Tampere University of Applied Sciences

Rigging a 2.5D Character in ToonBoom Harmony

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ABSTRACT

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Rigging a 2.5D Character in ToonBoom Harmony

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This thesis delves into the intricate production pipeline involved in illustrating and rigging a 2.5D character using the renowned software, ToonBoom Harmony. It aims to specify the popularity of this program within the animation industry and elucidate its distinguishing features from other animation software.

The thesis offers valuable insights into the concept of rigged characters, exploring how various visual decisions impact the rigging process and how they differ when combined with different visual techniques such as 2D or 3D animation. Wide range of data was collected from various sources to enrich the research. These include attending two online courses, conducting two interviews with industry professionals via LinkedIn.

Self-education played a significant role in the thesis, consuming a considerable portion of the research time. In hindsight, future projects could benefit from a more incremental approach, starting with a smaller-scale project plan and allocating greater emphasis to the theoretical aspects of the thesis.

By presenting a comprehensive analysis of the production pipeline for illustrating and rigging a 2.5D character in ToonBoom Harmony, as well as exploring its industry-wide popularity and distinctive features, this thesis contributes to a deeper understanding of animation techniques. It serves as a valuable resource for animators, researchers, and enthusiasts seeking to expand their knowledge and expertise in the world of rigged animation.

Key words: animation, rigging, ToonBoom Harmony

CONTENTS

ABBREVIATIONS AND TERMS

Rig   A skeleton that is created inside the graphics, to make them move

Cut out animation   An animation technique where a character is cut out into pieces in animation program and then stitched together

Rigging   Process of making bones or a skeleton and connecting them to the graphics.

Vector   vectors are shapes and colours created by mathematical formulas that can be scaled without losing its quality

Bitmap   Bitmaps are pixels of colours assembled in a grid format

1   INTRODUCTION

Being an active member of Finland's animation industry has motivated me to master Toon Boom Harmony professionally. My goal is to become an animation lecturer, who would then teach Toon Boom at university level. Harmony has been rising in popularity in the animation community for years now because of its industry standard animation production tools and rigging features. Making the education of the program more accessible to students would help Finland's animation industry to become more independent and slightly lower the outsourcing for animators outside of Finland. Aim of the project is to get an understanding and skill to produce industry quality 2.5D animation rig, while following a strict production pipeline. Other objectives include understanding what are the qualities that an animation rigger has to have in order to work on the field. This also includes interacting with industry professionals about the topic, so I can gather data from different sources.

2   HISTORY OF TOON BOOM HARMONY

Toon Boom Animation Inc. is a Canadian software corporation that specialises in the production of animation and storyboarding software. The company was established in 1994 and is headquartered in Montreal, Quebec. Toon Boom's software is designed for creating animation and storyboards for various media, including film, television, web animation, games, mobile devices, training applications and education. The company was acquired by Cory's Entertainment in 2012. Toon Boom's software is widely used in over 130 countries and has received numerous accolades, including the Primetime Emmy Award in 2005 and 2012. (Toon Boom Harmony 2018)

TABLE 1. Companies that use Toon Boom harmony

| Company	Country	Revenue	Company size
Loyola Marymount University	United States	200M-1000M	1000-5000
Seneca College	Canada	100M-200M	1000-5000
California State University-Stanislaus	United states	100M-200M	1000-5000
Ubisoft entertainment	Canada	>1000M	>1000
Economic modeling,LLC	United states	>10M-50M	>1000

Source: https://enlyft.com/tech/products/toon-boom-harmony

2.1. What is Toon Boom Harmony used for

Toon Boom Harmony is a software package that provides a diverse range of tools for animators to create cutout (puppet), paperless frame-by-frame, and traditional animation workflows from start to finish. These tools include a variety of features such as pencil lines with textures, deformation tools, morphing, inverse kinematics, particles, built-in compositing, 3D camera and 2D-3D integration. Harmony Server, which allows teams of animators to share their work files and access assets which contain a central database. This server enables sharing workload and renders across or between studios and available as an add-on for Harmony advanced and Premium subscribers. With the Toon boom's Storyboard Pro it is possible to create storyboards for any kind of project, whenever it is live action, stop motion, 3D or 2D. Vector and bitmap drawing tools are included with the tool set, as well as pencils, textured brushes, built-in camera, audio tools, 3D mode and a timeline timing control.

ToonBoom Producer is a digital asset management tool that has production tracking elements. The software is web based, so it is easy to access wherever you are. (Companies using Toon Boom Harmony 2023)
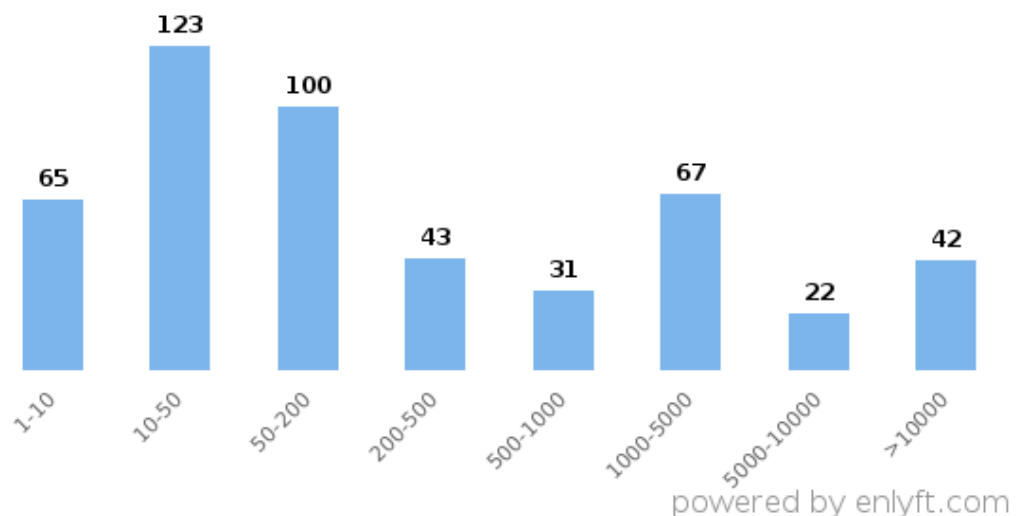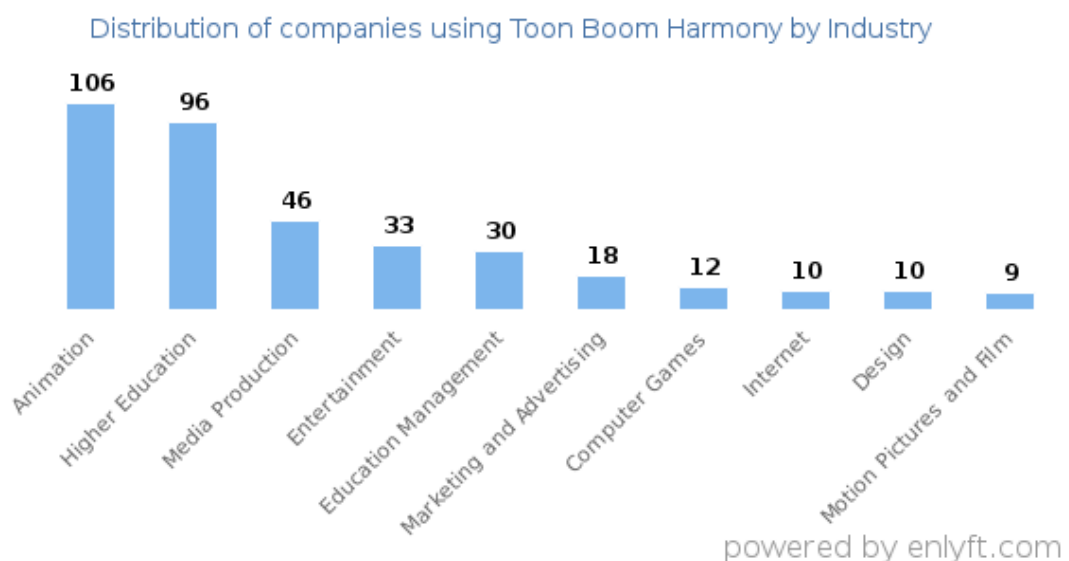

PICTURE 1. Graph that tells the companies that use Toon Boom Harmony by size Source: https://enlyft.com/tech/products/toon-boom-harmony

2.1.1 What makes Toon Boom unique?

Toon Boom Harmony has the essentials tool and more for a novice beginner who is just in the beginning of their animation journey, as well as a professional who has been using the same type of program for years. The interface has been designed with details in mind, since it is great for all users, not depending on their background. The only downside to this, is that the program has such a broad selection of tools and techniques, it can be difficult for a novice animator to start working. Toon Booms© website offers free lessons and a quick start course for the program, so the information and support are easily accessible. Harmony has been used by many well known animation studios, such as Disney and DreamWorks. Succeeding TV series that have been animated in Harmony are Rick and Morty, Futurama and even the newer season of The Simpsons. (With Toon Boom Animation (Sorted by Popularity Ascending) ;Toon Boom Training Courses)

PICTURE 2. Graph that tells the companies that use Toon Boom Harmony by industry
https://enlyft.com/tech/products/toon-boom-harmony

Even though Harmony is primarily used for animation production, it has a broad selection of digital tools that can also be used for digital painting. With the included tablet support extending to tablets such as Wacom and many other brands, creating digital art inside the program is quite easy. For example, it would be possible to create a storyboard, character designs and an animatic for a project all inside Harmony. There are three different editions of ToonBoom, each come with different add-ons. The cheapest subscription is the student version of Toon Boom Harmony Essentials, which retails for 29.00 EUR on the monthly subscription and the most expensive version retails for 1,057.50 EUR on annual billing. There are cheaper softwares for rigging than ToonBoom, but none of them are as industry standard for the job. In the effects and animation program Adobe After Effects, it is possible to download a 3rd party plugin DUIK Ángela which can be used to create a rigging skeleton for separate graphics and animate it inside After Effects. (Freebie: DUIK Ángela, After Effects Rigging Tool 2023; Benefits of Harmony)

3 OTHER PROGRAMS FOR RIGGING

Cartoon Animator by 2D Animation 101 is a 2D animation software that's main function is to create skeletons inside graphics, so that each image can be assigned with its own premade animation. Even though this is rigging in its most raw format, the outcome is not as industry standard as in previously mentioned DUIK Ángela plugin from Adobe After Effects. This program is a great example of the difference from Toon Boom, because even though they basically do the same actions, the outcome is majorly different. Cartoon Animator creates bones that control the mesh of the graphics which are attached to it, meaning that each part of the mesh moves independently while following the bone that it is attached to. These parts can't be animated unless you attach it to a new bone. Even though this technique is excellent for animation where you need to emphasize the flow of the graphics, in character animation, it's just too time-consuming.

Cartoon Animator 4 is animation rigging software for all levels of users. The software enables you to create custom 2D characters with its powerful bone rigging tool. You can easily make any static image move by applying different motion templates provided in the library. (Carrie 2021). One of the leading character animation programs is Moho. The program is suitable for rigging characters that have detailed abilities such as pinned bones for animating specific areas of a character. (LOSTMARBLE LLC© n.d)

3.1. Rigged- and non rigged animation techniques

Hand drawn animation, also known as traditional animation, is a type of animation that is created by drawing each frame of the animation by hand. This process involves creating a series of drawings on paper or a digital drawing tablet. With each drawing slightly different from the one before it, in order to create the illusion of movement when the drawings are played back in sequence. The process of creating hand-drawn animation typically begins with a storyboard, which is a visual plan for the animation that outlines the sequence of shots, camera angles, and character actions. After this, the animator creates rough sketches of each shot, known as key frames, which establish the basic motion and pose of the characters and objects in the scene. Once the key frames are finished, the animator creates in-between frames, which are drawings that fill in the gaps between the key frames. These in-between frames help to smooth out the animation and create a more fluid and natural movement.

3.1.1   Claymation

Claymation, also known as Clay animation, is a type of stop-motion animation that uses clay or other types of modelling clay as the medium for creating characters and sets. The animator creates the characters and objects out of clay, then takes a series of still photographs of them in slightly different positions to create the illusion of movement.

Clay animation is often used in children's television shows and commercials because of its playful and tactile quality. As any form of animation, clay animation requires patience and attention to detail, as even small changes to the characters and sets can affect the final animation.

3.2. Rigged animation techniques in Stop motion animation

Stop motion animation is created by manipulating physical objects and photographing them one frame at a time. In stop motion, the animator takes a series of photographs of an object or scene, making slight changes to its position or configuration between each photograph, creating the illusion of movement when the photographs are played back in sequence. Stop motion falls in between the rigged and un-rigged animation, since rigs are not essentials for the animation. Rigs are usually only needed if the character flies or is not in touch with the ground.
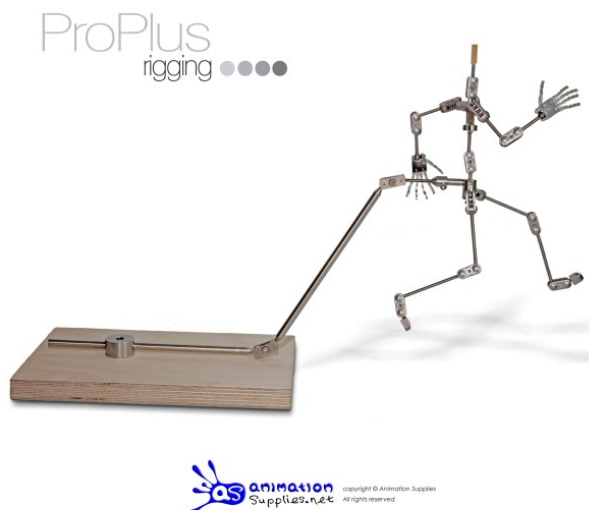
PICTURE.3 A stop motion rig skeleton

https://www.stopmotionstore.com/index.php?main_page=product_info&products_id=220

4   HISTORY OF CUT-OUT ANIMATION

Cut out animation was first used to make entertaining and simple animation, using hand cut pieces of paper. Characters are placed on a flat background and then moved slightly when filmed. This creates the illusion of movement. Even though the production was cheap, it was time-consuming to create the characters and scenery on top of animating them. In some cases, the puppet parts are sewn together with springs and wires, so that it is easier to move the puppet. (Rossum 2019)

PICTURE 5. Picture of Shadow puppets

https://www.pasttimeshistory.com/how-to-make-shadow-puppets-of-children-using-profile-silhouettes/

Alongside the evolution of software, so does cut out animation. The principle is still the same, parts of the doll are cut out and the software enables the animator to add pivot points to the body parts. After that the parts are moved to mimic the illusion of motion.

5   RIGGING IN 2D AND 3D ENVIRONMENT

The fundamental principles of 2D and 3D animation are alike, as they involve placing characters and objects in a specific space and manipulating them to create the impression of motion. Both fields often use computer technology to achieve convincing and life-like movements.

The process of 2D animation involves three stages: pre-production, production, and post-production. During pre-production, the foundational elements such as storyboards, character design and voice-over recordings are created. In production animators use the prepared materials to make rough animations by in-betweening, coloring, painting and tracing. Post-production involves enhancing the work done by adding sound- and other effects before rendering the final animation

Similarly, 3D animation also comprises three main phases: modelling, layout and animation, and rendering. In modelling, preliminary mapping of objects is done using points, lines, and curves to approximate the final shape. This stage is similar to 2D animation's pre-production as it creates foundational pieces such as characters, scenes, and objects. During layout and animation, models are positioned and animated into scenes, followed by key-framing or motion capture. Finally, rendering produces the finished images, much like 2D animation's post-production. (Business of animation n.d)

5.1. Understanding 2.5D Animation

2.5D, also known as two-and-a-half-dimensional, is a term used in computer graphics to describe a technique that allows two-dimensional images to appear as if they have depth or are three-dimensional. For example, if you were creating a 2.5D image of a city skyline, you might have one layer for the foreground buildings, another layer for the midground, and a final layer for the background buildings and sky. By adjusting the position, size, and orientation of each layer creates a sense of depth and perspective that makes the image appear three-dimensional. (2.5D 2021)
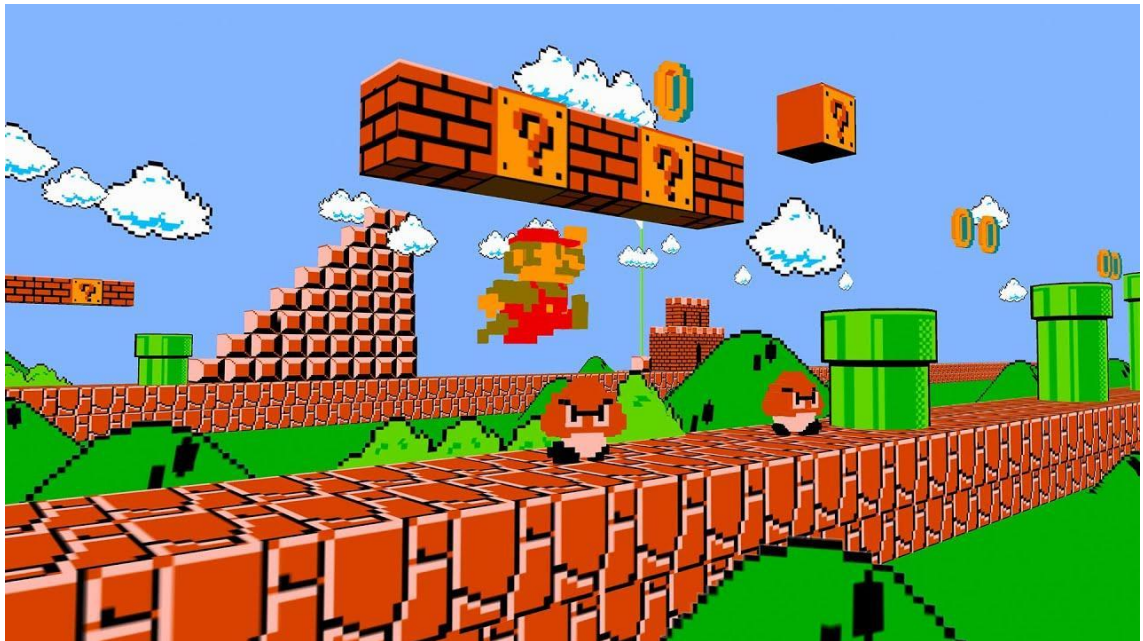

PICTURE 4. Mario world made in 2.5D
https://www.youtube.com/watch?v=aSfl-z_GP1k

6   DIGITAL CUT-OUT ANIMATION

Whenever a project is puppet styled cut out animation or traditional hand drawn animation, it is common to use hybrid cartoon techniques. It is important to set the style of the animation right away, so that there won't be any radical changes when the animation switches from cut out to hand drawn. (Cray 2023)

Cut out animation is significantly faster and affordable, since the animator's time is not spent on creating the graphics themself. Even though the same applies to 3D pipeline, it is good to note that 3D animation requires a lot more input to pose and fully animate the character. The visual goal was to create a character that would work in 2.5D dimensions. The Animated show" The Amazing World of Gumball" delivers this kind of art style, where most of the main characters appear ¼ quarter perspective, meaning that the back of the character is not seen very often. It also makes it easy for the animators to simply just flip the body anytime the character changes their head's direction.
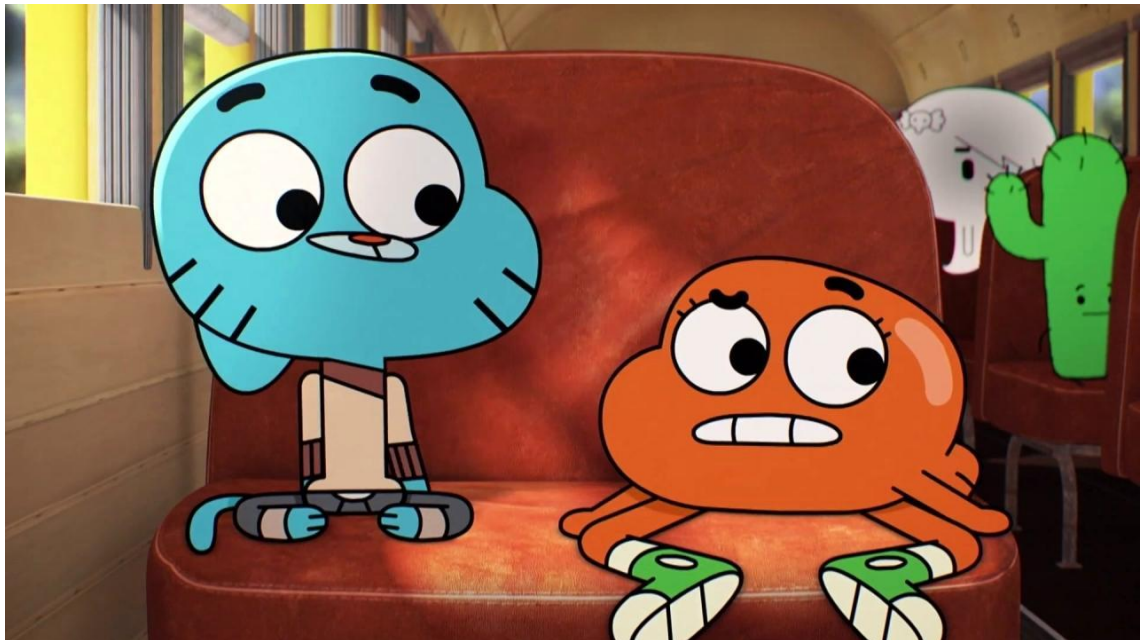
PICTURE 6. Example of ¼ quarter view in The Amazing World Of Gumball
https://www.kindpng.com/imgv/iTRhwRJ_my-little-pony-friendship-is-magic-role play-wikia/

Another great example of a characteristic that does this is the 2010 released "My Little Pony friendship is Magic" by Hasbro. The characters are mainly in the ¼ quarter perspective and hardly ever flip to the full side profile. Because of this it is really easy to create a simple rig that does not need a lot of in-between illustrations to work. In-betweening refers to the art of generating frames that smoothly bridge the gap between two distinct frames.

PICTURE 7. Fluttershy from my little pony friendship is magic 2010 Tv-series https://www.kindpng.com/imgv/iTRhwRJ_my-little-pony-friendship-is-magic-role play-wikia/

7   RIGGING AS A PRODUCTION PHASE

Having dedicated riggers is not common in a smaller scale animation studio. Commonly it is the animator who has to deliver the rigs. Even though this may sound like a lot of work, it is actually an advantage. The knowledge on how to create a working rig, makes the workflow more enjoyable later on in the production. In bigger productions it is also possible to do rigging as your full time job. But just like most of the jobs in the media industry, being a freelancer is the most popular working method.

On top of character rigging, the rigger is also responsible for rigging props that are in contact with the character and the environment. For example if a wizard character would have a staff that they would carry with them, the rigger needs to make a new rig and effects for the staff if it has animated qualities, as well as make sure that the character has a separate hand where the staff is attached. There is also the possibility to work as a freelance rigger that works for an individual client. There are also studios that only deliver custom-made rigs for productions, so that the studios do not have to hire a separate rigger. (What does a character rigger do? n.d.)

7.1. A riggers skill set

When the goal is to create a skeleton for a character, it is important to focus on the anatomy of the character and keep in mind the moving parts of the body. To have a basic understanding of character design and animation is a big plus when working as a rigger. For example if you are rigging a character who has an ability to fly you need to take into consideration the movement of the clothing, hair and any props that are attached to the character, and understand how you can make this character easy to animate. In this stage it is also great to have good communication skills, since you will be working tightly with the animators and character design department. (Character Rigger
The role, salary, software, and skills of a character rigger 2023)
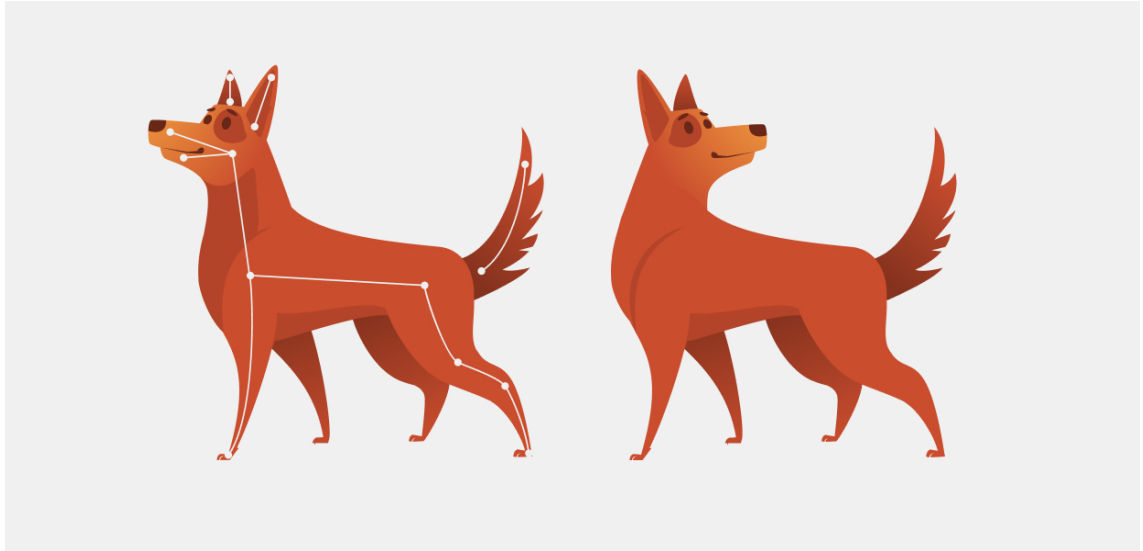
7.2. Rigging in both 2D and 3D

3D rigging involves creating a virtual skeleton that can be used to manipulate a 3D model. The skeleton is composed of joints and bones that are created inside the 3D model. Animators can manipulate the movement of the model by moving the joints that are attached to the skeleton. 3D rigging is used for creating characters in three-dimensional space, which can have more complex movement and expressions. (How Animation Rigging Can Save You Time Animating)
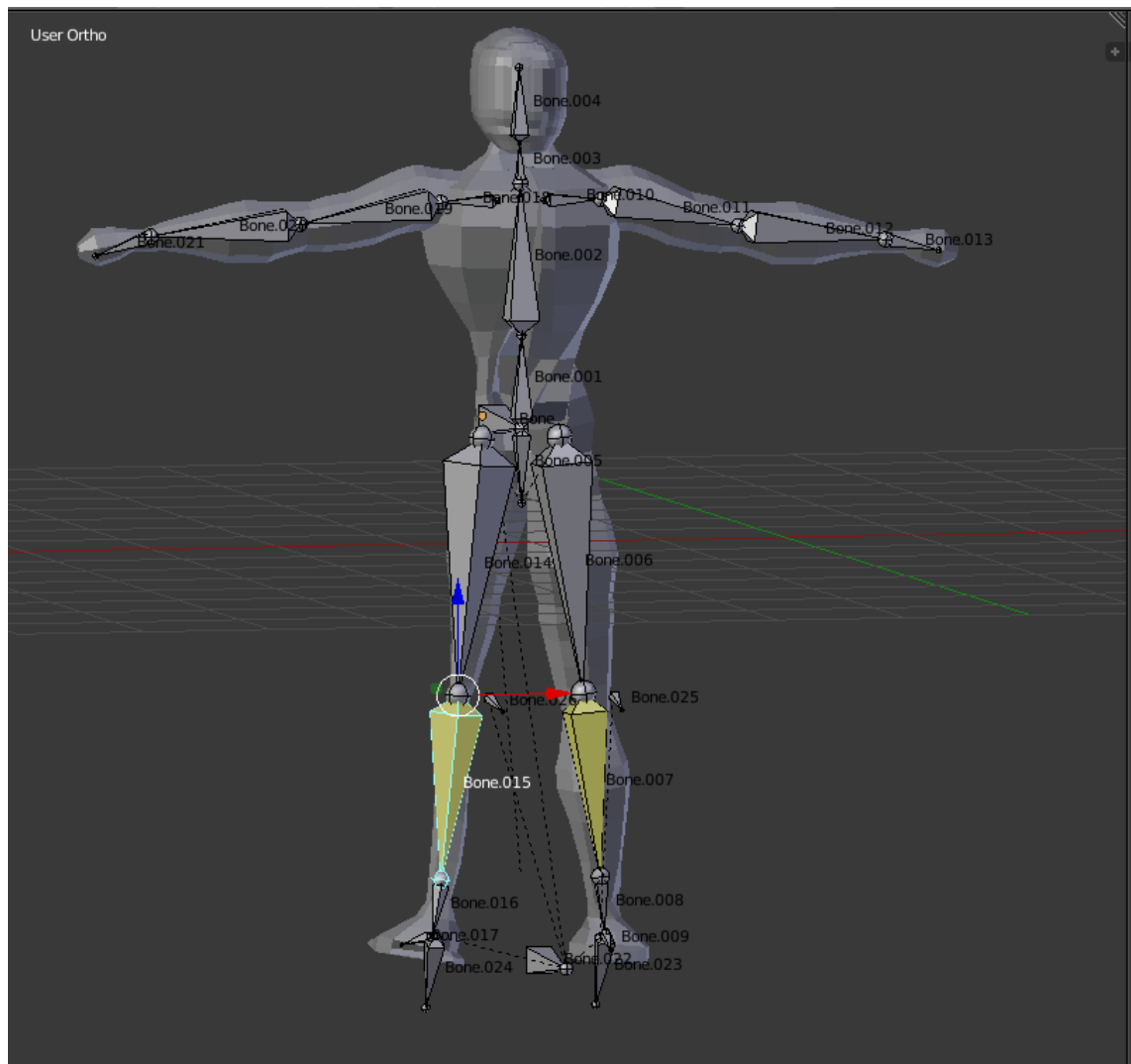
PICTURE 8. Example of a 3D rig skeleton inside a 3D mesh.
https://blenderartists.org/t/need-help-with-character-rig/695605

On the contrary, 2D rigging involves creating a virtual skeleton for a 2D image, that can be then manipulated to create movement. Unlike 3D rigging, 2D rigging is used to create characters that move in two-dimensional space, such as those found in traditional cartoons or side-scrolling video games.

PICTURE 9. Example of a 2D rig inside 2D graphics.
https://motionarray.com/learn/after-effects/5-great-2d-character-rigging-tutorials-for-after-effects/

8   DESIGNING A RIGGED CHARACTER

I started to create a character that would be easy on the program and wouldn't be too overwhelming to use as a beginner. I was thinking about a simple yet working design for a character and got an idea of this apple character, that would have a simple face and rubber hose type arms and legs.

8.1. Design choices for rigging

The character design is usually created so that it is easy to import it into a new project. Giving a thought about what parts would move or overlap with one another, helps with visualizing how you start the rigging process. It was challenging to think how the rig would behave with the graphics that I made, but in the end I am happy with how the character turned out. Since the character is going to be a 2.5D it is easy to just overlap the limbs with one another, to mimic the perspective of the character. In cut out animation it is important to keep in mind the folding point of the character, like the joint areas. When thinking about the details of the character design, avoid vertical details around knees and elbows. For example when animating a character that wears a vertical stripe suit, when animating the knees it is impossible to animate it without breaking the texture of the suit. This simple detail in the character design can add hundreds of animation hours, so it is important to be aware of your choices early on.

9   STARTING WITH TOON BOOM HARMONY

The beginning of the project started by downloading the advanced version of Harmony. It turned out the rigging properties were only available in the premium version of the program, so after a short talk with the IT department and getting a refund the production was ready to start. This misstep was also a very educating experience, since I got to test the customer support of Toon Boom and was able to educate myself on what each version of the program contains.

Gumroad is a website which allows users to download content for a fee, free of charge or allow the user to pay the price they wish on the product. The website is popular amongst riggers, since it is an ideal platform for sharing your complete rigs so that everybody who is interested in puppet animation gets a chance to download a rig for their own personal use. (Gumroad: Revision history
 2021)

A rigger and Toon Boom animator Matt Watt has an in-depth character rigging guide on his YouTube channel and shares his personal character shortcuts, the finished rig and a guide on his Gumroad page. Following his tutorial gave me information about the keyboard shortcuts and how to properly set up my Toon Boom Harmony interface. (Watt 2021). The difficult part in the beginning of this project was the fact that Toon Boom Harmony is updated constantly, so mixing the information about how the rigging was done in the older versions compared to the new ones took multiple hours of trial and error.

9.1. Importing the character turnaround

The project started when importing the turnaround of the character into Harmony, so I could start creating the puppet parts for the character. By importing the image in the program and also getting to open the node window, where you can see everything that happens in the program. This was my first time using nodes in a 2D environment, so after trial and error, I figured how everything links together.

After creating the sketch, note and line art colours on the colour window and also learned that different tools do not work on certain windows. First I created the breakdown of the character by numbering and naming what different parts are needed to assemble the character and move independently. In the breakdown stage it's important to think of all the sides of the character and how you can make the rig work in all of the dimensions. For example if the character has a mustache that's outline is coloured red and in the side profile of the character, the outline turns black, how does it change colour inside the rig?

Also are there going to be deformers in the rig or just simple "hard" graphics. Deformers are graphics that create a squash and stretch effect on the graph, making it into a poseable mesh. Thinking about what graphics are going to mask another is also important.

When building a rig it is important to think about the purpose of it. Oftentimes beginners get so carried away by the rig looking good and being complex, that they forget to take into consideration the functionality of the rig. Overbuilding means that the rig has been made too complicated for its purpose, for example adding details that do not serve the actual character animation or the storytelling. For example adding hair detail may serve a visual complementation, but animating it can easily add up to hundreds of animation hours that could be used to get the production further. Think about what the build needs to accomplish and build it to match the goals of the project.
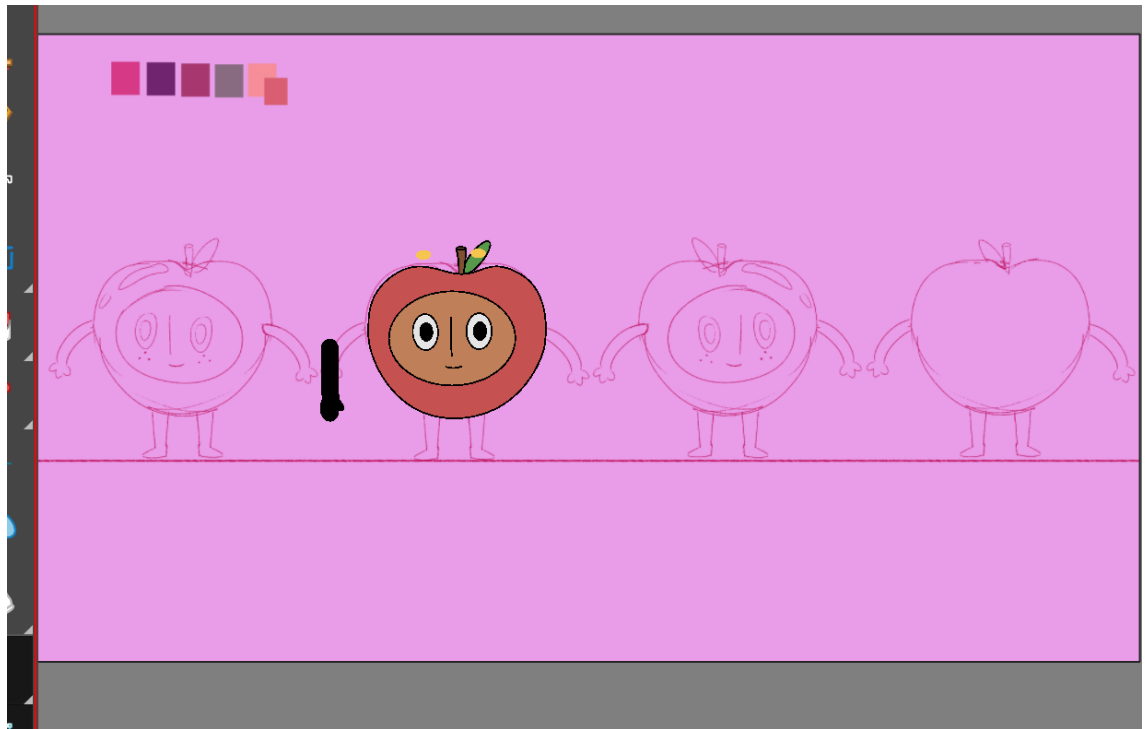

PICTURE 10. First version of the apple character over the turnaround layer

9.2. Node view

Node views is a representation of the elements in your scene. Each node in your node views represents an element in your project. When working with nodes it's important to acknowledge what parts need to be connected and which don't. For example all of your layers need to be somewhat connected to the display node, so that it can be seen in your camera view.

Clarity and organization is extremely important when working with nodes, composite nodes are essential when working with a rig. Best description for them is to think of them as shelves that contain all of your separate nodes. In the image above is a simple node tree, containing the drawing layer followed by the peg layer, which is created to work as a transform animation layer to protect the drawing layer. Pegs are also used to combine parts of the character for a more organized node view. When combining two pegs to one peg, both of the properties can be manipulated by simply choosing the peg leading peg. The leading pegs are usually called master pegs to make them stand out. It is important to create backdrops to the separate parts of the rig.

Backdrop is a colourful background that can be named in order to separate different parts of the character node. In the example below is a brown backdrop named BODY PARTS that contains my pegs and drawing layers that are contacted in my character's body. The backdrop system differs from every artist and studio, some for example like to make it so that all of the nodes are aligned in a row and some make it resemble the character physically, like the head node goes to the top, under that the body and so on. (About Nodes 2021)
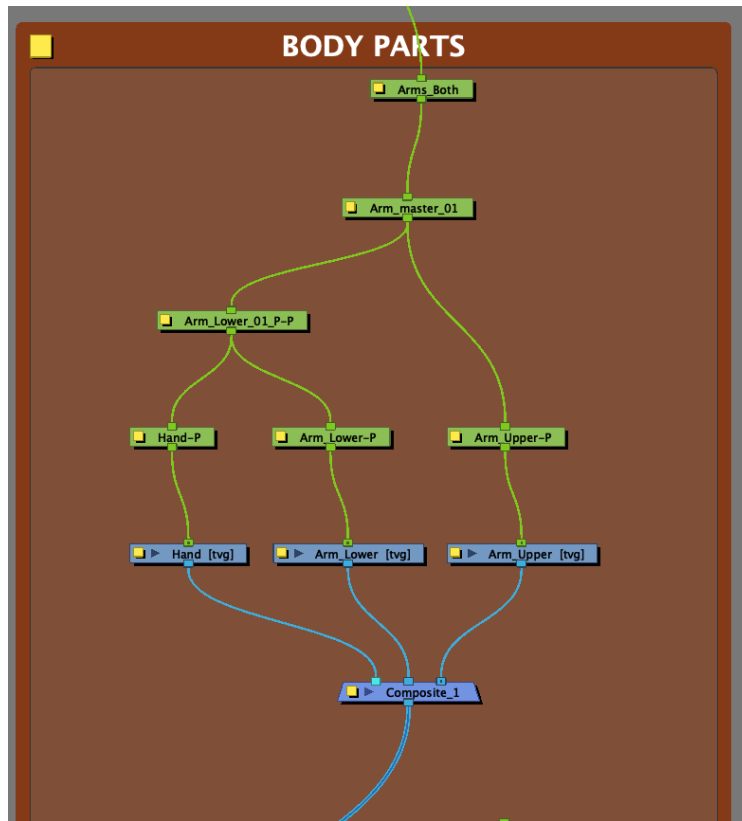
PICTURE 11. Example of a node backdrop on a body parts division

9.3. Creating the character pieces

I started by creating spheres into the traced space to mimic the placement of the joints and handles. I also traced the line art of the character since it's only necessary to make one copy of each body part, since they are eventually going to be copied and mirrored. It was also rewarding to create custom shortcuts and got to practice the drawing tools in Harmony. (Francis 2022)

The process starts by creating a custom colour palette. Open the colour editor and click with the colour picker to the drawing and choose the official colours straight away. After this I made a custom brush for the project. Even though I created some of the straighter lines with a line tool, I can always pick the lines with the selection tool and assign my brush setting to it in the tool panel.

This is extremely useful if you just want straight lines with the texture of your own brush. You can see in the drawing node if the art you created is vector or bitmap mode, you can also change this at any time in the process. My personal preference lies in working with vectors, because the quality of the image isn't lost when scaling up.
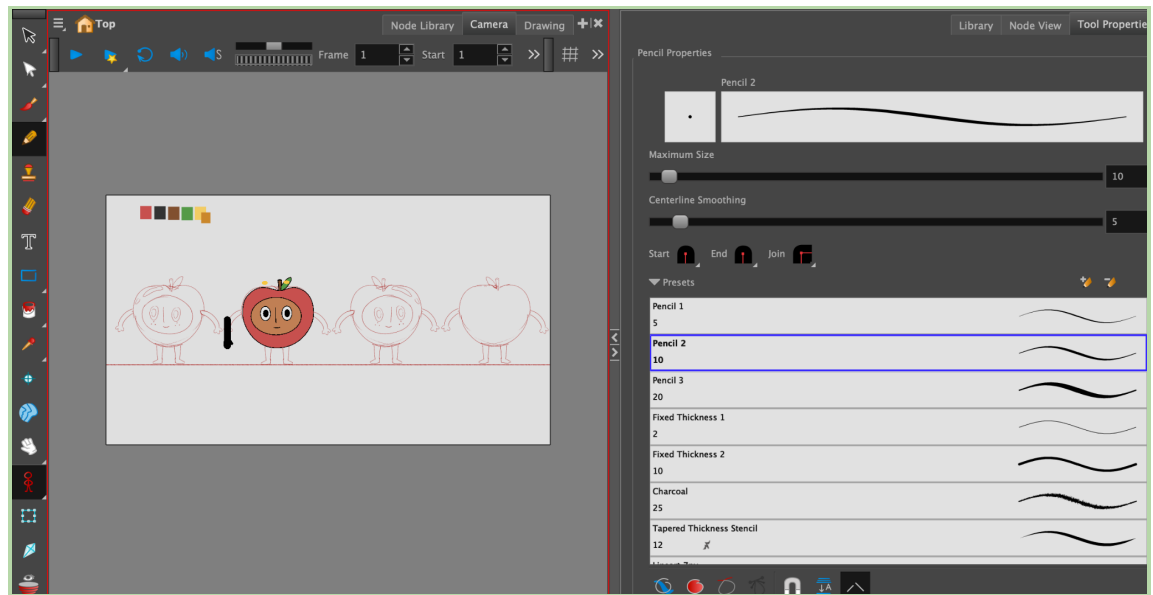
PICTURE 12. Example of the pen settings inside Toon Boom Harmony

9.4. Pivot points

It's important that each of the pegs pivot point is set. Simply choose the pivot point tool in the upper tool selection, and click on your image to drag the pivot to its place. When rotating a character's arms and legs it is common to move the rig pieces when animating, that is why it's important to set the pivot setting in the beginning of the rig. It's also possible to copy and paste other pegs' pivot settings to another by opening their peg settings and copy-pasting the stats.
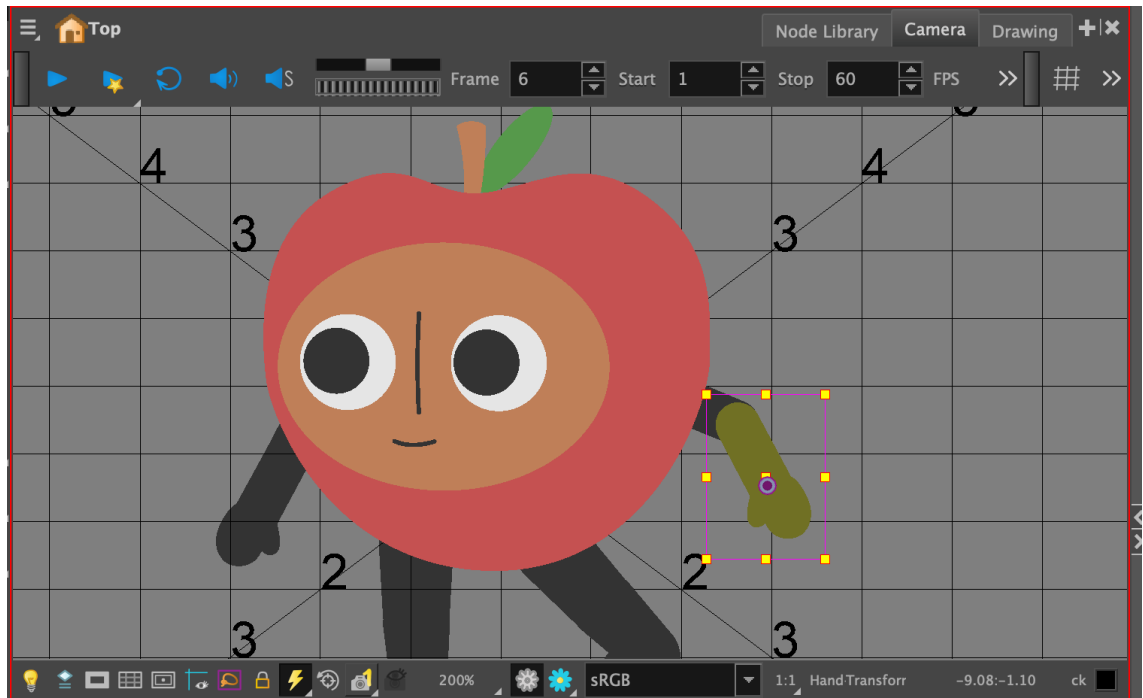
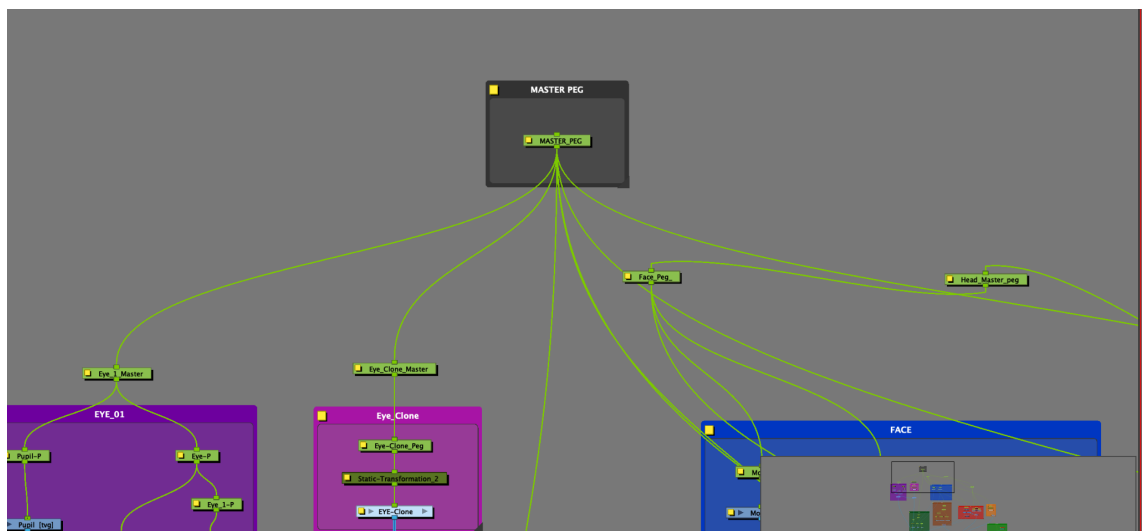PICTURE 13. Screenshot of the apple characters hand that has a pivot point

9.5. Creating peg hierarchy

When all of the parts of the character are drawn out, I can start building the node hierarchy. On top of the drawing layers it's important to create pegs, they work as a transform layer for our drawing layers. Here is an example of my face rig. Eventually make a stack of pegs that work as a hierarchy, when animating you move up and down with these pegs to get control of the character.
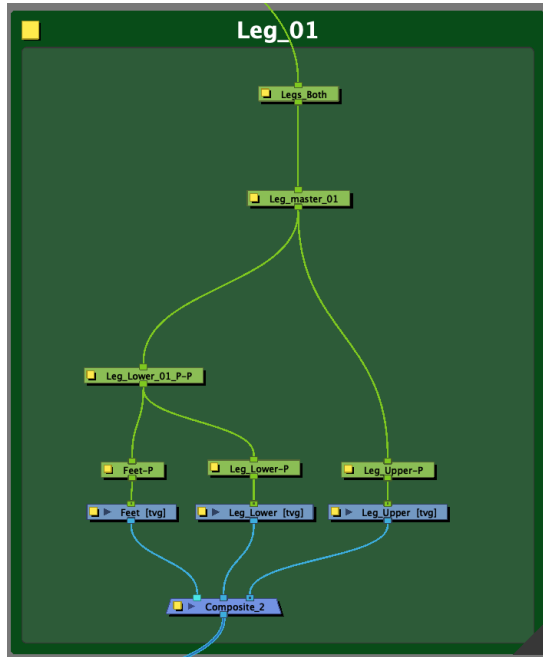
PICTURE 14. Screenshot of the hierarchy in the Leg_01

After each of the backdrops has a hierarchy, it is time to create the master peg. The purpose of this peg is to hold all the links to your character. Now to move the character you can simply choose this single peg, and not go through the trouble of selecting each part alone.

PICTURE 15. Screenshot of the Master Peg

9.6. Turnaround keyframes

When all of the pivots were in their place the next stage was to create the turnaround for the character. A common misconception with the turnaround is that you have to create an entire rig for each profile in the turnaround, when in fact you use the same rig in each of them, but just misplace each of the characters parts to fit the profile. Taking out the timeline and changing the settings to "animate current frame". Just copy and paste the amount of cells to the timeline for each pose. The turnaround sheet has poses that can be duplicated and mirrored, duplicating the effect that the pose heads into another direction.
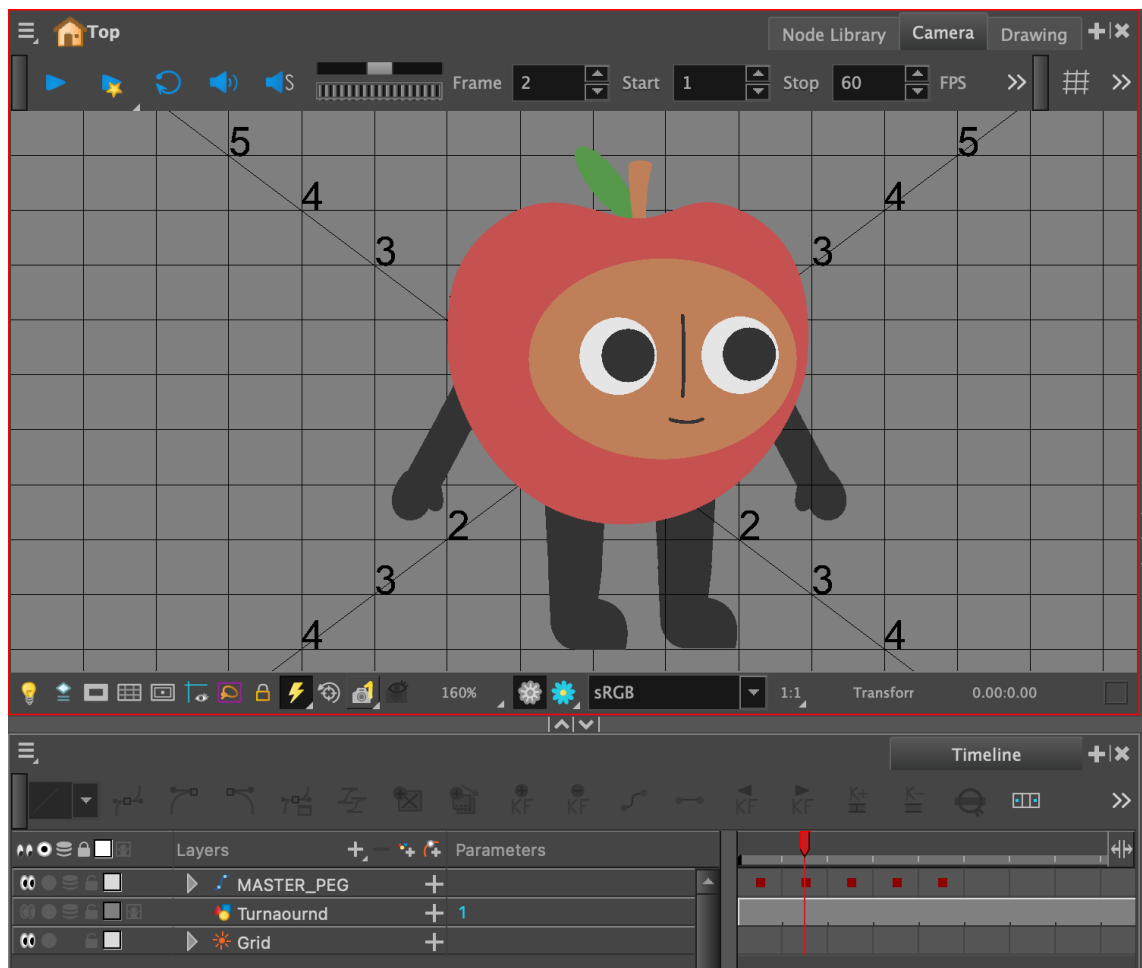
PICTURE 16. Apple character in ¼ view in a keyframe

9.7. Testing the rig

Animating characters often requires rotating various parts of the character to achieve the desired movements and poses. However, if the pivot points are not carefully positioned, it can lead to unnatural and disjointed animations. Hence, thorough testing is essential to ensure that the character parts interact seamlessly and that the pivot points are correctly placed. The pivot points must align with the underlying skeletal structure or rigging system, ensuring compatibility and proper functioning within the animation pipeline. Starting from scratch this rig took about 6 months to make. Taking into consideration that the working hours were 6 hours every day 5 days a week. If I were to start the project with the skills that I have acquired within this project, it would take me about three days to make a similar rig from start to finish. (Brander 2023.)
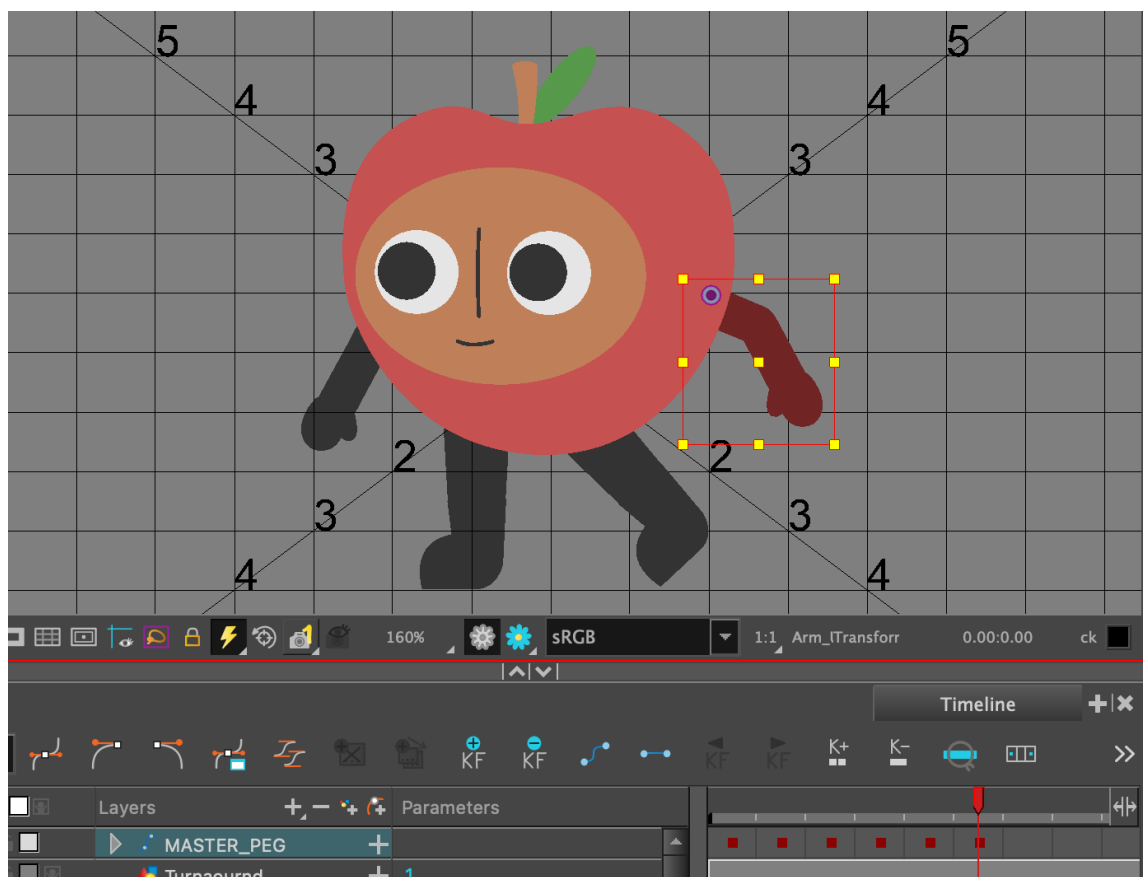
PICTURE 17. Screenshot of the rig in motion

10 CONCLUSIONS AND DISCUSSIONS

Rigging becomes easier once you comprehend the basics. The repetition of the process makes it easy to learn, the only problem is that the software surrounding it is not as easy to compare. Each studio has their own way to rig, so it's good to have data from multiple sources. The project was much more ambitious than it seemed at first. Learning a whole new program from scratch was much more challenging and time consuming than expected. Having no idea what and how to execute a simple task, led to frustration. In the future, it would be more suitable to execute small exercises inside the program like how to name files, navigate in the program and how each of the tools work. This would gain confidence and create small goals, so that the motivation for the project could be maintained. In the future it should be taken into consideration how much time a rigging project takes. With each project, comes more confidence, knowledge and skills. That helps to cut down time wasted on trial and error.

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