically calculates the surrounding mesh and creates the control objects. The outcome is pretty good. However, since it is not rigged manually, some adjustments were needed. When I first rigged the face of the main character, there was a problem when I closed his eyes. The eyeball came out through the eyelid mesh. I thought it was a problem with the face mesh or the position of the eye, but when I tried to solve those issues, I still had the same problem. Later, I discovered there

is a function called “corrective shapes” which allowed me to manually correct the meshes.



The Main Character Face Rig Test

Because of these problems, it took much longer than I expected to rig the main character. There was a lot of back and forth in tweaking the model and re-rigging. However, after I knew how to solve the problems, it took me less than an hour to rig each of the side characters. Facial expressions were very important in *Ensemble,* and with AS I was able to use various face controllers for the main character’s facial expressions.

Character Animation

I shot my own video reference for some of the main characters' actions which helped me a lot in knowing the timing of the action and also in finding details in the movements.

Still image from the video references

At first it took around 6-8 hours to animate a shot. I needed time to familiarize myself with the rig and really know my character. As I animated, it felt like I got to know the character much better, and I knew how he would react in each situation. I got comfortable with the rig as I spent more time working with it and my time on subsequent shots was gradually reduced.

I previously hadn't worked much with facial animation, and so as I animated the main character, I learned a lot about how a little change in position and timing of the eyes and mouth can make a big difference in the expression of an emotion. An emotion was more expressive when it was shown along with a body gesture.

I utilized the 12 principles of animation while animating, such as follow-through and anticipation. There are parts where it still needs more adjustments. However, as I continued animating this film I found myself seeing what I was missing from the 12 principles of animation and correcting more quickly.

In May, my dissertation committee asked me to work more on animating the family characters. Since I didn't have much time, I originally focused more on the main character and, as a result, the twins and dad characters didn't feel like they had a personality. It was suggested that I observe kids playing, and Professor Elliott-Famularo connected me to Professor Zhou to meet with her two lovely children. Spending several hours with them really helped me understand the twins' characters. Her kids were happy and excited to just have me in their home. They showed off their toys and art, and when I drew or painted things, they were interested and tried to follow me. Also, I noticed that kids don't stay still. Even when they are sitting, they move their fingers or legs. This observation time with the children was very helpful when re-animating the twins' character. They feel more like real kids, and we can feel the purity of them wanting to play with their neighbor - just as Professor Zhou's children wanted to play with me.

This was good practice in the importance of researching and collecting references for character development and animation. It led me to understand that, in character animation, adding more personality is just as important as improving body mechanics.

Character to Unreal Engine

After animating the characters, I made the smooth mesh into polygons which created the models in high resolution. Then I exported them as alembic.

The material (texture) used for the characters should be brought separately as an fbx file. I exported the fbx file from the C4D scene where I compiled the model object and texture from 3D Coat. When imported into Unreal Engine 4 as fbx, it has the materials which I can then assign to the characters from the alembic file.

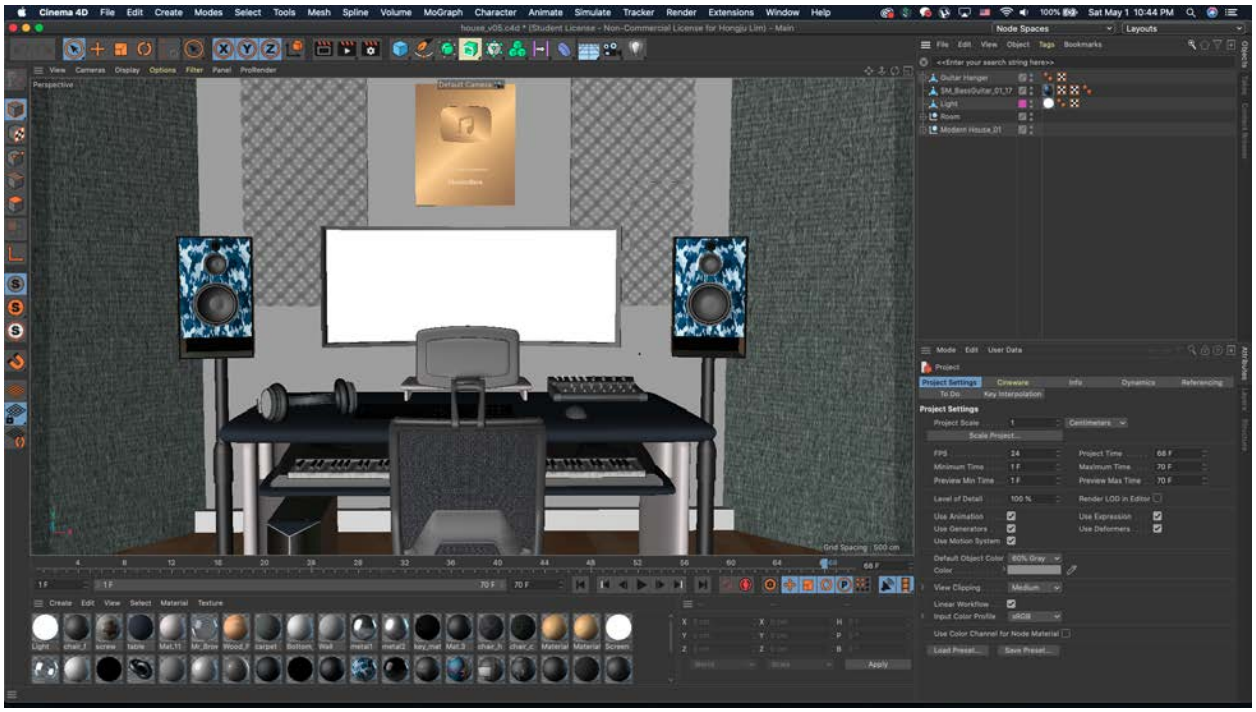
Environments and props

C4D to Unreal Engine 4

The main character's room was built and assembled in C4D. I got most of the props from websites such as "turbosquid," "CGtrader," and "free3D." Most of the props were similar to real world objects, but I wanted to avoid too much of a real world feeling. So I modeled the desk to have rounded edges to make it a bit more "cartoony."

When it was set, I saved the scene and imported the scene into Unreal Engine with a "C4D Datasmith" plug-in. It brought the scene with materials directly into the level I created in the game engine. If I need to change the prop position or add props, I can change them in Cinema 4D, and it will update it in the game engine right away when I select the re-import option.

There are texture problems with a one-face plane mesh. It shows the texture of only one side, depending on the surface normal orientation. The other side made the mesh look transparent. This happened to the back of the desk chair, tambourine rings, and inside the recorder. So I duplicated the plane and reversed the normal orientation to make the texture show on both sides.



Screenshot of scene in Cinema 4D of the main character's room

Set Blocking for Animation

To animate a character in Maya, there should be a guide for the environment so that it is clear where the character is in the scene. To block the environment for the animation, the environment scene in C4D was exported as a fbx file and imported into the Maya scene. Then I deleted or hid the props that I didn't need and had essential props for the guide. Animated props are exported as alembic to be used in Unreal Engine 4. Props that have a hierarchical structure should be connected (edit mesh > connect) when exported as alembic files.

Rendering through Unreal Engine

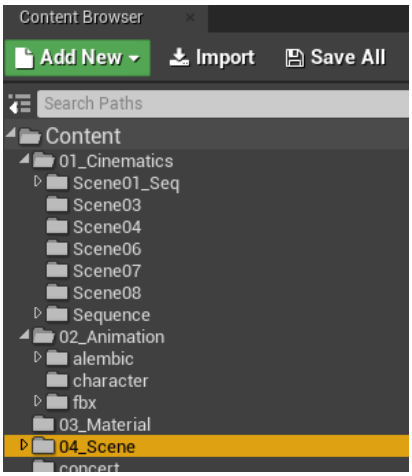
File Organization

Compiling all the elements into the Unreal Engine was fairly simple. It was important for me to organize the folder well in the content browser since there were many imported files. I made four main folders which were Cinematic, Material, Scene, Animation.

In the Cinematic folder, I put all the sequence files with subs-folders for each scene. This would be the folder I would use when I was working with the sequencer to create the shot composition and work with virtual cameras.

In the Animation folder, I put the alembic and fbx files I exported from the Maya. I organized them by making a subfolder for each scene since there are alembic files for each shot.

In the Material folder, I put all the textures and materials I imported. It also included the fbx files of the character which had all the materials for the characters. I also included the good quality materials that I got from the Quixel Bridge application.



In the Scene Folder, I put in all the versions and different levels that I made. I had a level for each environment which included the main character's room, the neighbor's yard, and the main character's front porch. The C4D files that I imported through the "C4D Datasmith" plug-in were also saved in the Scene Folder because the plug-in automatically creates a folder that includes all the props and textures from the C4D scene.

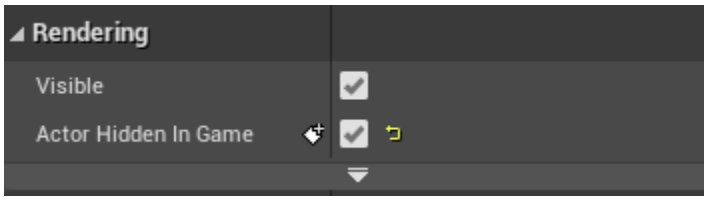
Sequencer

Sequencer is a multi-track editor in Unreal Engine 4 which is used for creating and previewing cinematic sequences in real-time. This very helpful feature allowed me to know, in real-time, how the final outcome will look.

I would first make a level and place all the elements in the right place in the level. Then I made a level sequencer for each shot where I can set cameras to control the individual visibility and animation of the element for the shot.

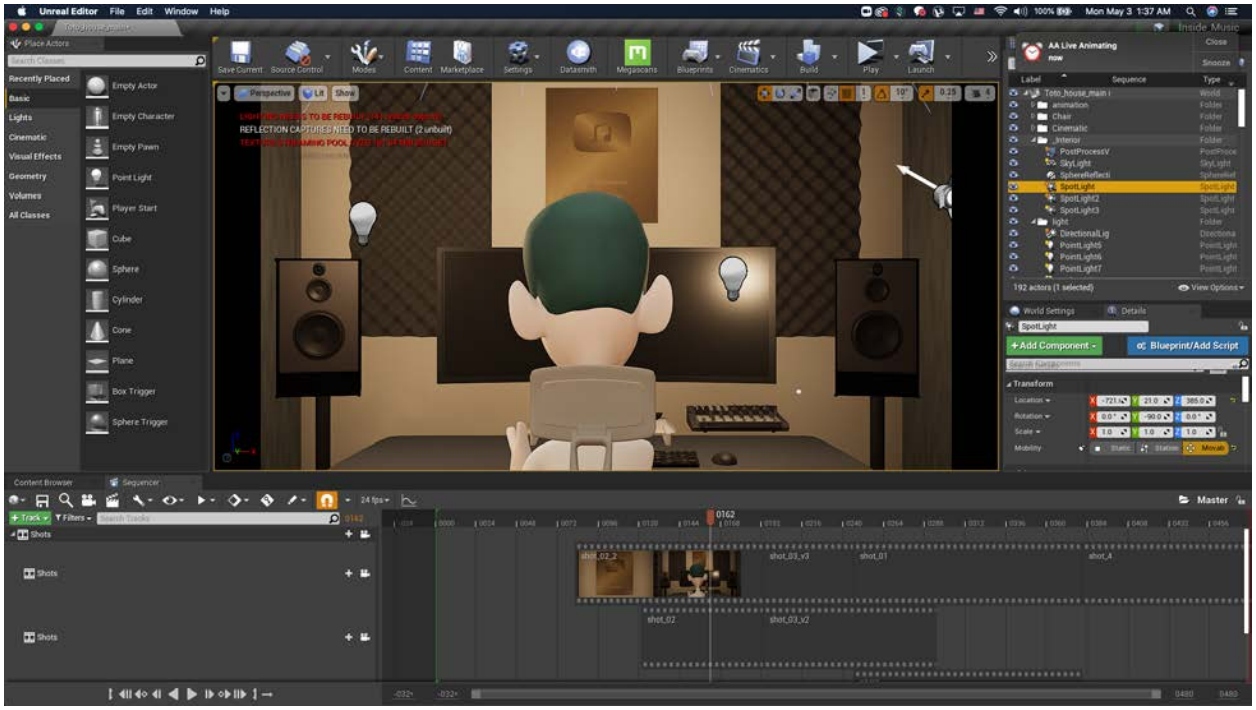
The visibility can be controlled from the rendering setting of each alembic file.

1) Set the “Actor Hidden in Game” check so the alembic file doesn’t show in all shots.



2) For each shot, drag the alembic file that will be used in the shot into the sequencer. Check the visibility (+ / Actor Hidden in Game).

3) Add the Geometry Cache from the + Icon. This will help control the alembic file animation.



Screenshot of working with sequencer in Unreal Engine 4

I was able to do initial edits of the shots in Unreal Engine 4 before I rendered and edited the shots through Adobe Premiere Pro. I was able to figure out what was missing and also knew whether the animation timing was working. The Unreal Engine 4 program has an option where I can change the speed of the alembic file. It made it possible to try out different speeds for timing and to figure out whether I needed to edit the animation or if I could just change the speed of the shot in Premiere Pro.

Lighting

The lighting feature was similar to that in Cinema 4D, so it wasn't difficult to use. It was great to see how lighting works in real time, so I was able to do many experiments to figure out the best lighting for a scene. The overall lighting of the main character's room scene has a warm tone so it created a contrast with the composer's "Music World."

With Unreal Engine 4, it is easy to see the result of the lighting through real-time rendering. To improve the quality of the lighting, light has to be built. This helps achieve higher quality indirect lighting and shadows. There are three types of lighting in UE4: Static, Station, and Movable. Movable is rarely used in cinematic lighting in UE. With Station light, you can change the value and color of the lighting after the light has been built. Only 8 station lights can be used in a scene. Static lights are 100% baked light, therefore, when I made changes, the light needed

to be rebaked. I used Static lights as prop lights and as the lights that were used in most shots, while I used station lights as key lights on the characters.

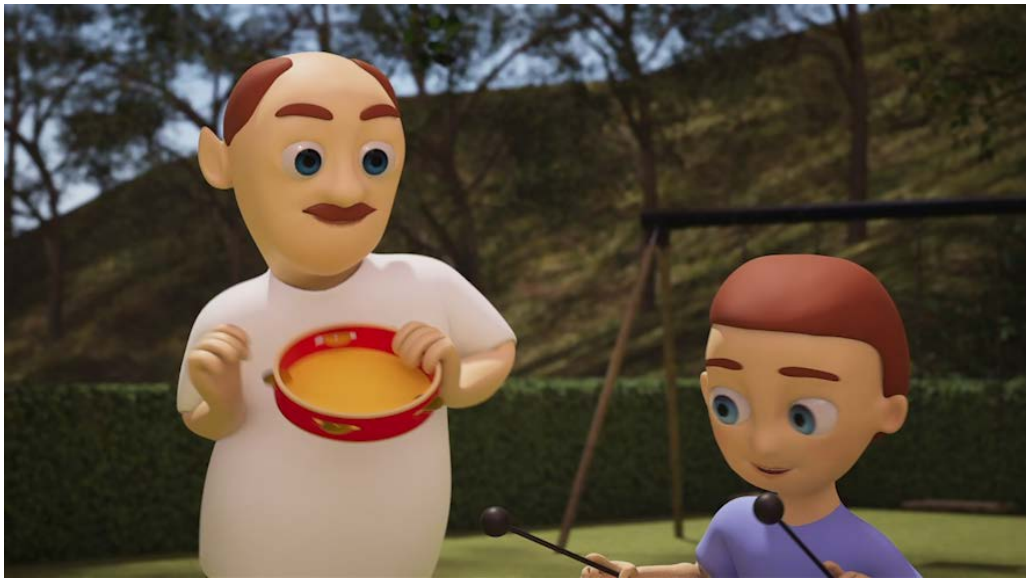
When building lights, it is time-saving to use the preview setting since it takes a short time to build light. After I was satisfied with my lighting, I re-built with medium setting for the final rendering.

Lightmass Importance Volume can also improve the lighting by concentrating the important areas to light.

Rendering

There are two ways to render out in UE4: the movie render setting in sequence, and the render queue. At first I used the movie render setting. This is a fast way to render out cinematic scenes, but, for some unknown reason, the quality of the shadow or depth-of-field was not good. I learned that most of the post-processing rendering can be set up through the render queue and it made a huge change. I referred to this Youtube video,
High Quality Rendering in Unreal (Tutorial), for my render setting. I took some unnecessary console variables out since they were making my rendering time too long.

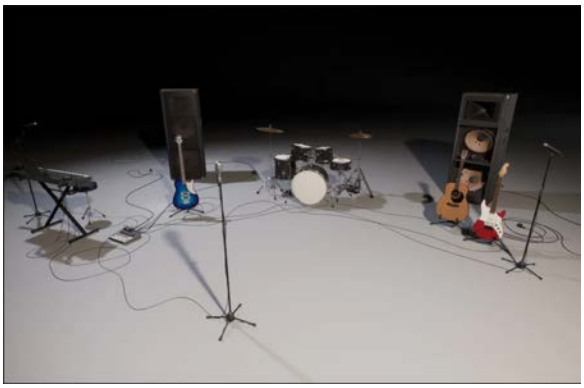
Rendered by Movie Render Setting



Rendered by Render Queue

Assets Used

I was able to get good assets and an environment from the Epic Games MarketPlace. These are the assets I used in *Ensemble*.



Musical Concert Props vol. 1

Modular Neighborhood Interior & Exterior Pack

Modular House

Contributions / Collaborative Process

Music

Music is an important component of the film, and I should have had the music ready in order to start animating the composer's "music world." I worked with my friend Juwon Lee, a music producer in Korea, to create the music for *Ensemble*, starting from the pre-production stage. We would have a zoom call whenever there were updates and discuss options so he could make fast adjustments to the music. There were four pieces of music we had to compose: 1) Opening Scene, 2) Music World, 3) Ensemble with Kids, and 4) Final Scene.

1) Opening Scene

I didn't give much initial direction to Juwon about the opening scene. I told him it is a 30-second scene and should be in the pop genre so it feels bright and exciting. Juwon sent the first draft, and it had an electric guitar solo. This solo made it feel more like jazz than pop. It felt too much like music from a 1990's soap opera. I asked him to emphasize the drum and make the beat faster. I also asked him to take out the guitar solo and play other instruments equally. The resulting music starts with a powerful drum which creates a cheerful and anticipating opening.

2) Music World

For the music that the main character is making, I directed it to be 40 seconds long, with a clear start. The piece should start as a single instrument and each of the other instruments should stack up on each other one-by-one. However, all of the instruments (drum, bass, electric guitar, and piano) should be stacked up within 10 seconds. The piece should have a certain kind of repeating melody that the audience can easily remember.

We tried several versions of the timing of the music as I animated and edited the shots. Since this piece is not supposed to be a satisfying piece for the main character in the film, we tried not to go crazy with the instrumentation and instead make the music seem flat. However, at the same time, we tried to have some variation in this 20-second piece so it wouldn't feel too boring to the audience.

3) Ensemble with Kids

I envisioned that this piece should feel childish but then sound beautiful when the instruments are played together. This video was the reference to the feeling I wanted. We first thought about the three instruments that the twins' family would be playing. Ultimately we chose a tambourine for the percussion instrument, a flute recorder for the melody, and a xylophone for a cute childhood feeling. It was difficult to make the playing of the xylophone sound unskilled

and child-like in Logic ProX. The xylophone in the Logic ProX sounded too beautiful. To solve this problem we bought a xylophone and recorded it.

We tried to come up with a melody that you might hear when passing by a primary school. We made several attempts, but it was hard to come up with that childish feeling. So we went back to very simple notes and also used only major chords. The resulting simplicity is what created that desired childish feeling, and Juwon added a few more notes in the middle which made it a little more fun to hear.

4) Final Scene

Juwon added the flute recorder and xylophone to the composer's previous "music world" piece as they were playing solo parts and added the tambourine to fill in the rhythm. We have them play as soon as the drum makes the intro of the final music. I asked Juwon to make this music piece continue for 1-minute so that it would continue throughout the end credits.

5) ETC: The Chaotic Ensemble

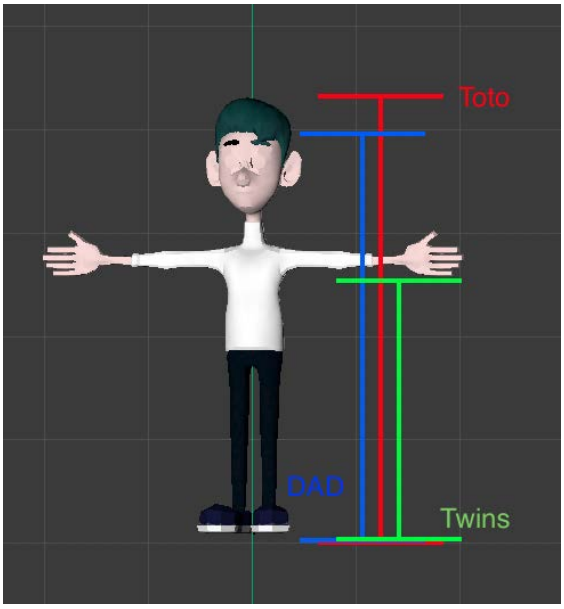
I also asked Juwon to make the chaotic music played by the twins' family. Juwon sent the draft and the melody was funny, however the recorder and xylophone sounded too beautiful. Juwon found an abnormal recorder sound from the Logic Pro X, but for the xylophone I asked him to hit the corners of the plastic case and to make the plate not ring. I laughed hard as soon as I heard the final outcome. It was definitely chaotic and funny, and it went well in the transitional scene from the music world to the twin family's yard.

I learned a lot about how music works in animation as I tried to create the right "feel" with the music director. Also, it was a good time to experience how to communicate the effects I wanted in the film to someone who was not familiar with the production of animation. I am glad that I had a part in making the music that I am using in *Ensemble* and that it was composed exclusively for this animation.

Kids and Dad Modeling

As I was working on the animation, I felt the need for an assistant to model the side characters. With a referral from Professor Dan Pejril, I hired a UConn DMD 3D Animation alumna, Carly Wanner-Hyde, to create the models for the dad and twin characters. I was really lucky to be able to collaborate with Carly. She is very talented and quickly understood what I wanted for the characters. She was a great help to me, and it was a positive experience working with her.

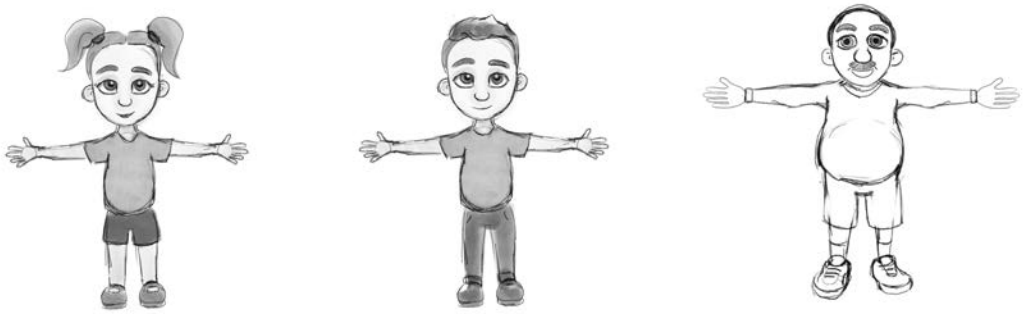
We first had a short meeting through Zoom. I shared the files of the animatic and the C4D files of the main character so that she knew the overall information. I gave her some notes concerning what I expected in the models.



Notes I first gave to Carly

- Twins are a boy and a girl and will have the same mesh for their head and body but different hairstyles.
- Dad is fat and a little shorter than Toto.
- Clothes can be simple. The season would be around the beginning of fall.
- I won't worry about textures for now.
- It would be great if it is UV mapped in one set
- For rigging, the hair, face, eyebrow, eyes, upper teeth, bottom teeth, tongue, and body should be separated.
- The model should be finished before the last week of Feb because I need time to rig.
- The image is the estimated size I want for the characters.

A week later, Carly sent me the concept art for the models, and I loved them. I had a few details I wanted to add. Since I didn't want to make the main character feel too much like a human, I made his ears sharp on the top, like an elf. So I asked her to also make the ears sharp for these characters so all of the characters had a common feature. For the hair of the twin boy, I wanted it to not be too stylized so there would be a contrast with the main character who has clean and neat hair.



The concept art from Carly

Carly worked only with 3D Coat and couldn’t use Cinema4D because of the license. There could have been many limitations, but the outcome was great. I did the work that could be

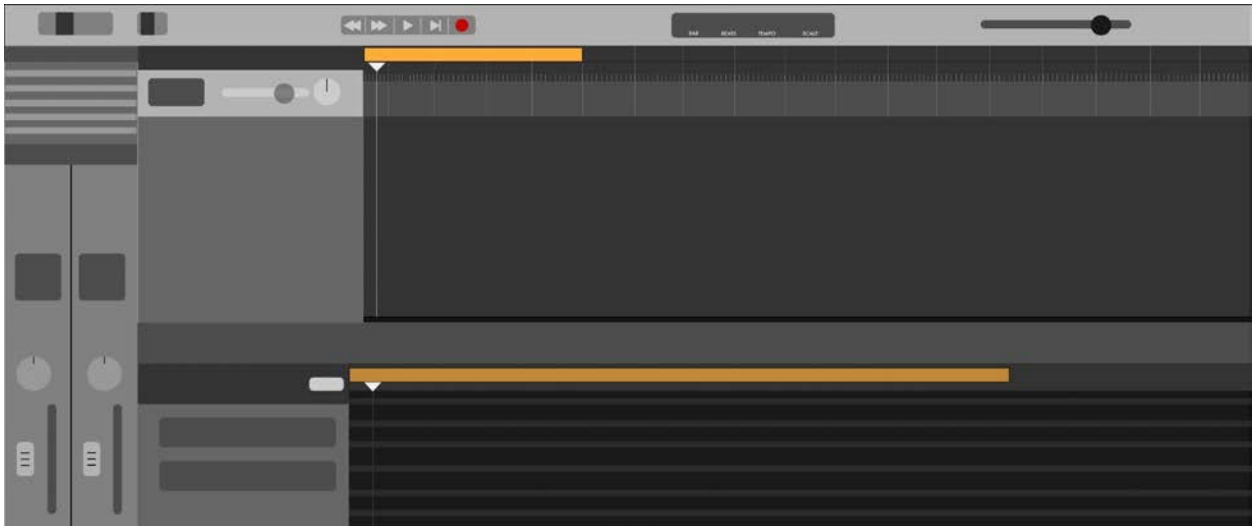
done faster using Cinema 4D. After I got the model from her, I separated the head and body and made eyebrows for the characters. I cleaned the topology a little and made it symmetrical for the rigging and set the UVs.

Left : Final Model I got from Carly Right: The final touch and rigging

Motion Graphics

Because of a referral from Professor Heejoo Kim, I worked with a talented UConn DMD student, Chaofan Yu, for the motion graphic of the texture in the main character's monitor screen. I gave him the Logic Pro X as the reference and sent him an animatic to show when this motion graphic would appear in the animation.

He first created an Illustrator file for the music program interface. It was great and we made only small changes in the tones.



The illustration of the interface of the music program

I asked him to create an animation of the mouse clicking the record button and playhead with a red line going across the timeline. I thanked Chaofan for his professional work. The Adobe After Effects file he sent worked very well and was organized very clearly so I could make simple adjustments for the timing.

Conclusion

As I transitioned my academic studies from film to animation, I was glad that I could begin my study of 3D animation in the UConn DMD MFA program. My future goal is to become a character animator, but I felt the need to understand and experience the overall production process for 3D animation. That is the primary reason that I chose to make a 3D animated short film for my thesis project. I wish I had more collaborators, but doing most of the work alone forced me to touch upon all parts of the process, and I have learned a lot from problem solving my mistakes and struggles. Using Unreal Engine 4 was an unexpected challenge for me because it took me many hours to learn and research how to use it in animation production. However, through this process I learned about many kinds of projects using 3D animation in game engines, and I want to use this experience to make various future 3D projects through Unreal Engine.

I found the production process for creating 3D animations very different from live action filmmaking, in every step from concept development to final finish editing and post-production. There were many frustrations and uncertainties along the way, but I received valuable help from people around me. With my committee's and many people's feedback, I was able to overcome hurdles and create an animation with a wonderful story. I am very satisfied and proud of the final film even though there is still more to be done. I would like to continue polishing it so I can share this animation with audiences at various film festivals around the world.

Links

Thesis Exhibition page - https://dmd.uconn.edu/2021mfashow/hongju-lim/
Film Teaser (Vimeo) - https://vimeo.com/523614796
Ensemble, 3D Animated Film (Vimeo) - https://vimeo.com/533129756
Password: mfa2021

Contact Information

Email: hongjulim13@gmail.com
Phone number: 860-634-9784
Vimeo page: https://vimeo.com/hongjulim

Appendix A - Final Ensemble Script

Ensemble(TBD)

Hannah Lim

1. INT/EXT. TOTO’S HOUSE-IN FRONT OF WORKSTATION - EVENING

Beautiful sunset sky, two houses are across the street from each other in a small town. Great music is playing in the background. Two kids, who live in the left house, run across to the right house. The shot jumps into a room. On a wall there is a shining GOLD PLATE of a music icon with the phrase "More than 1,000,000,000 Subscribers”(like a Youtube gold button). Camera zooms out and we can see Toto bob his head to the rhythm of the music. There are big speakers playing the music and a keyboard piano in front of Toto.

While Toto is focusing on the music, there is a knocking sound from the window.

Toto, in frustration, turns the music off and checks out the window. A girl and a boy, twins, stand outside the window with happy faces. The girl shows a party invitation letter they have made for Toto.

Toto looks at the twins to process the situation, waves his hand to show that he is not interested, then shuts the window. Toto goes back to his desk. The kids quietly push the letter into the slight opening of the window. The paper lands on the floor of the room. Toto, unaware of their action, puts on his headphones and clicks on a record button on the screen.

2. INT/EXT. INSIDE TOTO'S MIND

Toto is in his own world of music. In the middle of darkness, a spotlight is focused on Toto. Toto gives a cue to the left. Then a spotlight shines on a drum set and the drum plays on its own. Then Toto cues to a bass guitar, an electric guitar and a keyboard piano, respectively. Toto is obsessed with conducting. Then suddenly, a loud knocking sound interferes. Toto squints.

3. INT. TOTO’S HOUSE

Toto opens the door. The twins and their dad are in front of Toto’s house with a hotdog on a plate. The girl tries to take the hotdog from the dad’s hand, but it is too high for her to

reach. The boy is on the dad’s back leaning left and right. The dad almost loses his balance and kneels to get his son down from his back. The girl tries to grab the hotdog, but she accidentally drops it on the ground. Toto contemptuously picks up the hotdog, but the dad who didn’t realize that the hotdog had fallen on the ground, smiles to see Toto holding the hotdog.

4. INT. TOTO’S HOUSE

Toto shuts the door and throws the hotdog into his trash basket. As he walks back to his desk, he steps on the invitation letter and slips to the floor. Toto struggles back to his seat and tries to calm down. Toto puts on his headphones and clicks on the record button.

5. INT/EXT. TOTO'S MUSIC WORLD

Toto gives cues to the drum, bass guitar, electric guitar, and piano. It makes a harmony and he completes the song, yet Toto is not satisfied with the outcome. He thinks something is missing. As Toto tries to figure out what is missing, he hears chaotic music coming from the neighbors’ yard.

6. EXT. TWIN'S FRONT YARD

Toto stomps toward the twin's front yard and snaps the tambourine out of the dad's hand. Toto breathes hard with anger. However, the family is glad to see that Toto finally joins their party. Toto is confused, but gets interested in the instruments they were playing.

7. EXT. TWIN'S FRONT YARD

Toto makes a conductor pose. The twin's family is lined up straight with each of the instruments in their hands, waiting for cues. Toto gives a cue to each of them resulting in harmonious music.

After the music's over, everyone cheers. The twins hug Toto, and Toto looks happy and smiles.

8. EXT. TOTO’S ROOM - NIGHT

In Toto’s music world, there is a recorder and a tambourine and the music sounds richer. Toto turns around and the space changes to Toto’s room. The twins' family is sitting around in the room enjoying and clapping to the music. Toto is satisfied with his music and smiles.

CREDIT

Appendix B - Storyboard

ENSEMBLE STORYBOARD

SCENE 01

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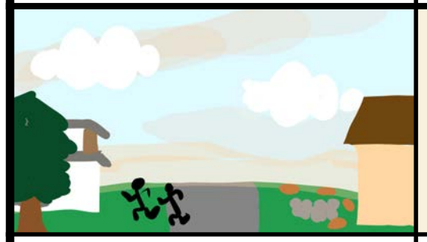		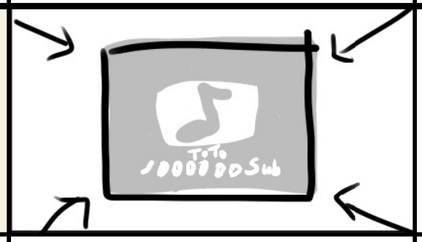			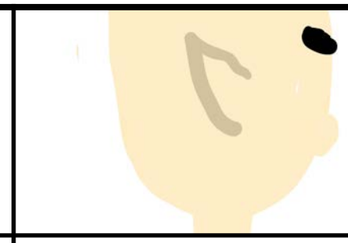
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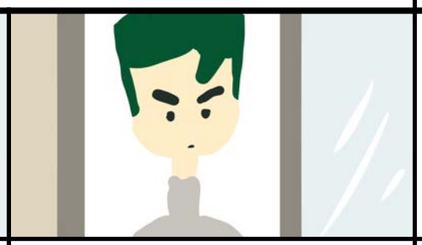
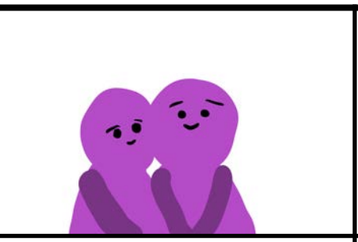
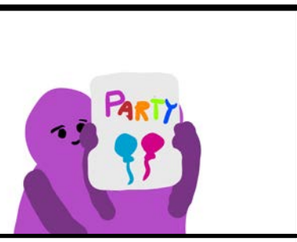
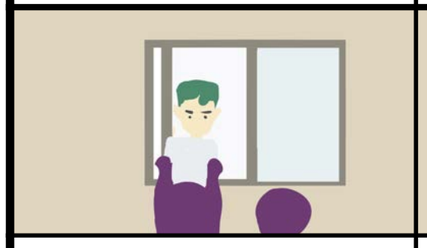
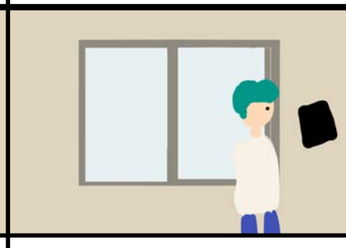
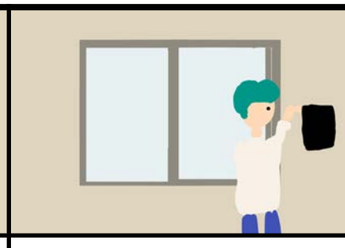
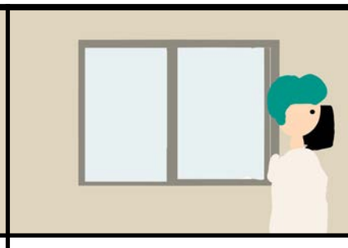
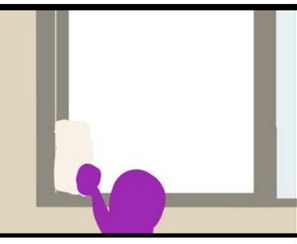
					
	9			**10**	**11**
					
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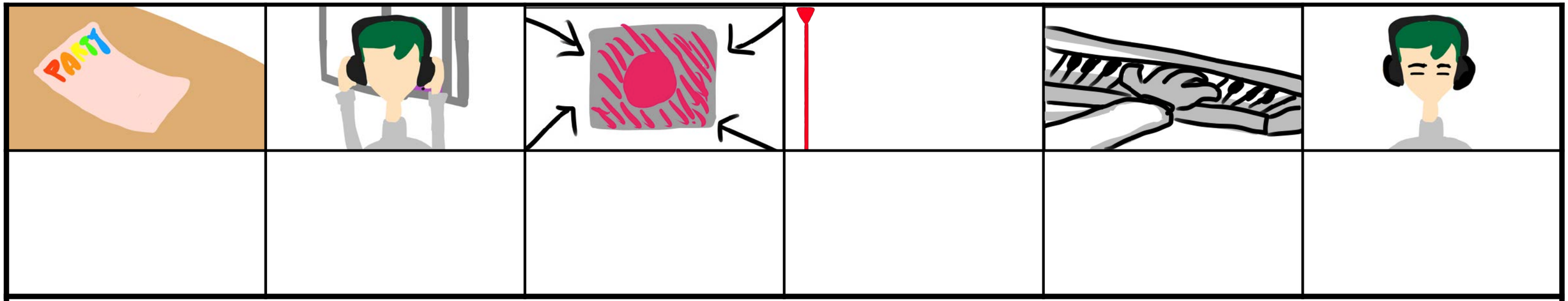


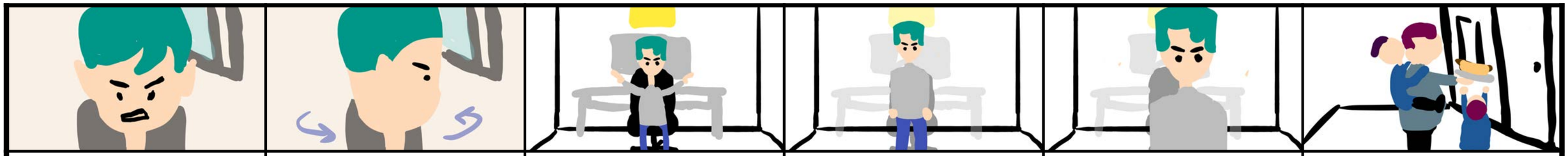
SCENE 02

1	2	3	4	5

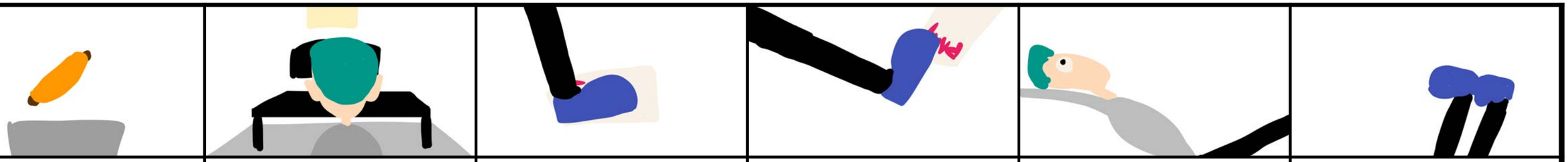
6	7	8	9	10	

SCENE 03

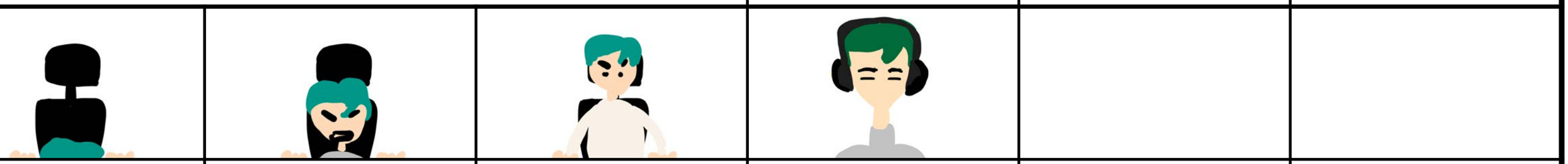
1	2	3



4	5		6	7	
9	10				
SCENE 04					
1	2	3		4	5

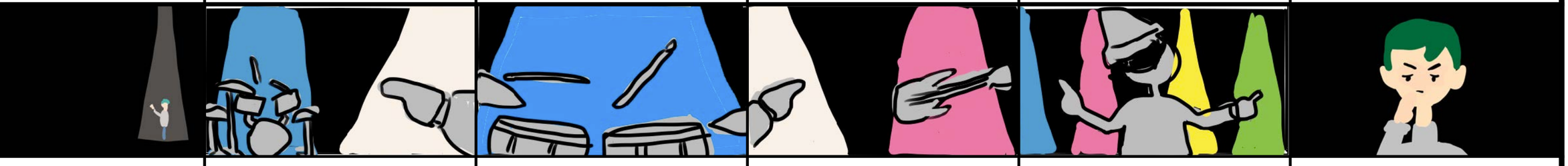


6 | 7



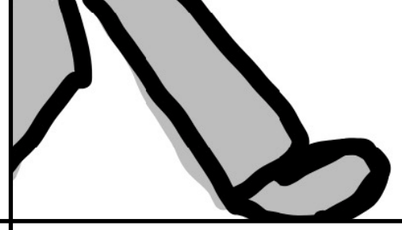
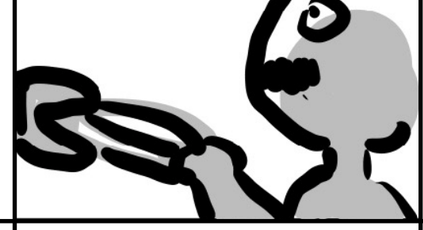
SCENE 05

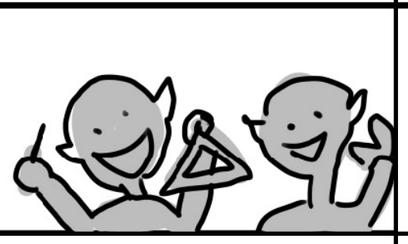
1 | 2 | 3 | 4 | 5 | 6



7

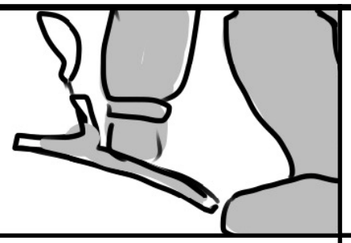
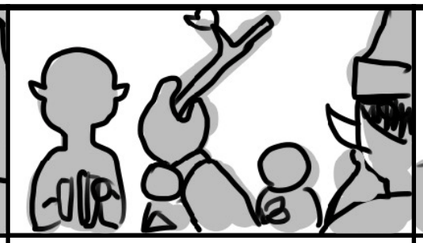
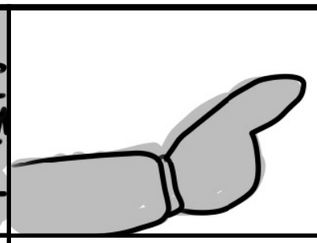
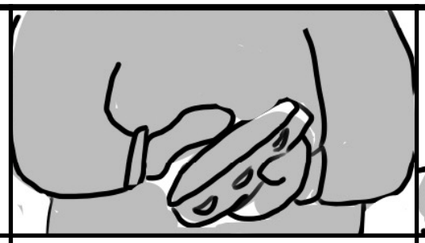
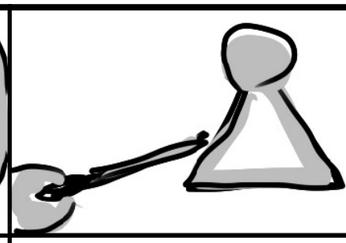
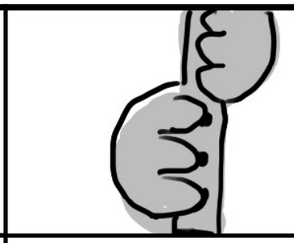
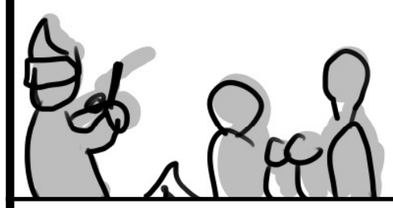
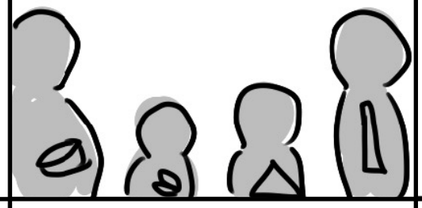
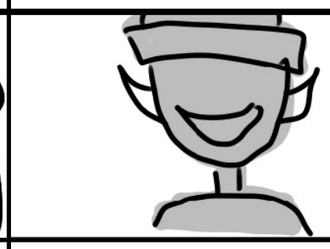
SCENE 06

1	*2*	*3*	*4*	*5*
				

6	*7*	*8*			
					

SCENE 07

1	*2*	*3*	*4*	*5*	*6*

					
7	*8*	*9*			
					

SCENE 08					
1	*2*	*3*	*4*	*5*