JOINT AND SEGMENTATION DESIGN ON PAPER PUPPETS FOR CAT CHARACTERS IN CUT OUT STOP MOTION ANIMATION

Dominika Anggraeni Purwaningsih

Abstract: Stop motion, particularly paper cut out animation, is one of the oldest yet surviving animation techniques to date. Similar to other traditional animation techniques, it offers appealing looks unique to its nature. With the development of new technologies, stop motion continues to evolve. Paper puppet act as actor, therefore it's the most essential element in production of paper cut out animation. Careful designs have to be made to ensure movements can be performed well by animators. The biggest question when designing puppets are how do we divide the parts (segmentation) and what kind of mechanism should we use to connect these parts (joint)? Several factors are to be considered when deciding the right approach for the answer. This qualitative research will use both observation and experiment method. Observation is conducted by studying existing paper puppets from other paper cut out animation shorts, tutorials, commercials, and behind the scenes videos from the film maker. Following the observation is experiment where author will use the data to explore paper puppets making, comparing benefits and weaknesses, and adjust the final method to comply the needs of the short animation project titled "Spay & Neuter" where the final design of the cat puppets will be applied.

Keywords: joint, segmentation, puppet, cut out, stop motion, cat

Introduction

Stop motion (stop frame animation) is an animation technique where pictures are shot frame by frame with physical objects moved between the frames and then arranged sequentially to create illusion of movement (Priebe, 2007). Nowadays the term stop motion has been widely known as animations that use 3D puppets with armatures (bones), although various other objects can be used in producing stop motion animation such as paper, sand, clay, paint, everyday objects, and even yourself (Kalif, 2018). Stop motion animation that uses paper puppets is usually re-ferred as cut out animation. Cut out animations can also be done digitally with vector technology, but this re-search interests in traditional paper cut out animation. A beautiful example of traditional paper cut out animation is Hedgehog in The Fog by Yuri Norstein (1975), while a popular example of digi tal cut out anima-

Dominika Anggraeni Purwaningsih adalah staf pengajar di Program Studi Film, Fakultas Seni dan Desain, Universitas Multimedia Nusantara (UMN), Tangerang

e-mail : dominika@umn.ac.id

tion is South Park series (1997-present), although South Park might started as traditional cut out as first.

Cut out animations can be seen as a form of 2D puppet animations which possess unique characteristics resulting from gestures from animated figure, constructions, materials, and movement limitations (Shadbolt, 2013). Other than characteristics related to aesthetic standards of cut out animation, consequences of using figures on a flat surface are difficulties in achieving depth and limitations of camera move-ments (Yuan, 2010).

In Indonesia, the idea of spay and neu-ter is still uncommon. There are still a lot of people who haven't realized the importance of spaying and neutering in controlling stray cats population which affects animal welfare (Bianca Founda-tion, 2018). Most of them even despise the idea of it because they think it's cru-el and unethical, closing their eyes on the impacts of stray cats overpopulation that occur every day around them. This issue is relatively a hard subject to bring up and frontal method can caused re-jection, therefore animation media is needed because animation has the unique ability to deliver sensitive topics and camouflage them into an enter-tainment that can be accepted by audi-ences (Wells, 1998).

Short animation "Spay & Neuter" tells a story about the life of two cats named Maggie and Bella who live in different cities. Maggie lives in a city where the society is not aware of the importance of spaying and neutering stray cats. Thus resulting in poor animal welfare. While Bella is the opposite. The ap-proach of this animation project is to educate by treating it like a story rather than a patronizing video.

Research Objectives and Method

Production of paper cut out animation is relatively easy compared to other stop motion techniques, so it's often used as an introduction tool to anima-tion for beginners especially children. However, based on the quality of the craftsmanship and story, the result can be very simple or very complex. The main problem in making paper cut out animation is how to make the right joint so the puppets can be easily animated by the animators. Beside joints, how we divide the characters into segments also plays a role in creating articulated paper puppets which have flexible movements. For example, in creating a fluid movement of a cat's tail, the tail has to be divided into several segments. Too few can result in stiff movements, but too many is inefficient to animate. Therefore, the objective of this research is to find the most suitable segmentation and type of joint. The re-sult will be applied to cat character puppets in short animation titled "Spay & Neuter".

This qualitative research relies heavily on observational study and experiments. Before conducting experiments on seg-mentation and joint, the movie concept and draft of the character design has been completed. it is necessary to have knowledge about the whole process of cut out animation production especially to understand the process of shooting the puppets; the tools, procedures, equipment, problems, etc. And then data about existing segmentations and joints are collected through observations of existing short animated film, webseries, behind the scenes, and commercials that use paper cut out animation technique to understand the design logics, differences, strengths and weaknesses of each segmentation and joints. Writer also studies anatomy of cat skeleton to better understand realistic segmentation and how to simplify the segmentation properly. Based on the data collected, then experiments are conducted according to the character design and the concept of "Spay & Neuter" short animated film to find the

most suitable segmentation and joints.

Understanding The Shooting Process in Cut Out Animation

Paper puppets are physical objects, so in order to better understand the needs of the puppets, we need to know the production process of shooting cut out animation especially technical aspects. Traditional cut out animation can be shot with the camera facing forward, but is usually shot with multiplane camera set up where the pictures are taken with the camera positioned above the animated objects (down shoot) in several layer of transparent platforms to create depth of space (Purves, 2010). With this method, animators don't have to deal with problems related to gravi-tation and joints in puppets, although journals have stated that most of the articulated puppets in cut out animations consist of several segments which are connected to each other with some kind of joints. This kind of articulated puppets enable animators to make ex-pressive movements (Barnes, 2008).

Old fashioned down-shooter stand (known as Oxberry Stand) is complex, large, and expensive. Many independent film makers chose to make their own version of this stand as long as it does the job. They are much smaller and practical (The Crankshaft Publishing, 2018). Basic elements needed to create a functional stop motion down-shooting system are:

1. Camera. Any kind of camera that takes HD photos can work. Would be better if the lenses are equipped with anti-glare filter to avoid any lighting reflections from the surface under it.

2. Tripod. The tripod should be steady and adjustable to enable film maker to shift the distance between the camera and objects.

3. A flat surface or table to place the puppets and other assets, can be made from steel, wood, or glass.

4. Another transparent surface to press and flatten the paper puppets. This part is not mandatory but preferred to avoid hard shadows under the puppets.

5. Lighting system (according to the needs, the lighting can be placed above or under the flat surface). Other than the lighting system, a black out room is needed to maintain lighting consistency.

6. A computer unit with stop motion animation software installed, connected to the camera to take the pictures remotely. This way, we avoid risking shaking the photos by clicking buttons on the camera. Pictures taken can be directly seen on the computer's monitor.

Figure 1. Down-shooter stand as part of shooting system that has been custom-made for the purpose of this research

Segmentation and Joints Study

In order to be animated, an articulated puppet must have multiple segments that are divided according to a real anatomy, whether it is a human or an animal, although simplifications can be made. And due to its nature, puppets that are shot with down-shooter camera can have no joints at all because gravita-tion would loosely make all the segments stay in position (Purves, 2010). The figure is cut and separated according to their segmentations (limbs, head, waist, etc) and put

back together under the camera to be manipulated by moving each part delicately frame by frame. This method is problematic if the segment separated too far and has inconsistent pivot. That's why one of the solution is to add a joint between the segments (The Crankshaft Publishing, 2018). There are 3 types of joint that are commonly used in paper puppets which are wire, wax, and rivets.

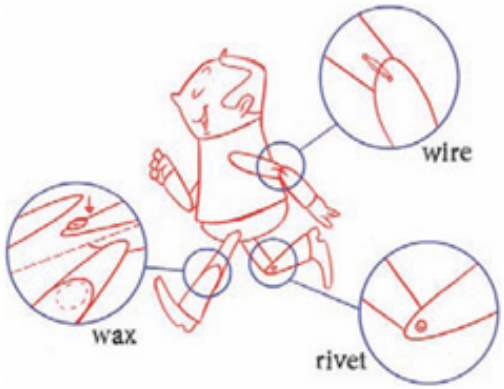

Figure 2. Wax, wire, and rivet used as joint in puppet (http://what-when-how.com/wp-content/uploads/2012/06/tmp833198.png)

Behind the scene video of United Airlines commercial "Dragon" (2007) which also used cut out animation technique, shows that although it wasn't shot with a down shoot method, the puppets used wire joints. The wire joint was easy to move and the mechanism of the joint made it stayed in position while hidden from the camera. As for the segmentation, it was pretty efficient. Parts that required detailed movements would have more segments.

The use of rivet joints can be observed from an animated webseries "Domestikia" (2013). The artistic style of this webseries was designed to look like a surreal collage with lots of visual details but limited movements. The animation was designed to be stiff and artificial because the story was driven by a (textual) narrator. The characters were only accessories. That might also be the reason to use rivet as the joints as it was visually obvious and had a sense of handmade feel to it. In this case, the motivation was weighed on the aesthetic looks.

Another method to make joints is by using thread and tape. Thread a hole penetrating a segment through its adjoining segment. And then with a very small piece of tape, secure the thread to the reverse side of both segments in whichever direction it wants to go (Applemouf, 2011).

Figure 3. Segmentation and wire joint in puppets from United Airlines commercial "Dragon" (2007) (United Airlines Making of 'Dragon', 2007)

Figure 4. Segmentation and joints in puppets from "Domestikia" (Domestikia, 2013)

Interesting approach in choosing joints can be seen in a short animated film "Being Bradford Dillman" (2011). There were two kinds of joints used in the puppets and how they were used were based on the reality of the characters. The imaginary characters used visible joints, which was thread, while the real charac-

ters used invisible joints hidden well from the camera (there was no data about what kind of joint used). It was made that way to suggest that the imaginary characters were not real. So the decision was more conceptual. The segmentation in human characters was pretty standard on the appendages with addition of replaceable facial features. The cat character in this film can be a great reference for this research.

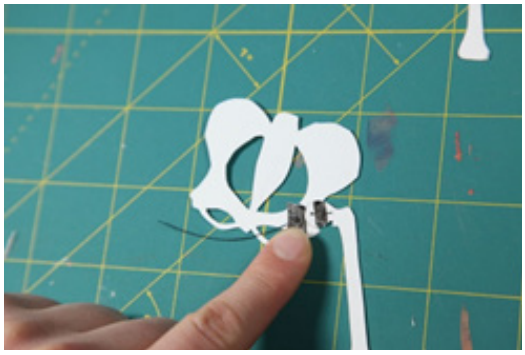

Figure 5. Thread and tape used as joint in puppet (https://cdn.instructables.com/FCB/4W7Z/GJHV9EJA/FCB4W7ZGJHV9EJA.LARGE.jpg)

Figure 6. Segmentation and joints in puppets from short animation "Being Bradford Dillman" (2011) (Being Bradford Dillman, 2011)

In the music video of Paper Plane (2013) by Massimo Giangrande which applied cut out animation to match the song concept, the puppets used wire joints and pocket joints. Pocket joints were especially used in segments where the movement were not circular but more of back and forth (elongated movements) such as hands beneath long sleeves. This pocket joints were not fixed so the segments could still be separated. As for the segmentation, as stylized as it may seem, the segmentation was pretty detailed especially in the face. The film maker used replacements method to create a more realistic expression.

Figure 7. Segmentation and joints in puppets from music video "Paper Plane" (2013) (Paper Plane by singer Massimo Giangrande, 2013)

A different kind of joint and segmentation can be found in puppets from animated film "Consuming Spirits" (2012) by Chris Sullivan. In his behind the scene video, he demonstrated the making of his paper cut out puppets. He used joints that were made from a small circular paper and glue. He made a circle on a segment and put it under its adjoining segment and then put a small amount of glue right in the middle of them. And then small circular paper not wider than the overlapping segments was used to cover it and pressed together to act as joint. Apart from its invisibility, he claimed that this kind of joint is the most durable, allowing the puppets to withstand extensive actions, especially because his film was a feature film.

Figure 8. Segmentation and joints in puppets from animated film "Consuming Spirits" (2012) (Cut Out Paper Puppet Demo by Chris Sullivan, 2012)

Design Process and Experiments

Before conducting this research, author has finalized the preproduction process of animated short "Spay & Neuter" which resulted in character designs, storyboard, and look development. Author has also prepared a specific downshooter (camera set-up) for this project. These factors will be the considerations in making the design of puppet segmentation and joints.

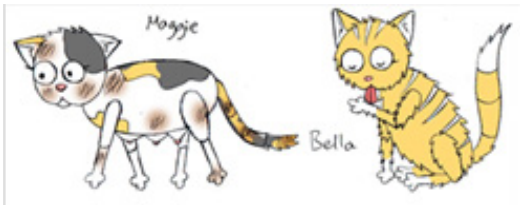

Figure 9. Maggie and Bella character designs

Segmentation of the cat puppet is based on the character design sheet, movements needs according to the storyboard, and of course real cat anatomy. The storyboard required the cats to be able to perform fluid and believeable movements as well as various facial expressions. The result from the analysis is shown in Fig. 10 below. Author uses replacements, joints (for ears), and pocket (mouth) for the cat's facial features, allowing it to create actions like moving the ears and, eyeballs, open/ close eyes, and meows. The head then connected to the body with a single joint to make it capable to rotate Seg-mentations on the body is designed to be as efficient as possible while still allowing basic movements like walk, sit, sleep, and jump. Front leg is divided into 2 segments, so does the hind leg. The body has only one big segment while the cat tail has between 1-4 segments according to the length. Each cat puppet has roughly 21-23 segments.

Figure 10. Designing segmentation on the cat puppet for animated short "Spay & Netuer" (figure of cat anatomy (upper left) was taken from https:// animalcorner.co.uk/ wp-content/ uploads/ 2015/02/ catanatomy.jpg)

Figure 11. Front and back side of the final joint on cat puppets for short animation "Spay & Neuter"

According to the study, there are roughly around seven types of joint system. Author has experimented each type of joint and found that each type has its own strengths and weaknesses. The final design of the joint uses a combina-tion of the joints mentioned before. The joint uses thread and tape for the basic but with a little bit of modification. The thread end is made to be intentionally visible to the camera, while the other end is taped at the back of the lower adjoining segment. This joint allows the segment to rotate freely. The reason for this design is to make the puppets look as hand-made as possible because the concept of the film is children storytelling. The same look can also be achieved by using rivet or paper fastener but technically rivet caused the puppet impossible to be flat pressed perfectly when taking photos.

Conclusions

After researching on segmentation and joint in paper puppets for traditional cut out animation, some conclusions are drawn:

- To produce a good stop motion animation we need not only well-designed puppets but also a prop-er tools/ system to take pictures (downshooter).

- The complexity of puppet seg-mentations is determined based on narrative needs. The more the segments the more realistic and fluid the movements will be. But remember to keep the segments as efficient as possible because a lot of segments means a lot of parts to be animated. Efficiency of the segments can also be achieved through a clear storyboard.

- No matter how stylized your characters are, always try to ref-erence the segmentations on real objects.

- There are at least seven (7) types of joints which are no joints, riv-et/ paper fastener, wire, wax, thread and tape, pocket, and pa-per joint. Each has their own strengths and weaknesses.

- How we decide to use which joint can be based on technical (puppet material, shooting methods, or other tools), conseptual, or aes-thetic aspects.

- These joints can be modified and developed further

- It is likely to use more than one type of joint in a single puppet.

Figure 12. Screenshots from animated short “Spay & Neuter”

Acknowledgement

The images and animated short presented in this paper was started as a project in second semester during au-thor's Master of Animation study in University of Technology Sydney, Australia. The project was then developed into further research in Multimedia Nusantara University, Indonesia, where author works as animation lecturer. Author would like to express gratitudes to all of the people involved in this research.

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