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Wycinanki: Production of a Non-Photorealistic Rendered Short Film

Irena Rindos
Clemson University, irena.rindos@gmail.com

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WYCINANKI: PRDUCTION OF A NON-PHOTOREALISTIC
RENDERED SHORT FILM

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of the Requirements for the Degree
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Digital Production Arts

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by
Irena Rindos
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Dr. Timothy A. Davis, Committee Chair
Dr. Brian Malloy
Dr. Andrea Feeser

ABSTRACT

Animals have traditionally occupied a special role in human culture and media, and are also often the focus of today's computer-animated films. The computer graphics (CG) short, *Wycinanki,* examines the human-animal bond through the story of a woman who rescues animals in Poland. Additionally, *Wycinanki* draws on the cultural history of its protagonist with its unique paper-cut render style. The goal of this film is to engage viewers and enhance the staying power of the film's message via a compelling story and visuals.

A significant amount of environment and character development and testing was necessary to translate the 2D art of papercutting into an effective animated CG short. The final render pipeline, while incorporating varying graphics programs and approaches, resulted in efficient renders and composites that satisfied the visual demands of the story.

DEDICATION

I would like to dedicate my thesis to my mother, for her influence on my compassion for animals, interest in art, and as the inspiration for *Wycinanki*. I also dedicate this thesis to my father for his encouragement to pursue a degree in Digital Production Arts, and for fostering my love in the math and computer science side of DPA.

ACKNOWLEDGMENTS

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CHAPTER ONE

INTRODUCTION

Animals have traditionally occupied a special role in human culture and media, and are also often the focus of today's computer-animated films. Sociological theories contend that the natural connection humans feel to animals makes them ideal story vehicles for morality and other message-based tales [Brya06, Flynn08, Irvi01]. By couching messages in relatable, yet indirect, "messengers," the moral of a story can be made more appealing to an audience [Brya06, Shap93]. Similarly, cinematic interpretations of classical story-book narratives have often engaged viewers through the use of bold illustrative styles that transport the viewer to fantastical settings [Duke03, Herm10]. In 2D, this approach is achieved with traditional animation styles, while in 3D, non-photorealistic rendering (NPR) can be used to the same effect [Duke03, Coop02].

The goal in the production of *Wycinanki* was to examine the human-animal bond, ideally in a way that would encourage viewers to take a closer look at our relationships to animals. Humans derive benefits from animals in a multitude of ways, often, unfortunately, at great expense to animal-kind [ASI12]. Early in production, *Wycinanki* was awarded a Culture & Animals Foundation grant to support the film and its goal. The mission of the Culture & Animals Foundation is to

> [appeal] to individual intellect, creativity and compassion… [to]
> awaken people to the plight and grandeur of kindred animals–and
> ultimately build a deeper understanding of human-animal relationships
> and a greater respect for basic animal rights [Cult12].

This goal overlaps with the intention behind creating *Wycinanki*. For this reason, the use of animals and a unique non-photrealistic rendered (NPR) Polish papercut style were chosen to appeal to viewers and enhance the staying power of the film's message via a compelling story and visuals.

CHAPTER TWO

BACKGROUND

Wycinanki is based on a childhood story of the author's mother in Poland. After initial research in contemporary and traditional Polish art styles, the vibrant colors and visually compelling patterns of Wycinanki, or Polish papercutting, led to its choice as the film's visual style (and, eventually, its name). As an added benefit, this unique style offered an opportunity to break new ground in NPR rendering.

2.1 Story Influence

Wycinanki was inspired by the following true story, told to the author as a child. Irena, a woman in Poland, hears of a stray dog lingering around the town's schoolhouse. Upon finding him, and seeing his starved condition, she lures him home with food. From that point, the dog, Ringo, sleeps at the foot of her bed.

Several months later, Irena finds a kitten near the road; its mother had been injured by a vehicle along with its siblings, and it would die without the care of its mother. At that time in Poland, veterinarians were not available for "pets," so Irena nurses the kitten until it is old enough to eat solid food. The cat, Lucyna, joins Ringo at the foot of the bed.

More time passes, and the woman notices one of the chicks in her yard is unable to eat with the others. She lifts him up and finds that he has difficulty eating due to a

crooked beak. As with Lucyna, she feeds him by hand until he matures to a rooster. Dzubek, as he is named, sleeps alongside Lucyna and Ringo.

Unfortunately, the woman eventually must leave Poland for the United States. The animals, left in the care of her mother, become dejected and refuse to eat in the days after her departure until they receive a letter from her. From that day forward, they are content and sleep with the letter.

2.2 Wycinanki: Traditional Polish Papercutting

As mentioned above, wycinanki refers to the Polish papercut art. Traditional wycinanki were cut from multiple layers of colored paper to create seasonal household decorations depicting pastoral scenes. Figure 2-1 shows examples of traditional wycinanki.

Wycinanki originated in sixteenth-century Ukraine as "vytynanka" and migrated through Eastern Europe. Original vytynanka drew on a limited color palette, were often of simple design, and were crafted from bark and occasionally leather [Udzi26]. The evolution of vytynanka to colorful, multi-layered, and complex wycinanki developed as the result of its growing popularity in nineteenth century Poland [Udzi26].

Choosing wycinanki as a visual influence represented a unique opportunity to develop a new non-photorealistic rendering (NPR) style. Papercut NPR is not unique in itself, as several CG papercut animations and published techniques exist; however, these renderings have mainly imitated Chinese papercuts, and none have attempted to imitate

wycinanki. Additionally, with the exception of a Chinese papercut tool created by Yan Li and Jinhui Yu [Li07], the field of NPR has not explored methods of simulating a papercut look.

Figure 2-1: Traditional wycinanki

The choice of a 2D NPR approach instead of a full 3D adaptation of wycinanki had two aims: to represent wycinanki more faithfully, and to draw on the ability of NPR

to affect viewers [Cole06, Duke03]. These two goals were complementary, as a successful and impactful NPR style is often a close imitation of a 2D technique [Gree99, Litw99]. Additionally, using an NPR for the film ultimately resulted in a more efficient rendering pipeline.

CHAPTER THREE

IMPLEMENTATION

The production of *Wycinanki* was initiated with story adaptation and boarding. Implementing the *Wycinanki* render style followed with look development and progressed through character and environmental design. After 2D and 3D assets had been created, the film began its final stages in rendering and compositing.

3.1 Story Adaptation and Boarding

The base story for *Wycinanki* was strong, but presented several obstacles in creating an effective and comprehensible film and necessitated changes to the original story. Additionally, as the film was to be told from the point of view of the protagonist, the story was developed in the form of a narrative script. Script development occurred concurrently with storyboarding, which provided an effective means of evaluating the way the story would be presented in a film format.

Initial story drafts were linear, and consisted of the protagonist's discovery of Ringo and ending with her arrival in the U.S. and the animals' receipt of her letter. This storyline was enhanced with a narrative framework that opens with her writing a letter and recounting her story of her time in Poland, and closes with her completion of the letter and its delivery to the animals. This narrative choice was made to aid the viewer in

connecting with the main character by establishing the film as a recounted, personal story.

The most significant change from the original story was in the animal discovery stories, as some aspects of the original accounts were too detailed for a short film and would be hard to convey. The discovery process was also altered such that the current "family" of Irena and animal(s) was involved as a whole in finding their new members. This process was intended to strengthen the on-screen bond between characters; it also added to the story-book nature of the film through the three repetitive "acts" in which a character is discovered, eats at the house, and then joins the others at the foot of the bed.

Ringo's discovery story underwent the least change. Instead of being found near a schoolhouse, he is found outside a village by the road. This change was included because a schoolhouse in the scene was considered too much of a visual and narrative distraction. Additionally, as Lucyna's real origins were graphic and would involve explaining animal care in Polan, her story was simplified to a discovery while the Irena and Ringo are walking through a field. Finally, Dzubek's story was changed to avoid explaining the implications of a crooked beak; in the film, he falls off a chicken truck in front of the house and is brought to Irena by Lucyna and Ringo.

Storyboarding (Figure 3-1) for the film occurred alongside story development and underwent several iterations. For the creation of initial story board reels, several frames were drawn for each scene to establish camera movement, scene framing, and character action. These frames were then sequenced in FinalCut and augmented with temporary

narration for story testing. If a scene was confusing, it was re-drawn and the story reel was re-edited for comprehension. The majority of early storyboard reels were edited in this way to change scene framing and action, while changes to later boarding reels focused on narrative refactoring of the story.
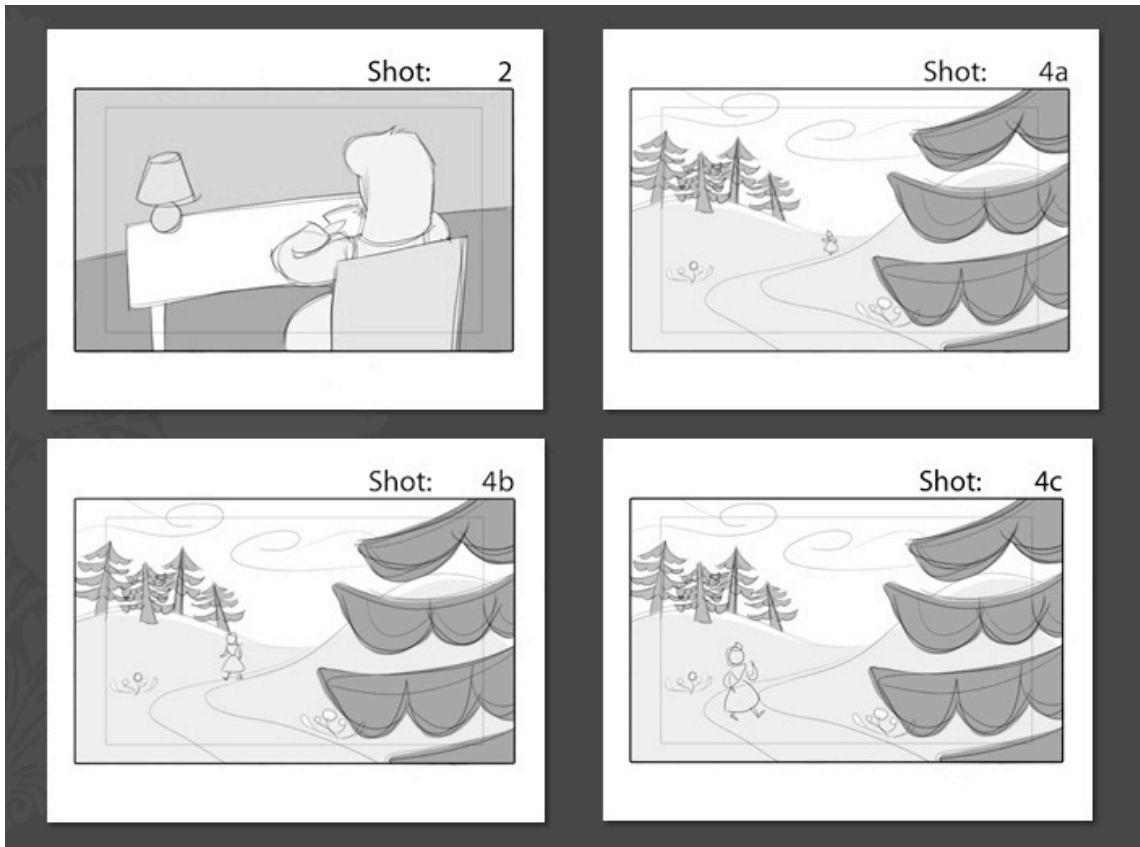

Figure 3-1: Sample storyboards

3.2 Look Development

The initial goal of look development was to apply traditional 2D wycinanki patterns to a fully 3D world. After 3D environmental tests, however, a "2.5D" approach with 2D environments and 3D characters was adopted. From that point onward, the environmental and character design processes diverged slightly.

The inspiration for environmental look development was plentiful, as traditional wycinanki papercuts always incorporate floral designs. After a library of floral examples was compiled, attempts were made to create digital floral elements. These early designs lacked the complexity of physical papercuts and were time-consuming to create; therefore, the approach shifted to digitizing physical papercuts. Several hand-cut trees, flowers, and bushes were created (Figure 3-2), scanned, and transformed into vector images for use as environmental assets (Figure 3-3).

Figure 3-2: Hand-cut wycinanki for the film

Character look development was significantly more involved than environmental development. As mentioned previously, traditional wycinanki designs focus primarily on floral patterns. When animals do appear, most commonly they are roosters or doves. For this reason, Dzubek's character design most closely mirrors the traditional art. As seen in Figure 3-4, his design coloration is nearly identical to traditional wycinanki, with a black base layer and corresponding feathers in shades of red, blue, and green.
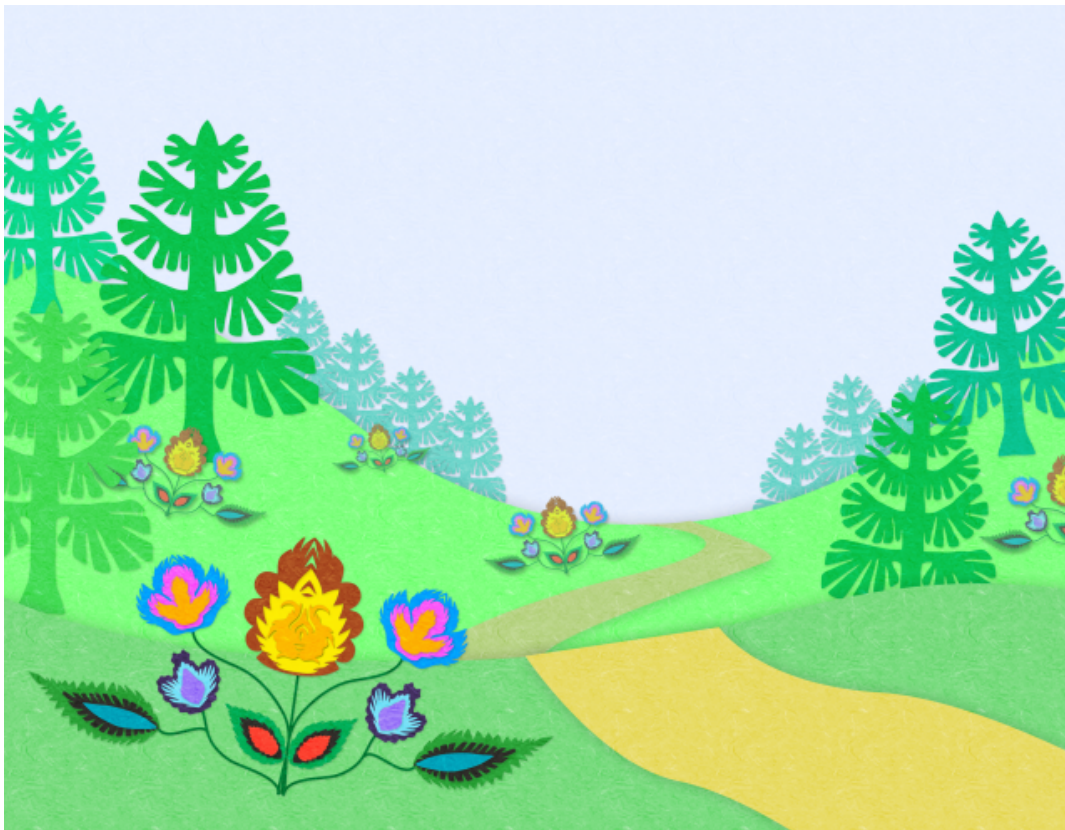
Figure 3-3: Vectorized papercuts in Adobe Illustrator

Wycinanki featuring people in traditional Polish clothing are most often found in "narrative" wycinanki illustrating peasant life. These people, as in Figure 3-5, wear colorful and voluminous clothing. As the film takes place in the 1980s, the design of the main character was an attempt to modernize this look, while still meshing with traditional wycinanki. This look was achieved via the use of a modern clothing design on a moderately billowy dress (see Figure 3-6).

Figure 3-4: Dzubek's character design compared to original wycinanki

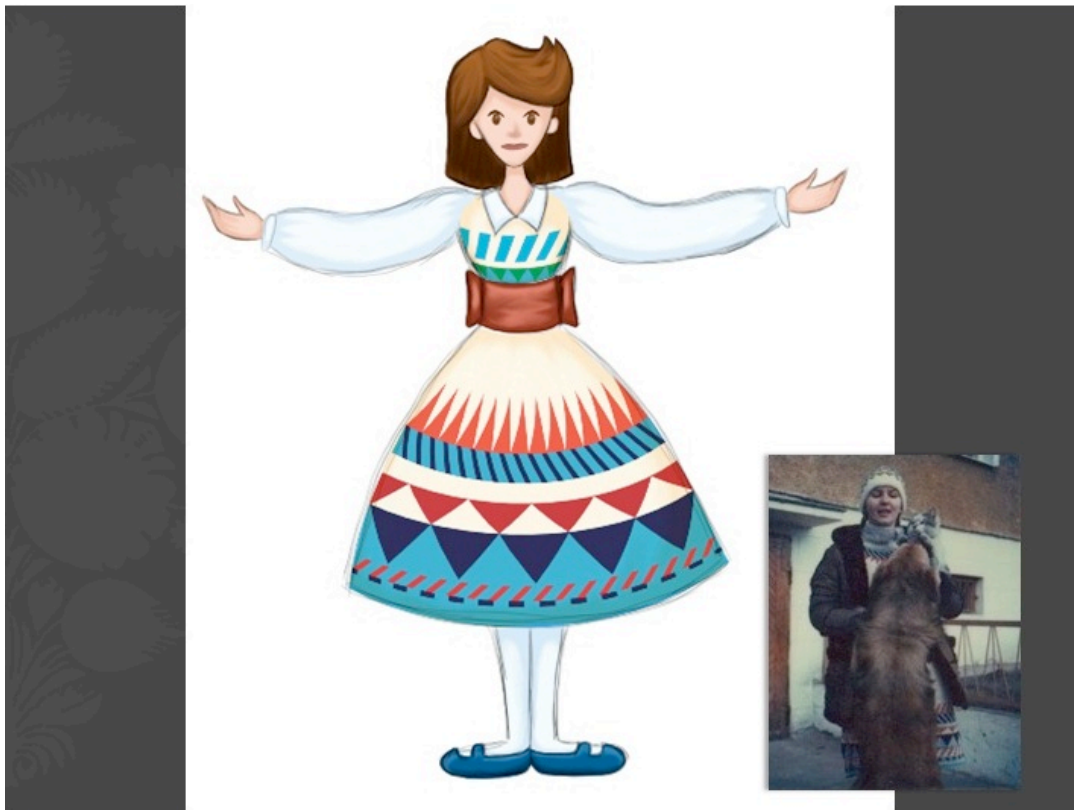**Figure 3-5:** Traditional dress in wycinanki papercuts

Figure 3-6: Character design for Irena, inspired by her actual dress

Unfortunately, examples of cats or dogs in wycinanki are rare. The few examples of cats and dogs found were plain black creatures with few distinguishing features. As a result, designing textures that fit with the look of the film and worked well with the model topography of Ringo and Lucyna presented challenges. To aid in this process, rapid pattern prototyping using Photoshop was employed to view multiple texture variations on the character forms. Figure 3-7 shows a few of the draft textures for Ringo.
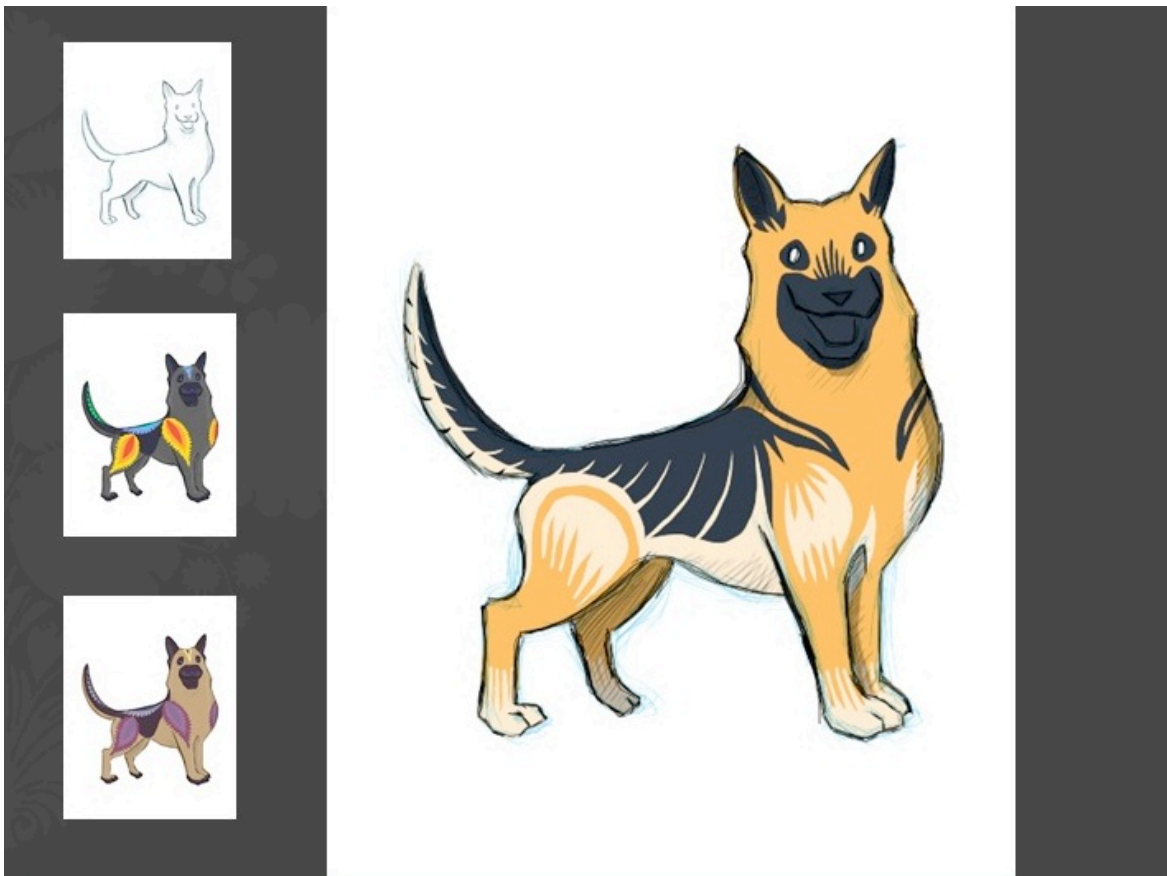

Figure 3-7: Character design drafts for Ringo

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3.3 Character Creation

Character modeling proceeded directly from character design sketches. Character sketches were imported on two to three reference planes in Maya, enabling modeling artists to faithfully reproduce *Wycinanki*'s concept art in 3D. This approach worked smoothly and resulted in effective character models, with the exception of the cat and chick. The original design of the chick character, while true to the original art, was too "flat" and did not read as a 3D model. Obversely, the initial cat design was too photorealistic and did not fit amongst the other characters. Both designs were revisited in 2D and remodeled to fit within the character lineup.

Texturing represented an important step in the film's pipeline. The texture designs (Figures 3-8 and 3-9) remained intact in 2D, but questions remained concerning the rendering of textures under deformation. To prevent potential deformation issues, texturing preceded rigging in the pipeline so that textures could inform the rigging and weight painting process. Preliminary movement tests were conducted by animating a textured character through an expected range of motion to observe texture deformation (see Figure 3-10). These movement tests allowed for identification of troublesome texture areas; corresponding texture maps were changed accordingly.

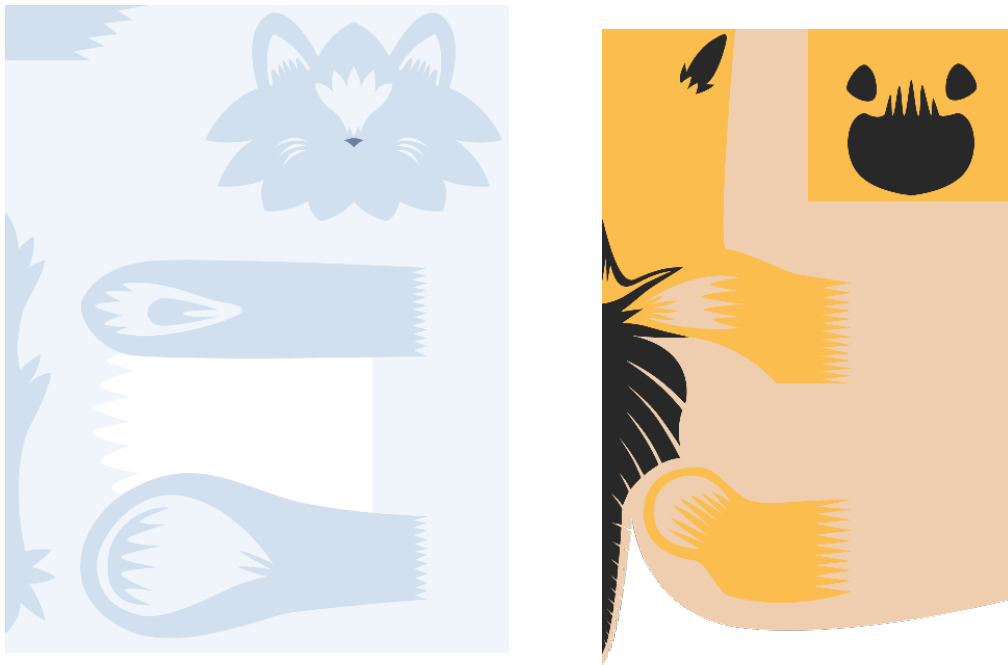**Figure 3-8:** Characters after modeling, with textures applied

Figure 3-9: Sample character texture maps for Lucyna and Ringo
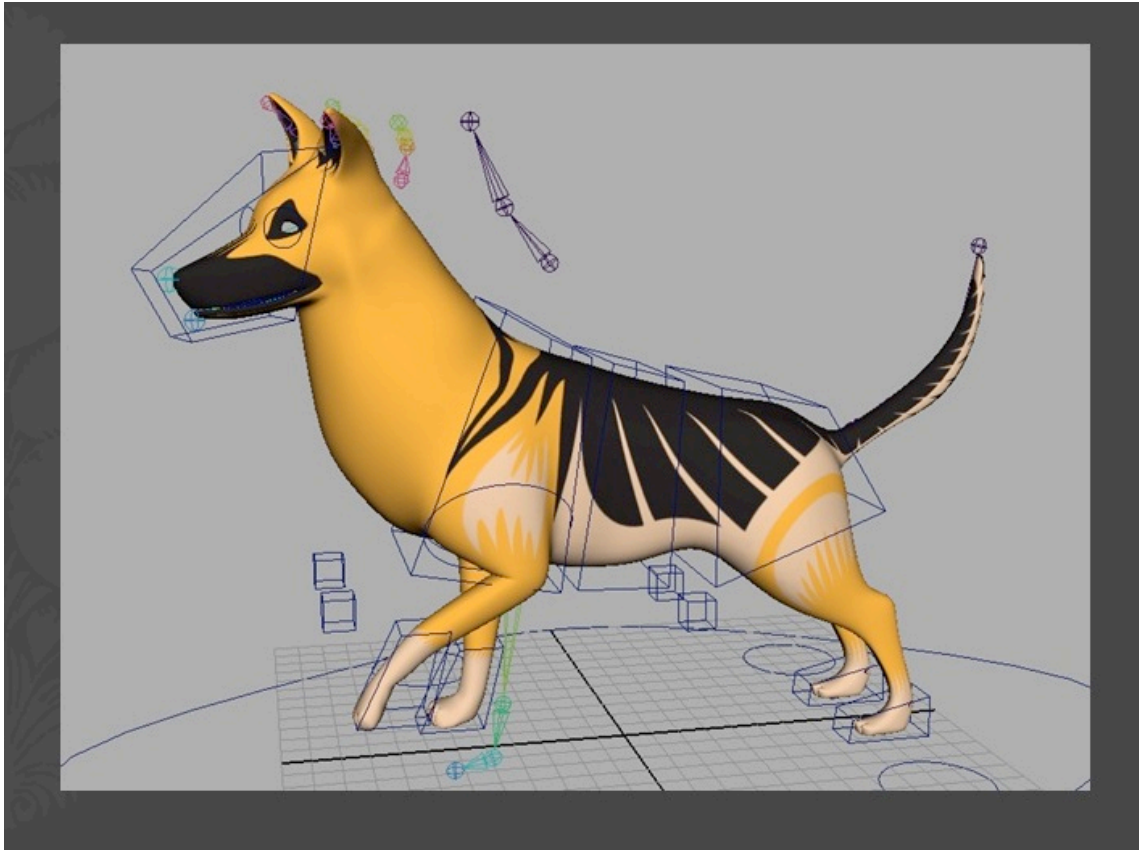
Figure 3-10: Ringo, rigged and undergoing texture testing

3.4 Animation

Prior to animation, storyboards for the film were translated into 3D Maya shots via a layout animation phase. Character stand-ins, such as a block representing the protagonist, were animated to further finesse shot timing. As none of the environments in *Wycinanki* would be rendered from 3D, simple backgrounds and models were used for environmental scene elements; these environments remained in use for the entire character animation process. Animation of environmental elements was achieved later in

the compositing stage of production. Once shot timing was finalized in layout, character models were referenced into shots for animation passes. Character animation in each of the film's 30 shots were critiqued and refined over a two month period.

3.5 Rendering

Two approaches were tested in the development of a rendering process for *Wycinanki*. Initially, characters were rendered in one diffuse color pass, with the intent of compositing character renders with paper textures unique to each character. This approach was soon discarded, as the characters appeared too "flat" and did not appear to have the layers representative of a papercut.

To provide rendered characters with a layered paper depth, texture maps were separated into layers by color. Characters were then assigned diffuse color render passes for each texture layer. To facilitate the creation of multiple render layers for each character, a MEL script was developed by production team member Cory Buckley to automate this process. This script prompts a user to select a character, and all textures associated with that character. The script then creates render layers for each texture selected. The result of this script, as applied to Ringo, is shown in Figures 3-11 and 3-12.
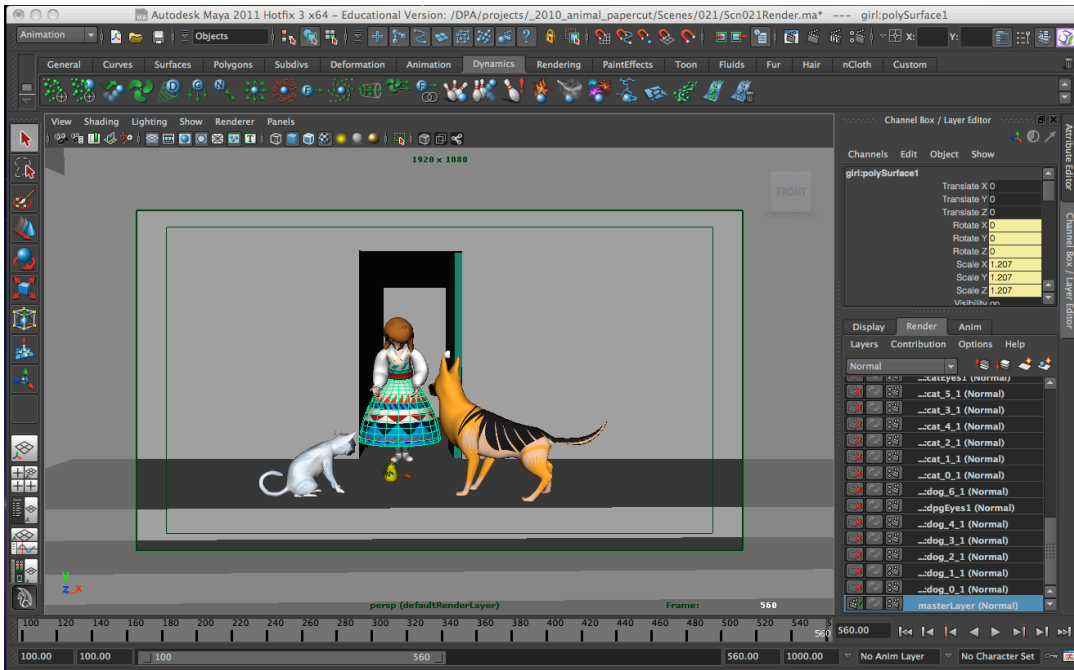
Figure 3-11: Scene with render script applied
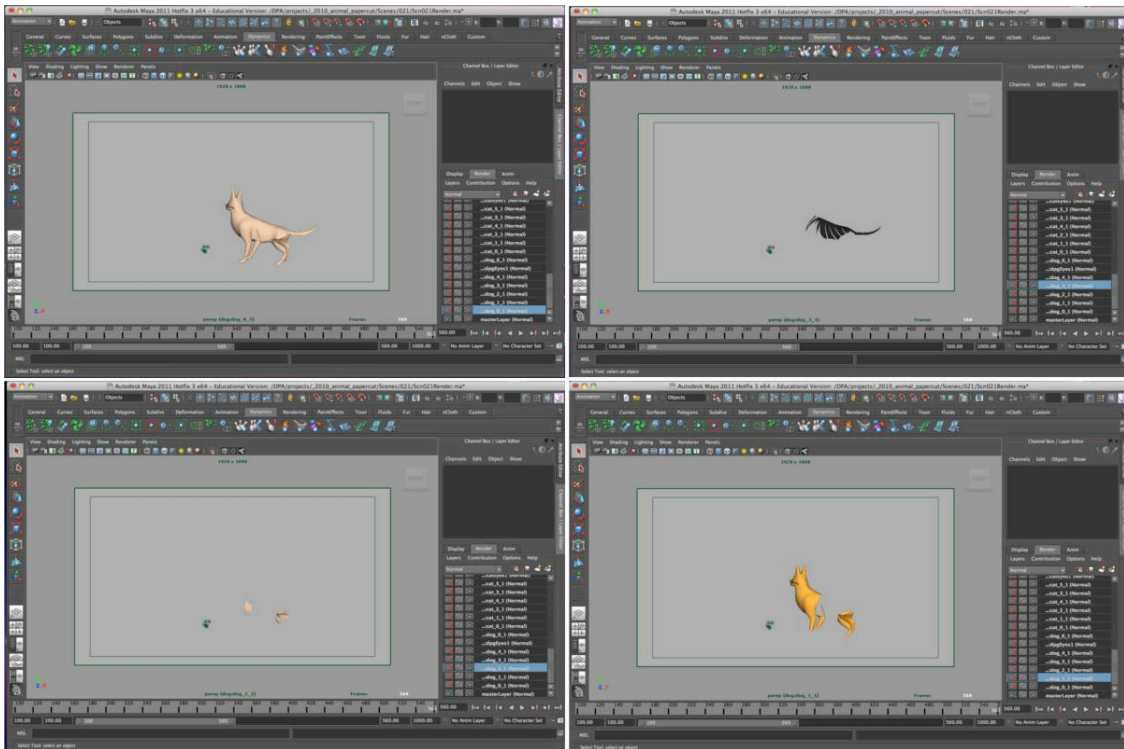
Figure 3-12: Four diffuse color render layers for Ringo

3.6 Compositing

After rendering was completed, each scene was loaded into a template Shake file for compositing. The template file contained node trees for each character, which were completed by loading corresponding render layers. A node tree for a character consisted of the character's color layers, stacked atop one another with the "over" and "drop shadow" nodes in Shake so that composited layers resembled layered paper. A paper texture was then applied via the "multiply" operation before layers were merged to form the character as a whole (Figures 3-13 and 3-14).

Figure 3-13: Render of Ringo in Shake

Figure 3-14: Example character Shake trees

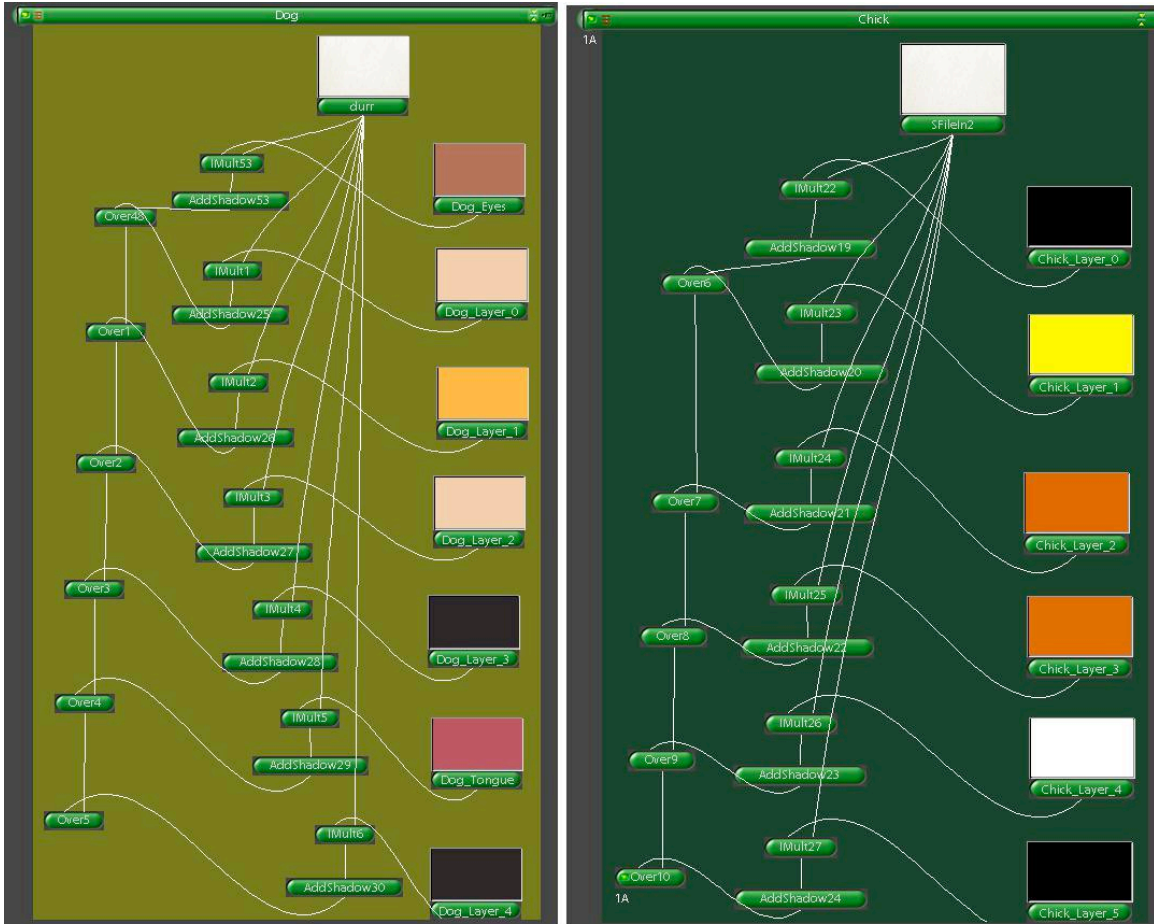Early composites were largely successful; however, shots with substantial character movement exhibited the "shower door effect," where characters appeared to swim through their paper textures. To combat this texture swimming, character movement was tracked in Shake such that a paper texture could follow a character across the screen.

After character compositing was finished for a shot, background planes and floral components were imported into Shake for environment animation and final compositing. Background planes (hills, roads, sky, and other elements) were created in Adobe Illustrator; scene flora and props were then placed accordingly into the scene. Once scene composition was finished in Illustrator, the file was imported to Photoshop and saved in layers. These layers were added to Shake; environmental elements such as clouds, trees, and flowers, were animated using Shake transform and shear nodes to simulate movement in the wind.

CHAPTER FOUR

RESULTS

The rendering approach used for *Wycinanki* proved successful in translating the look of static traditional 2D Polish papercuts to a 3D animated film. Figures 4-1, 4-2, and 4-3 show final rendered frames from the film. The wycinanki papercut art style provided the basis for a visually compelling and unique film.

Figure 4-1: Rendered frame from final film

Render times for a single frame with standard HD resolution of 1920x1080 pixels averaged about 2 seconds per layer; in a scene with all four characters and their requisite layers, a frame could require up to a minute to render. The final film, with a running time of 3:18, was fully rendered and composited over the span of two and a half weeks.

Figure 4-2: Rendered frame from final film

Figure 4-3: Rendered frame from final film

CHAPTER FIVE

CONCLUSION

As of the publication of this thesis, *Wycinanki* has been accepted at eight film festivals and three art exhibits. *Wycinanki* has also won two awards: Best Narrative Short at the 2011 North Carolina Family Film Festival, and Best Animated Film at the 2012 Greenville International Film Festival. These promising results would seem to indicate that the film is successful both in its papercut aesthetic and in conveying its message on the strength of human-animal bonds. Additionally, audience reactions have been empathetic to the message of the film, as evidenced by commentary at screenings; therefore, *Wycinanki* has apparently succeeded in making an emotional impact on viewers.

Though *Wycinanki* was completed in April 2011, several areas of the film could be finessed. The introductory writing scene was problematic, as it involved animation of a hand writing text in a letter. In another scene, where Ringo is eating bread, the composited effect of the bread's disappearance could be enhanced with smoother transitions between bites.

Overall, however, the processes developed in film production for texturing, rendering, and compositing *Wycinanki* were effective and time-efficient. Additionally, the wycinanki rendering style is a first in the field of NPR. Hopefully these achievements

in production and rendering, as well as the film's positive impact on viewers, give

significance to the production of *Wycinanki*.

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