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Baba Yaga: Character Design and Collectible Figurine

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Baba Yaga:
Character Design and Collectible Figurine

A Culminating Experience

presented to

the faculty of the Department of Digital Media

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In partial fulfillment

of the requirements for the degree

Master of Fine Arts in Digital Media

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by

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ABSTRACT

Baba Yaga:

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The first edition of a series holds value. It is a bookmark that holds a place in time that the artist can look back to and see the progress that led up to that point, as well as the continued progress that's been made after. Designing and creating a set of characters, bringing the main character through 3D modeling, and printing it has multiple uses in the industry. The techniques learned through this process have been used in toy design, stop-motion animation, museums, and medical applications. 3D printing is advancing and providing an opportunity to create high-definition models that can be reproduced quickly while maintaining their initial integrity. This paper will go through the model's design concept and how to execute it. It is also a culmination of all the traditional skills acquired from a fine art background combined with all the new skills learned in the digital media field.

This project aims to create a cohesive set of 2D character concepts centered around the story *By Command of the Prince Daniel* (Nikolaevich, 1915). The main antagonist, Baba Yaga, was then brought through the 3D modeling process so she could be resin printed and turned into a collectible figurine. Descriptive character traits from her stories were reimagined while providing a unique approach to the design that still preserves the story's essence.

Acknowledgments

I want to thank all who helped me through this process. Cher for giving me feedback, helping me through the character design process, and organizing my thoughts; Jacy for always being willing to provide feedback and keep me focused on the end goal; and Sarit for being supportive and helping me with learning Z Brush and aiding in form. Others that have helped along the way were Greg Marlow, Megan Smith, Jarrett McGill, and Miguel Caffey, who are excellent animators that provided input on posing and form. Ben Carroll-Garrett for being a ray of sunshine and optimism, Alex for always helping me figure out why “the thing isn’t doing the thing”, Grayson, Lily, Ashley Thomas, Maheen Pulak and many others aided me and taught me new skills to implement in the modeling process. The long nights of learning new software and having colleagues present to aid in troubleshooting software and being supportive through the process is what allowed me to be successful. The entire Digital Media department at ETSU has been amazing and I’ve appreciated the willingness to help with questions or offer critique when requested. Dr. Tod Emma especially for helping me obtain a GA so I could go down to part time with my day job so I could graduate on time. I would also like to thank the ETSU Graduate School for awarding me with the small grant to fund my capstone so I could purchase all the supplies I needed. Lastly, my family, they’ve supported all my adventures and their love and help have made it so I could focus on my projects and succeed. I love you all.

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Chapter 1: Introduction

This project has three objectives that it works through. The first objective is conceptualizing characters based on a story, the second is translating those 2D concepts into a 3D model using Z-Brush, and the last objective is 3D printing and painting the model. This aims to show how to move through each step of the creative pipeline with the goal of having an heirloom-quality painted figurine. Creating works in 2D and developing the ability to translate them into 3D allows for growth by strengthening awareness of space, depth, portion, and perspective.

Utilizing 3D printing for this project is necessary to allow consistent production of detailed models. Similar to how a traditional printmaker would create works with screen printing or lithography, 3D printing promptly opens up a world of opportunity for duplication without losing quality. Laika Studios implemented this process with their stop-motion animations. They had an animator animate dialog and then exported out face plates that were 3D printed and brought to the set, but this creation method can also be used for props, toys, model kits, and collectibles. (See Figure 1) Jordu Schell and Thalasso Hobbyer inspired the desired level of detail for the final model and painted print for this project. Their work is dynamic and full of life as if the creatures were frozen at a crucial point in their story and pulled into our world. (See Figure 2 and 3)

Figure 1. Collage of Laika Studio production method using 3D printing and modeling for stop-motion animation

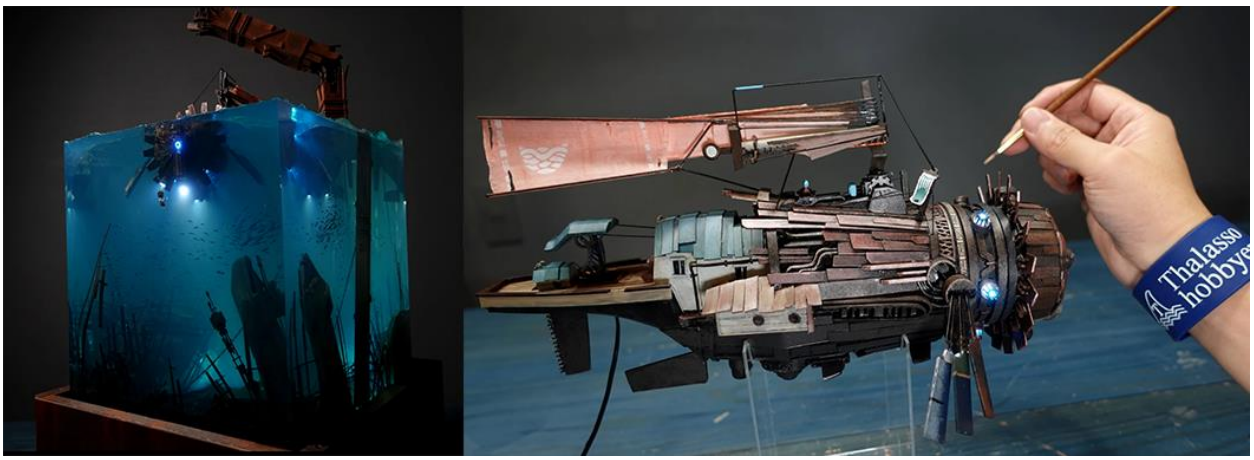

Figure 2. Thalasso Hobbyer "#21 Diorama of FAR: Changing Tides. Inspiration for level of detail and posing to capture a moment in time.

Figure 3. Jordu Schell Maquette "Slab", inspiration for texture detail with skin folds and painting.

The selected narrative for this project centers around *By Command of the Prince Daniel* (Nikolaevich, 1915), featuring Baba Yaga as the antagonist. The prince is provided a ring and told it will fit the finger of the one he is meant to be with, so he exhausts all search options to find someone who can wear it. His sister playfully tries on the ring, and it fits perfectly, then magically clamped around her finger with no way of removing it. The prince declares he will marry his sister, but the sister protests to no avail. The adventure starts with the princess escaping with the help of the beggars to the dark woods, where she encounters Baba Yaga. The end of the story is a magical chase scene depicting Baba flying through the woods, trying to

capture the princess, who narrowly escapes using magical items she stole from her home.

Baba Yaga was explicitly selected for this project because she had two elements that allowed exploration. Her mortar and pestle allowed her to work with hard surface modeling, while Baba was completely organic. She has a character that provides an opportunity to work on both, making for a unique and exciting design. One of the notions that was kept in mind while illustrating and conceptualizing her was the thought of magic being science that we do not understand yet. When looking at Star Wars, any SiFi film, and even fantasy, there's always an explanation of how things function or are created. Even spells or potions have a root system that has to be followed for casting. The aim was to design Baba so that she would feel more technologically advanced than everyone else around her, leaving her with the title of “witch” because the people did not understand her creations.

Chapter 2: Literature Review

Figure 4. Baba Yaga Flying Down the Mountain. Digital Illustration created based on her physical descriptions

"The Witch who lives in the forest, rides the winds in a mortar, devours human flesh, lives in a hut on cocks' legs…"

(Nikolaevich 1915, viii)

That is the standard description of Baba Yaga from around 18th-century Slavic folklore. (See Figure 4) She has had many variations on her story, and in recent history

she's been reinterpreted into film which provided a renewed interest in her. In the PBS series *Monstrum* Season 3, Episode 1, *Baba Yaga: The Ancient Origins of the Famous 'Witch'*:

> Baba Yaga was once more goddess than witch, who reigned over time, life, death, and elements. She was associated with strong winds and dark forests, connected to the earth, the heavens, and the underworld. She straddles the boundary between life and death. Associated with powerful magic and accused of cannibalism, she has immense powers over animals, the elements, and even time. (Zarka 2021, S3 E1)

The most notable roles Baba has played in her stories are "witch, grandmother, cannibal, examiner, and helper." (Rudy and McDonald 2016, 1). She's also. "…a threat to life and a benefactor of light. Her wonder, thus, is marked by being awful and full of awe." (Rudy and McDonald 2016, 1) Despite her image evolving over time, she has key physical features that she's maintained which make her unique from other witches. She has a nose that reaches the ceiling, old and weathered skin, tall in stature with legs compared to wooden sticks due to how thin and frail they appear, and iron teeth. Even her name has devolved in meaning to something derogatory.

"Baba in traditional Russian culture meant a married peasant woman, one at least old enough to have children. (In Russian now, Baba is insulting word for a woman: it suggests low class, slovenliness, lack of emotional restraint, or sexual availability of an aging or otherwise unattractive kind) …The second part of her name, yaga, is harder to define. Scholars do not know exactly what it means." (Forrester, Zipes and Skoro 2013, xxii-xxiii)

According to Plazonja, Baba is the contemporary obsession with age and womanhood, and she feeds into that stereotype of old and ugly yet retains feminist strength. Baba is unapologetically herself and lives on the outside of social norms by flying around in the nude, isn't ashamed of thinning hair, or losing teeth, and acts on

impulse without regard to consequences. She takes on the role of monster by housing what we fear with age. In the story Plazonja analyzes, we don't see Baba Yaga as a villain or trickster. She's looked at as a nuisance for being present, but praised when she's able to provide aid, and then dismissed again when she slips back into a senile state. Seeing her in this state pulls sympathy from the Protagonist and leaves a feeling of melancholy. This leans into the fear of other stigmas that come with age like being ignored or forgotten.

Just as Baba starts to seem helpless and her mind slipping away into the void of time, she comes back with sharp wit in the story *BABA YAGA AND ZAMORYSHEK* (Nikolaevich 1915, 48-51) In this story Zamoryshek is one of 40 sons that were born from chicken eggs, and him with his brothers are instructed to go and find brides so they make their way to Baba Yaga's home. Upon arrival, Baba's home is described as being up a steep mountain and is a "white stone palace with high walls round and iron columns." (Nikolaevich 1915) They tie their horses to her fence and when she questions why they are there, the brothers have the gall to demand she bathe them and feed them before asking questions. Whether it was due to societal standards at this time, or whether they thought they could take advantage of her old age to get what they wanted, Baba complied with their demands. This is when we learn that she is a mother and has 41 daughters that are all the perfect age to marry. She brings them all down and everyone celebrates the many engagements all night, and at one-point Zamoryshek steps out to check on his horse he's informed that he and all his brothers need to trade clothes with their new fiancés. Zamoryshek listens and then when everyone is asleep Baba shouts, "Ho, ye my faithful servants! Will ye cut off the heads of my insolent and

uninvited guests?" (Nikolaevich 1915) and the servants do as she commands but mistakenly cuts off the daughter's heads instead. When the brothers escape, they take the daughter's heads and place them on the stakes of the fence surrounding the palace.

These events are important for Baba's character development. Her home before the iconic magical hut, and how her fence came to be decorated with skulls and bones as described in the *Monstrum* episode by Emily (Zarka 2021) paint a picture of egregious loss and her justifiable hatred for Russian men. Having all the bones and skulls surrounding her hut left people with the impression that she (and her daughters) partook in cannibalism. Having iron teeth as one of her common physical descriptions, it would make since for her to have false metal teeth in order to crush and chew through the bones of her victims. The reasoning for acknowledging her having false teeth is due to the bulk of her illustrations show her as having missing, or little to no teeth.

Baba Yaga and the Kid leaned into those speculations by stating, "Yaga-baba dragged the kid home, put him in the stove-box, stoked the stove herself, and said to her eldest daughter, "So girl! I'm going to Rus.' You roast up this kid for my lunch." (Forrester, Zipes and Skoro 2013, 11) The rest of the story is about the child being clever or feigning ignorance which allows the child to evade Baba and her daughter's attempts to roast the child for her to eat. The kid turns things in their favor by tricking the daughter and Baba by getting them to lay in the pot and the child shoves them in the oven in which they roast to a golden brown. In this story, aside from her described cannibalistic behavior, Baba is specifically described as riding around in "the mortar, pushed along with the pestle, and swept away her tracks with a broom." (Forrester, Zipes and Skoro 2013, 9) This is how she was able to kidnap the child to bring it back to

her hut. This is her primary mode of transportation; she's often illustrated riding on it as she's flying through the woods like a wild woman. "Yaga flies through the sky in a fiery mortar, which she urges on with a burning broom and that during the time of her flight the trees groan, writhe and crack, and the winds howl." (Ivanova 2013, 1857)

Looking into that imagery of her being untamed, giving into her whims, and taking on the personality traits associated with being monstruous by not caring about the potential consequences of her actions; Ivanova brings focus to one of Baba's most notable talents which is magic. In the majority of Baba's stories there's a magical element of some kind implemented whether it's flying around in her mortar and pestle, enchanting objects the protagonists use, creating illusions, or casting spells. "Magic is an area where popular culture meets with learned culture… Magic represents a particularly interesting crossroads between fiction and reality." (Zipes 2012, 62) The ease at which Baba Yaga uses it as if it's an extension of herself is what makes her formidable and a challenge to patriarchal standards. Researching all these facets that are part of her character were crucial elements in successfully redesigning her for this project.

Chapter 3. Character Development

Figure 5. Shaded Character Lineup

In order to do Baba's concept, there had to be an understanding of the other characters in the story and the development of a cohesive design so they felt part of the same world. Baba was also designed in two parts, one being her body and the second being the mortar she rides in. Above is the lineup of all the characters illustrated for this brief. (See Figure 5)

The beggars provided the key to the threshold for the hero's journey, so their design was made around visual balance and pairing. I wanted one to be tall and lanky and the other to be short and stout to complement each other. (See Figure 6)

Figure 6. The Beggars. Concept art with notes and mood boards to display development for final illustration

The prince was the key to giving the princess a reason to flee into the woods, where we would encounter Baba Yaga. His personality was obsessive, unable to listen to reason, and he did not care about the pleas of others. (See Figure 7)

Figure 7. The Prince. Concept art and mood boards to show iterations and development that led to final illustration.

Designing Baba

With the central focus of this project focusing on the redesign of Baba Yaga, her image was designed to portray her as a self-made scientist and tinkerer who had advanced beyond the comprehension of those around her, so she was regarded as a witch. Reflecting back on the idea of magic being science we do not understand yet; this

prompted further research into engineering and robotics while designing the mechanical aspect of her mortar and back piece. With all the changes that were going to happen, the essence of her character in the story needed to stay present for the end product. Notes of her physical features that carried over through multiple stories were specifically woven into her design so she would still feel like Baba.

Rather than having her fly around in a mortar with a pestle, she is physically representative of the pestle. Her legs were removed with the thought of them breaking down with age, and with the modifications she was already placing on her body, she had obtained the skills to perform self-surgery to remove them. Pulling from her traditional description, her large nose that points up to the ceiling was kept to enhance her silhouette. (See Figure 8) There is a mechanical spinal support with bolts on the outside she can reach with her wrench to adjust them as needed, polydactyl to aid her with tinkering, and her hair is designed after driftwood. (See Figure 9) The wood was an essential element to help balance the wood on the end of her mortar legs so the design would feel consistent and cohesive.

Figure 8. Concept Art of Baba Yaga. Mood board to show inspiration and sketches show flow of development to reach the final design.

Figure 9. Hand Study. Sketches exploring the ways Baba could be polydactyly while maintaining a functional extra thumb.

In Baba's stories, it's said she has iron teeth, so a logical conclusion would be she is using dentures given her age. In her final pose she is sculpted without the dentures so the face can cave in on itself more do to the missing support of her teeth. Her home would have a variety of dentures she’s created stored on a shelf with some being made only with canines so she could shred flesh, others are made of different

metals, some with wood, and so on. This would allow her to change out what she needs for whatever or whoever she is eating.

Designing the Mortar

When approaching the design of the mortar, research on robotics, hydraulics, and insect joints is required to understand how they're able to move. It needed to feel believable and functional as if she pulled all the parts from a junkyard. The initial design had a small ball bearing that was supposed to spin around and allow the leg to have 360 rotation, and the mechanical components were hidden behind some fabric, but after printing it, the legs looked like they could only go up and down. Going back into it, I changed the joints where the legs were connecting, took inspiration from smaller metal robotic sculptures, and decided to make the join a sphere so it would feel like it had more diversity with movement. It has 6 legs to ensure it will be stable no matter how it's posed for the final print. (See Figure 10)

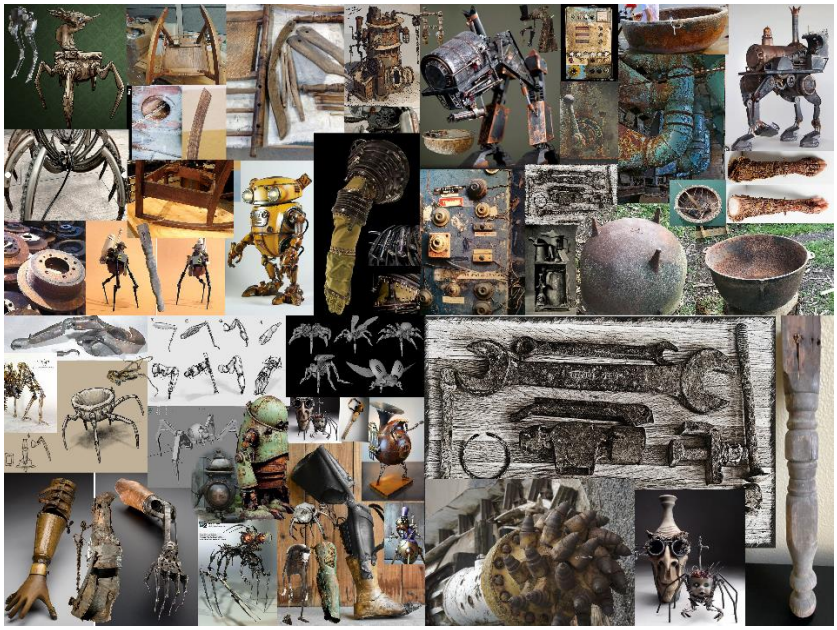

Figure 10. Mortar Mood Boards. Visual research on joints, hydraulics, and texture.

The fabric on the inside is supposed to be soft leather to protect Baba's skin while she's riding around in it, and there is now a hatch under the mortar that can open up and initially placed there to allow her access to additional wiring and fixtures. The concept of the hatch grew and was changed to allow escape if needed, or to relieve herself while she was moving about. Handles have also been added to aid in accessibility so she can pull herself into it when she's outside of it. Control boxes, hydraulic lever to finely tune the height, gages, and switches were also added to push mechanical feel. The ends of the legs will stay wooden as depicted in her stories, and for functionality they will be easily replaceable as the wood wears down and eventually breaks. (See Figure 11)

Figure 11. Initial Concept for Mortar. Sketches in lower left focus on functionality of leg based on mood boards.

Chapter 4. Methodology For Developing the 3D Printed Figurine

Although Baba Yaga and the mortar were one character, but they both went through different development processes separately before being brought together. While sculpting each of them, one would be worked on and progressed, then paused while the other was brought up to the same level of finish with the digital sculpting. They were pulled into the same file together when it was time to pose them for the final keying of the mortar's legs. Due to the complexity and different modeling requirements, Baba and the mortar are broken up into subcategories for this chapter.

Sculpting, Printing, and Painting Baba

The 2D concepts are completed, and now Baba Yaga is ready to be modeled in Z-Brush. She was constructed with basic shapes that were pulled and altered with the clay builder brush until her form started to resemble the concept. This process is called organic modeling, which means you use shapes and forms that flow and move to resemble living creatures like people, animals, and plants. Spheres were floated in to build volume and merged together in her stomach, chest, and butt cheeks then carved back until they achieved the feeling of older skin. (See Figure 12) In prep for this project, toy design courses were taken to prepare my model for 3D printing by learning how to key. Keying is the process of creating cuts in your model by inflating the piece you want to cut with by 3 so that when you print the pieces, they will seamlessly fit together. If you don't do this step the joints will be too bit to fit together. (See Figure 13) The program used for all the modeling on this project was Z-Brush. It's a concept artist's modeling software, and it feels like you're sculpting with digital clay, which makes it easier to translate traditional sculpting techniques.

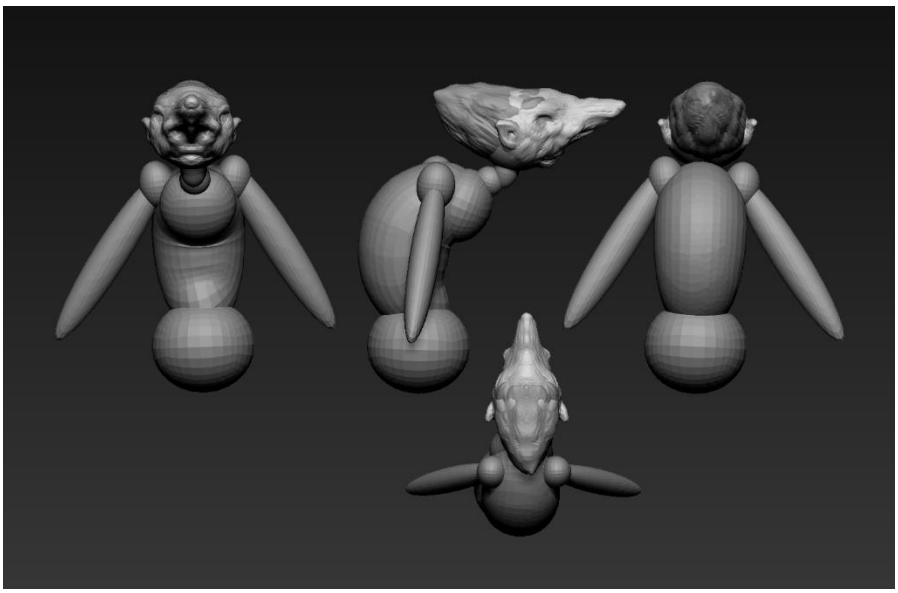

Figure 12. Building Form with Spheres. This was the start of the blocking out phase for sculpting her body and establishing a general idea of how everything would fit together.

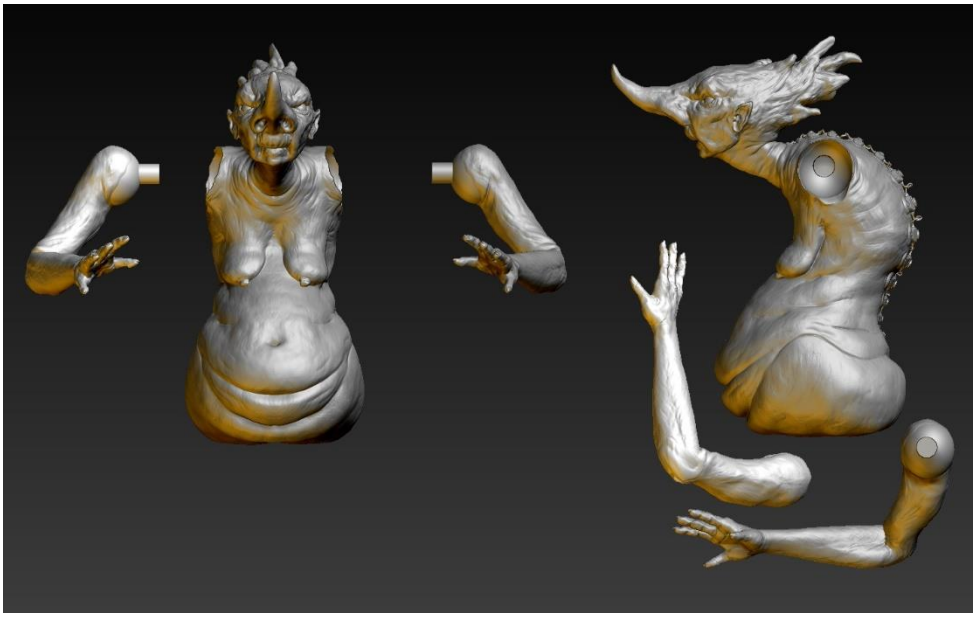

Figure 13. Keying Models for Printing. This shows how the pieces are cut and will fit together after printing.

While sculpting her, some problems arose from the original design that needed to be adjusted. Her eyes were on the side of her head, not the front, so she looked like she had the eyes of a prey animal. Her neck was also way too long, and there were issues with the overall portion. (See Figure 14) Moving her into 3D allowed for quick changes to enhance or fix any 2D design elements because you can rotate your model around and physically see how it's interacting within the space. Being able to pivot artistically when encountering a problem area will help strengthen problem-solving skills. Once the physical features above were addressed, she was able to be fleshed out quickly. (See Figure 15)

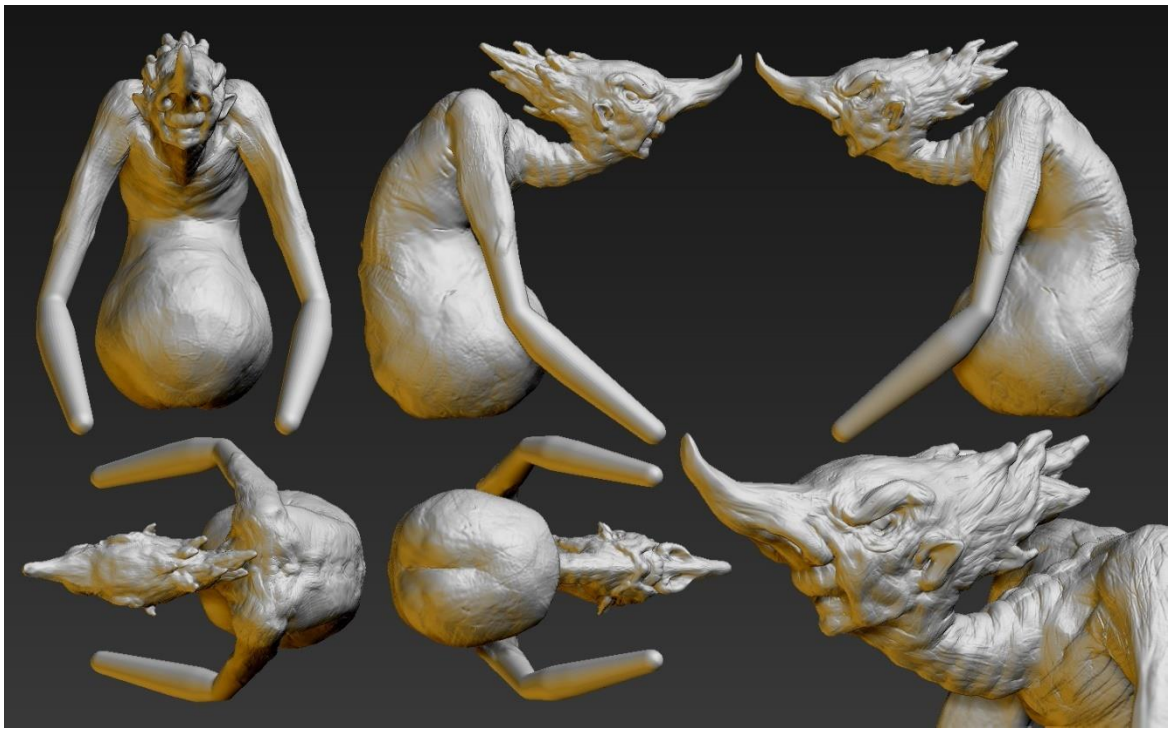

Figure 14. Discovering Problems with the Concept. Here the eyes were based on the concept art and they were on the side of her head rather than in the front and neck was too long.

Figure 15. Applied Corrections. Eyes are in the front, neck was shortened, and shoulders were spaced better.

Using Z-Brush also allowed for quick testing with the RGB poly painting so color could be tested to see which would potentially work the best. The initial color inspiration was taken from the monster in the 2006 movie Pan's Labyrinth. The flesh was translucent but had beige tones mixed with pink and red areas where the blood pooled in the extremities. The dark fingers were stained black from the blood of all the victims that this monster consumed. Although Baba Yaga is a cannibal, the idea of her fingers being black has more to do with a combination of oil, grease, as well as blood. Her skin needed to feel dirty from working with mechanics constantly, and she wasn't vain enough to care about her appearance. (See Figure 16)

Figure 16. Poly Painted Baba. This was to test placement of color and possible blended areas like the heads and head for the physical print.

With this being the first pass of Baba, several problems came up when trying to 3D print her. There were numerous fails for different printed parts, and it was determined that the resin was causing all the issues. It was cold in the print room, which affects the viscosity and curing time of the resin while it's printing, and the resin wasn't the same brand as the printer, so the curing time was different. It was found later that other people in online forums had the same problems where it would break or crack before it was ever removed from the build plate. These failures also provided insight to the way she was constructed and improvements were made to the way she had originally been keyed in her arms. The first version of her had cylindrical keys and a rounded socket, but where her arms needed to stay in a specific position her keys were

changed to hexagons with a flattened socket so they would simply slide in after printing and not try to spin around. (See Figure 17)

Figure 17. First Set of Failed Prints. You can see the new hexagonal keys for the shoulders, interior supports, as well as the different levels at which the prints were failing.

Below are the revisions made after the first set of failed prints. Her arm positions were changed to help support herself. She was meant to be sitting up with most sculptures if you have 3 points touching you can achieve physical balance. Once her print was finished, welding resin was tested as a means to attach her arms and fix damaged sections that cracked while it was curing. It worked really well and was able to be blended into the body so when primed you wouldn't be able to see where it was used. After obtaining a successfully completed pass, it was used to experiment with a brand of airbrush modeling paints called Warpaint. They behaved completely differently

from acrylics and oils. They dried really fast, layered fairly easy, and the opacity was nice, but they were not friendly when trying to use them with a brush. The paint bloomed and was difficult to layer without getting streaks when using the brush. (See Figure 18)

Figure 18. Testing Visibility of Welding Resin and Paints on Baba. The welding resin was able to be camouflaged for a seamless look after being painted over.

Having a tangible print to see how the 3D model was being translated gave insight on areas that needed to be improved with Baba's design. She needed to have her symmetry broken up because nothing in nature is perfectly symmetrical. Her legs didn't feel like she had surgically removed them herself yet, and her body left the impression that she was born that way. In order to apply these changes and bring in an asymmetrical balance to her design, a deep dive for reference images of double hip disarticulation was required. Images showing the documented healing process for the different stages of this kind of amputation were imperative to help understand the

distribution of fat, shape of the scars, and potential necrosis in the amputated areas. (See Figure 19)

Figure 19. New Mood Board for Lower Body. You can see how the scars from the original model shown earlier don't convey a surgical procedure had taken place like in the images here.

While applying the new changes to her body, the back of her head was also updated so it would line up more with the original concept art. It didn't feel wooden yet, and she was missing small branch pieces that were meant to help break up her silhouette and add interest. (See Figure 20)

Figure 20. Adding Asymmetry. The scars were added, wooden features were sculpted on back of head to better align with concept art, and mouth was opened.

For the painting process, she was given a solid coat of acrylic to set the undertone of her skin, then airbrushed with the Warpaint to build up depth and shadows to it. Drybrush, washes, and sponging was used to build texture and interest. (See Figure 21)

Figure 21. Painting Progression on Baba. From left to right, you will see the primed model and build up of skin tones and depth before final protective varnish was added at the end.

Sculpting, Printing, and Painting the Mortar

The initial model of the mortar was created using a hard surface technique. This is the opposite of organic and it is meant to be used to create machines, vehicles, weapons, or any sort of non-living object. In order to build the form of the mortar, cutters were created to carve it out rather than going in by hand to do it. Any sculpting with the clay builder tool automatically made it look more organic so it was crucial to refrain from doing that. The deformer tool as well as the Z-Modeler tool in Z-Brush are the main tools used to helped achieve the many facets that were needed to construct this machine. The only piece on it that had any organic feel was the leather that was stretched over the wooden rim.

The first model of the mortar had several balance and design flaws. The concept art had larger legs and a smaller bucket for her to sit in, but when it was modeled the legs were way too small and had to be scaled up before the first print could be made.

Having a physical prototype of the mortar was helpful in seeing what needed to be changed on it to enhance the design or add elements that were missing from the first pass. (See Figure 22, 23, and 24)

Figure 22. First Modeled Mortar. You can see the imbalance of the bucket in comparison to the legs and the legs look like they would snap under the pressure.

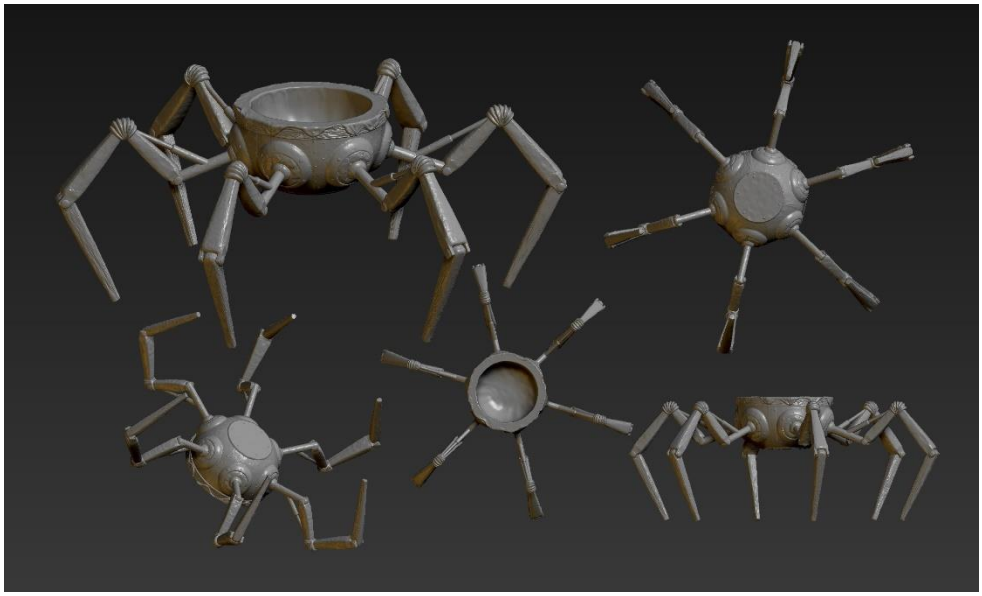

Figure 23. Revised Mortar. The bucket was scaled down and the legs were scaled up in size and the legs were also reworked to look functional.

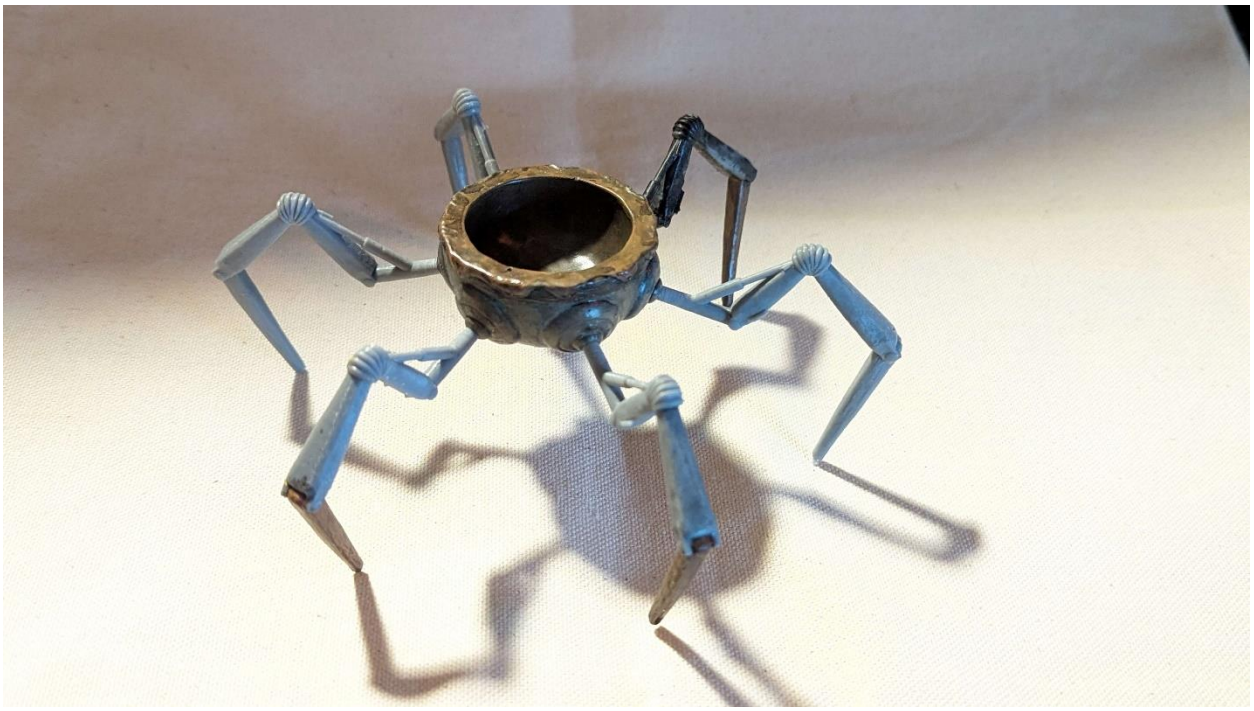

Figure 24. First Printed Mortar. Physical prototype helped show how much detail was able captured in the printing process. Painting techniques were tested to see how it would build up with washes and dry brushing.

Using screenshots from Z-Brush and pulling those into Photoshop and Fresco, revisions were drawn overtop the existing model to create a plan. The ball joints on the prototype visually had minimal movement. The burlap texture that was meant to hide the workings behind the joint made it look like the legs could only go up and down and had limited range in motion. The mortar was also missing the control panel, a way to get into the machine, and the bottom plate that was initially there to protect the undercarriage was way too small. (See Figure 25)

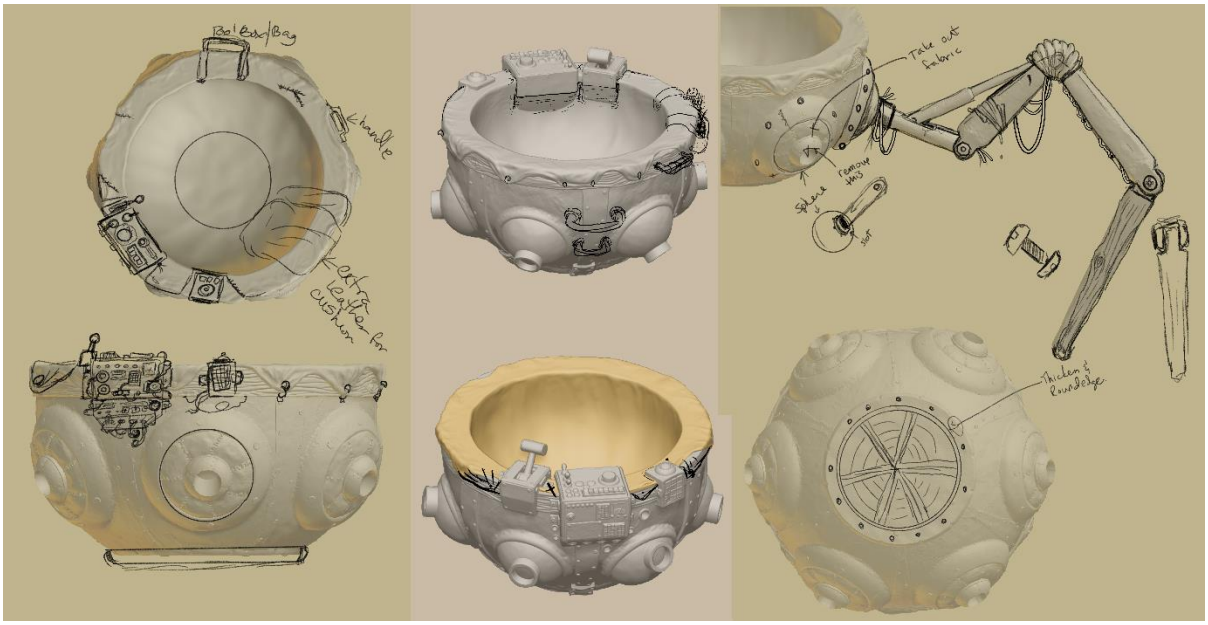

Figure 25. Drawn on Screenshots. Sketching over your model aids with perspective issues and quickly visualize how new elements could look on your model.

Her control box needed to feel like it was thrown together by someone figuring out how by trial and error how electrical equipment operates, in fact her entire machine was designed to look that way. It needed to feel like she gathered all her parts from a junk yard or made them herself. The control boxes and lever to control the hydraulics were initially clustered together on one side of the mortar which left the back feeling empty. To fix it, one of the smaller boxes were shifted around to balance out the form so it would be interesting from each angle it was viewed from. In the model you can also see decorative rivets. These were sculpted in so wire could be added after printing because the smallest the 3D printers can print is 1mm. This also eliminated the danger of printed wires breaking when removing supports. (See Figure 26)

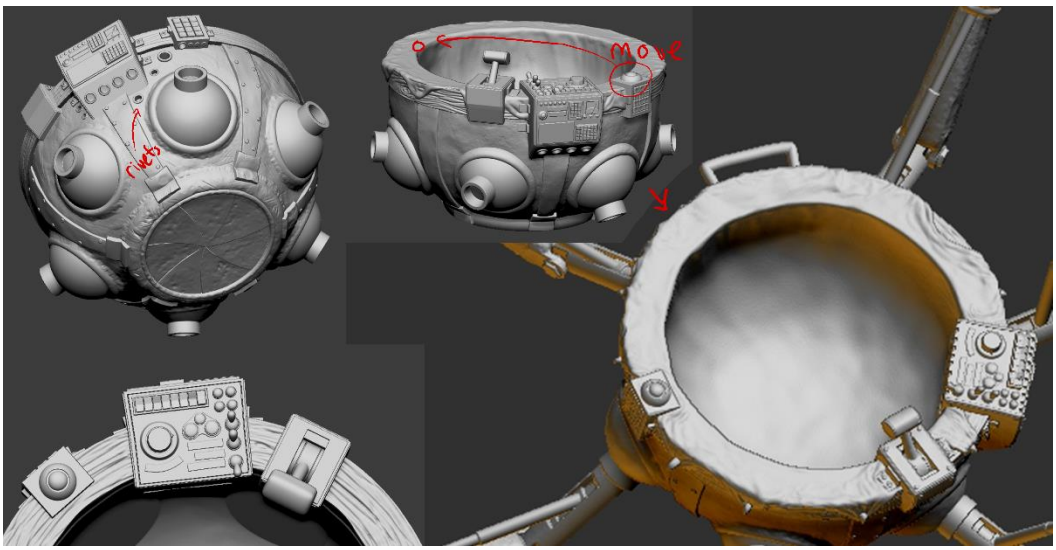

Figure 26. Control Boxes and Rivets. Adjusting placement of control boxes and placing rivets.

Mood boards were created in order to pull different references for metal textures, rust, erosion, and aging. Once the control boxes, levers, and ball joints were redone these boards were used as inspiration and direction in adding metal details. Alphas were created in Photoshop and imported into Z-Brush so textures could be pressed into the model and surface noise was placed on top of that to give the metal a porous feel.

After the surface resembled a solid metal surface, it was time to add wear and tear to it. Damien standard brushes, clay builder brushes, and HP polish tool brushes were used in combination to rework to add a hammered metal feel to the surface as well as add welded edges around the joints. They were also used on the control boxes so it would feel like it was scratched up and worn out. When adding detail, the carving needed to be deep enough to show up when printed, and it needed to catch paint when washes were applied. Once the models were completed, the mortar was sent to the printer, and it took close to 13 hours for each set of prints due to the size.

The prototype of the mortar was used to test different painting techniques before painting the final model. Doing a wash over the wooden legs after painting them a cooled burnt sienna made the woodgrain pop but going back over with a dry brush to add in highlights was problematic. The grooves weren't deep enough to prevent the dry brush from filling in all the details. On the final piece highlights were manually painted onto the wood to give it depth. For the final piece the mortar was taken through many layers of airbrush, dry brush, and wash techniques in order to build a rich color and weathered metal surface feel. The first layer was airbrushed on as a warm gray so set the tone for the metal. The legs and the bucket were painted at the same time to ensure consistency in color and shading application. After applying the base coat, a warm deep marron was airbrushed around the edges where the metal surfaces met to help accentuate pieces that were sticking out like the bolts and edges of panels. For the rust, it was placed specifically where you would normally see it on any metal surface. Any overlapping metal, joints, bolts, and welds would see a natural buildup over time. Once these two colors were laid out, the remaining painting application was building up those colors and then dry brushing with a pewter acrylic metallic paint between layers. The goal was to make it feel dirty, grimy and used. (See Figure 27)

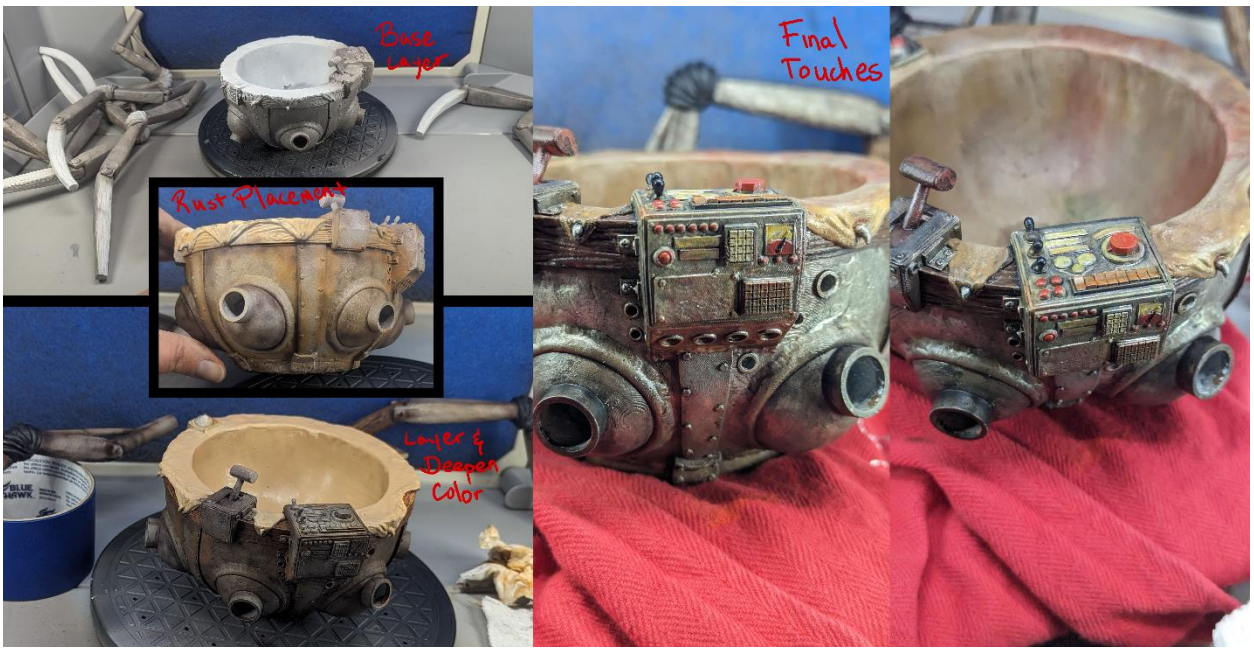

Figure 27. Painting Progression of Mortar. Layering paint washes, dry brushing, and airbrushing to create depth and texture.

Bringing Baba and the Mortar Together

When the final models were completed, they were brought together so they could be posed before the final keys for the legs would be cut out. Where this is meant to be a collectible figure, having a dynamic pose would pull the viewer in and create interest in her story. The part of her story that was used for the pose was the chase scene when Baba was running through the woods in pursuit of the escaping princess. In order to achieve the best pose, feedback from several amazing animators was acquired and a strong line of action was developed. (See Figure 28) If you're going to pose something that captures life and movement, reaching out to those who move things for a living made the most since. With their feedback Baba was able to be put into a dynamic

position and the legs could be cut out. Taking the extra time to make sure her pose was right was worth it when looking at the final result below. (See Figure 29 and 30)

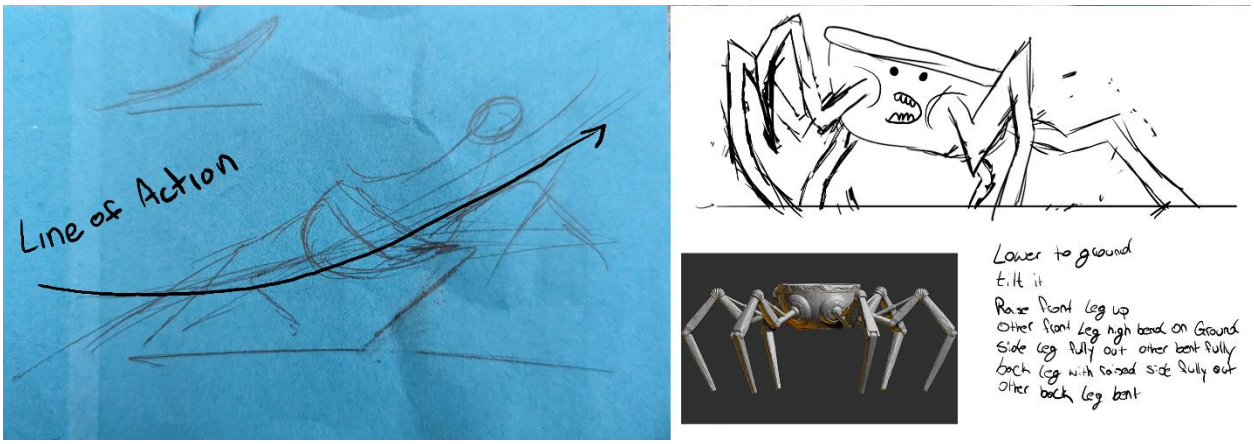

Figure 28. Feedback from Animators. You can see the strong line of action and personality that the sketches expressed.

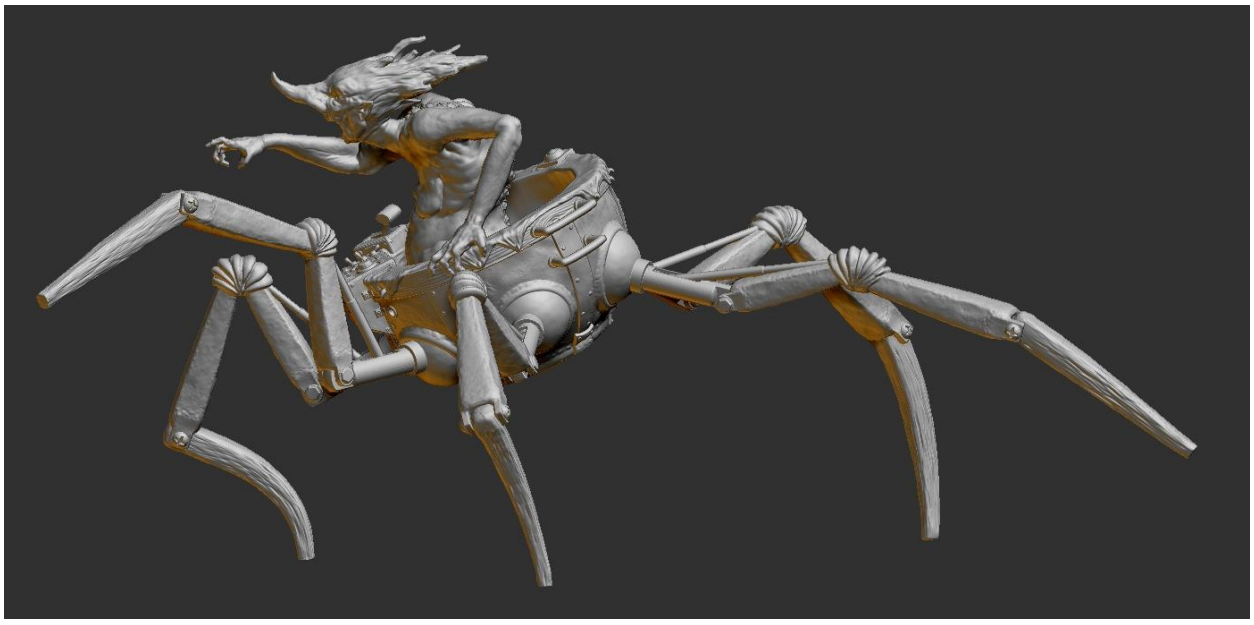

Figure 29. Final Posed Model of Baba in her Mortar. You can see how the feedback was applied and how much it enhanced the interest of the model.

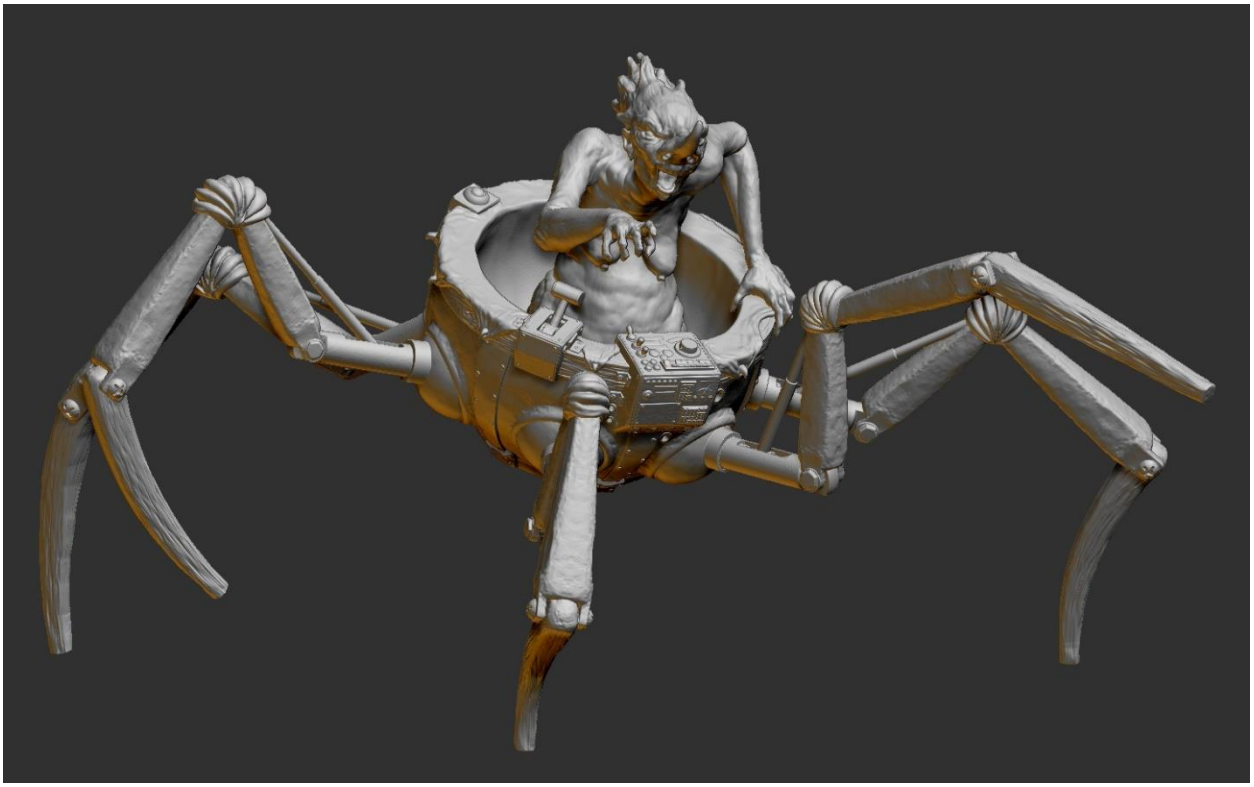

Figure 30. Front View of Baba Posed in her Mortar. The forward momentum and line of action needed to be felt from all angles.

Now was the time to print. Baba had several fails when trying to print but the first test that came out showed that she needed to have a peg added as a hidden element to keep her upright in the mortar. Baba also kept failing at different increments while printing. Her arms and head were chopped off in order to get a completed body then later reattached. The cavities that were being created when the resin was printing was the reasoning for her fails. She also needed extra curing time for the inside of her body to make sure the resin was fully set. This is important because the uncured resin will cause a model to crack and break down over time as it erodes it from the inside out.

With printing completed and the pieces painted as described above, she is finally finished and ready for display. (See Figure 31, 32, 33, 34, 35, 36, 37, 38, and 39)

Figure 31. Baba in Pursuit. Left Side View.

Figure 32. Baba in Pursuit. Right Top View.

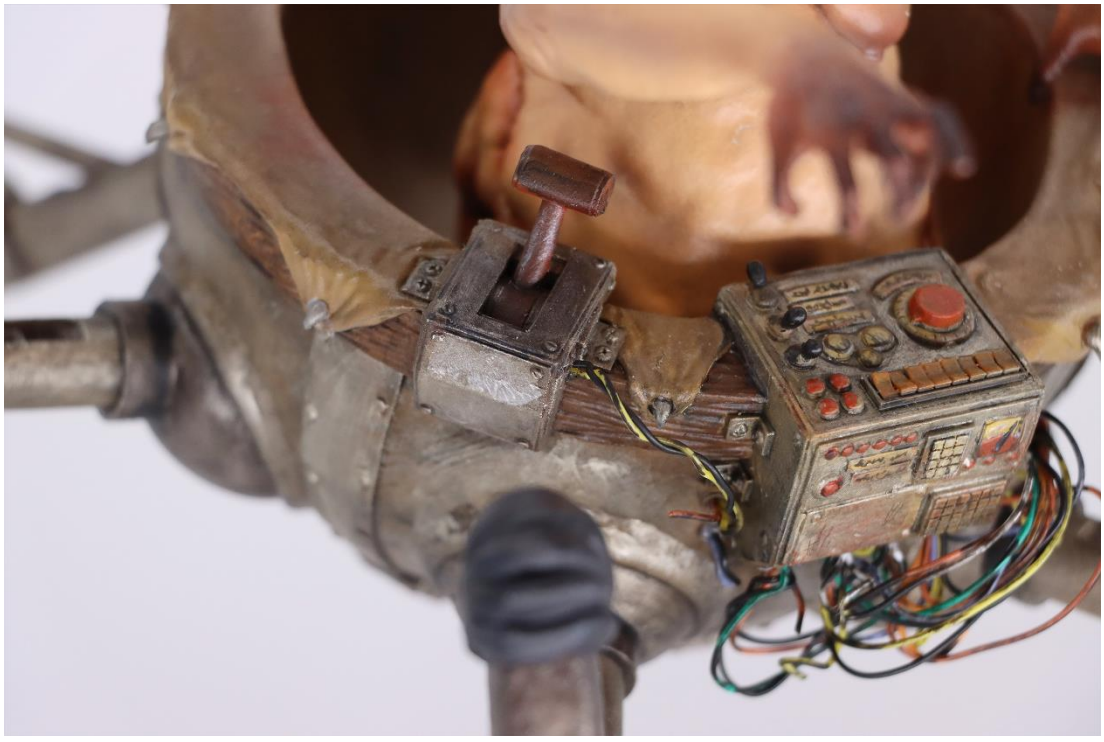

Figure 33. Detail Shot of Main Control Panel. Wires were glued into rivets with E6000.

Figure 34. Baba in Pursuit. Back View.

Figure 35. Baba in Pursuit. Front View.

Figure 36. Detail Shot of Broken Control Panel.

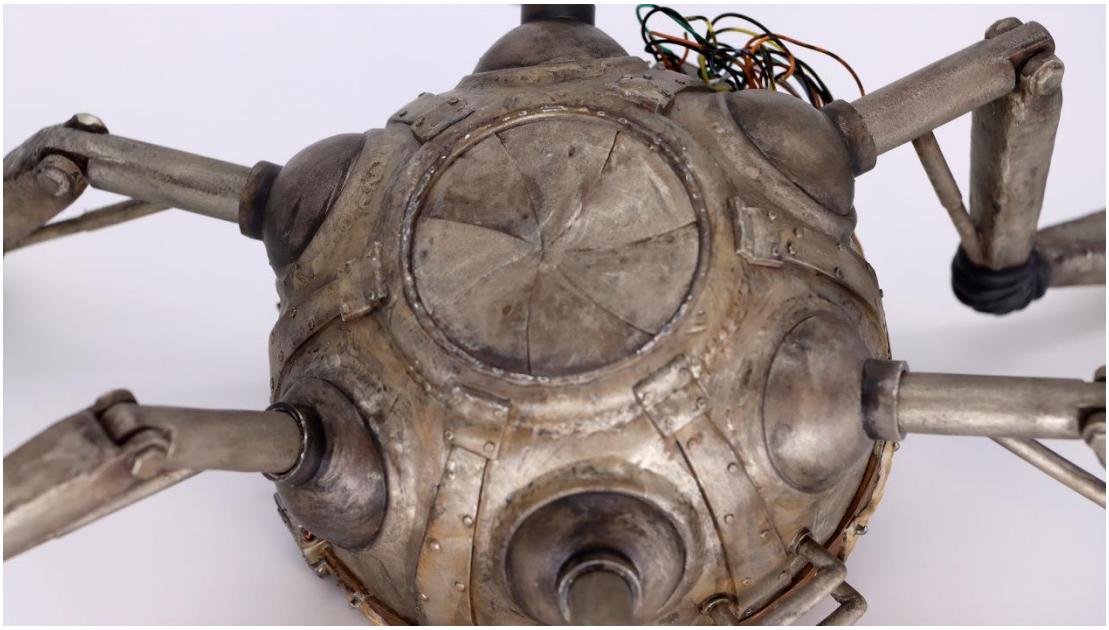

Figure 37. Detail Shot of Mortar Underside. Rust was painted along edges of metal where it would naturally build up. Dry brushed pewter acrylic on panels to add old metallic sheen.

Figure 38. Close up Profile Shot of Baba in Pursuit.

Figure 39. Turnaround Shots of Finished Baba. Highlights were painted on back of head to pull in woodgrain detail. Scars were accented with reds to show irritation.

Chapter 5. Conclusion and Future Research

I learned how to successfully design a cohesive set of characters from an existing story, pull one of those characters into a 3D modeling software, alter any problems that came with that translation, and then 3D print and paint her. She was successfully created into a collectible figurine.

This was a very humbling process, and the initial goal was to create something even larger, but I quickly learned that good character development takes time, and modeling organic and hard surfaces takes even more time. The original idea was to sculpt her hut, the beggars, and the princess but the time it took to establish solid concepts for each character took more time than I ever imagined. Her initial design was going to have interchangeable parts, but with the type of detail I wanted her body to have created limitations with the kind of parts you change. The most she would have been able to have would have been different hands. Her muscle structure would have to have been completely redone and extremely simplified if she were to have different arms and heads. There's a reason most commercially made dolls have minimalistic forms and this is it.

When setting aside time to print, double whatever amount you think it will take. The prototypes that were printed just to ensure everything would work took a month. They were a fraction of the scale of the final piece, but it was crucial in order to see what was and wasn't working. The final prints took a solid 2 weeks. That consisted of printing every single day and changing out the files as soon as one was completed. If the print failed, an additional 30 minutes or more was needed just to clean the printer and filter the resin so no particles would be floating around, which could cause the next

print to fail. Fails are opportunities to learn. Aside from printing, you need to set aside enough time to paint and polish your pieces. Making miniatures of your final will be the best tools to practice and learn how the paint behaves and what techniques will work best for you.

As for uses for this project, it extends to animation, like what was mentioned in the intro. Stop motion animation studios have been using 3D prints to create face plates to speed up the production process. It can also be used to create models for the production of silicone masks, toys, collectibles, pieces for tabletop games, and so much more. If you save the successfully printed files you can continue printing as many copies as you'd like without losing quality. It also saves time and money to print in house rather than order through a 3rd party. You can get your prints quicker if you do it at home and you can fix any problems immediately without having to wait to get the results back through the mail.

As an artist, it's important to reach out and get feedback along the way because critique helps strengthen your work. I sought feedback from those who wouldn't shower my work with compliments because I wanted to improve and create something the viewer would want to take home.

I want to continue working on the character development for this project and eventually bring the others from the store through the same process. I believe it will be quicker the next time around. Having a completed set for the whole story would provide me with a solid body of work that could be exhibited in gallery shows and hopefully inspire others to enter the digital world of creation.

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