

Innovations Project Report

**An exploration of the union of 2D animation with a 3D
animated environment**



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1. Introduction to the Project

1.1 Aim

To firstly formulate a comparative analysis of existing production disciplines and to investigate the techniques and methods used in both 2D and 3D productions. I will then back up this investigation by using these techniques for the creation of my own animated.

1.2 Product

A 4 second animated short illustrating the merger of traditional 2D hand-animated style with the more recent 3D computer animated style.

1.3 Introduction

'Animation can explain whatever the mind of man can conceive.'

Walt Disney

This project is about an exploration of two apparent disciplines of animation; traditional hand drawn animation, and modern three dimensional computer animation. It will look at the techniques and methods used throughout a project's development and explore the reasons and the need for computer animation being born out of this traditional approach. It will also review the creation of a merger between the two styles (predominantly through the films of Walt Disney) and illustrate the effect this has had on the industry. I will also be looking personally at how important it is to understand the underlying principles of traditional animation in order to successfully move into three dimensional computer animation.

Steve Roberts explains,

'A computer can take a lot of the drudgery out of animating, but you can end up doing a piece of animation without quite understanding how it happened'

and whether it works or not.'

Steve Roberts, 2004

Through this project I have the aim of learning another aspect of animation I was previously unfamiliar with - hand drawn animation - and seeing how I can apply what I learn directly to my current knowledge of computer animation. The final animation I produce as a result of my research will be a short piece of mixed disciplined work combining 2D and 3D into a single effective production.

I will firstly explore the 2D animation process in detail, comparing it to that of the 3D process. Then uncover the reasons for these styles decidedly merging and computers being used for an increasing amount of work within predominantly 2D productions. I will then outline my own animation pipeline and discuss problems and solutions I encountered whilst creating my own work, before looking back on the finished product and constructively criticising it, learning from my mistakes. The final chapter will conclude the project.

1.4 The Project as an Innovation

There is nothing really innovative about the process of traditional animation since it has been around for over 200 years.

'Persistence of vision was first discovered in the 1800s. This led to such devices as the zoetrope, or "wheel of life" to be created.'

(Rick Parent, http://www.siggraph.org/education/materials/HyperGraph/animation/rick_parent/Intr.html)

Similarly the process of computer animation has also become well engraved into today's industry. However, the subtle combining of these two disciplines is an innovation that I feel has too quickly come and moved on. Mixing the hand-drawn with the computer generated developed too quickly into fully 3D productions and seems to be continuing that way.

There doesn't seem to be anywhere near enough emphasis today on the importance of life drawing, or acting. As Milt Kahl (Disney's master animator) explained,

'I don't think it's possible to be a top notch animator without being an excellent draftsman...You need that figure drawing background in order to sharpen. Every animator should have this background and unfortunately they don't!'

Milt Kahl (The Animator's Survival Kit. Pg 24)

Having studied computer animation for 3 years now, I still find it unsettling that at no point have I been taught, or decided to learn about traditional hand-drawn animation. Nor even thought about the improvements this may bring to my computer animated work. It seems that computer animation students can quite easily sit down at a computer and work away through trial and error to create something that looks reasonable. In comparison, traditional animation students study the subject in incredible detail and not surprisingly, produce far better results.

Those who have mastered the art of animation may find it relatively easy to transfer their skills to a computer program with relatively small problems. However, for a computer animator to suddenly switch to traditional animation naturally proves a lot more difficult, almost as if it's a step backwards.

I hope to be innovative in my work as a computer animator by taking this step 'backwards' and exploring the production methods and skills involved with traditional animation, in the hope of being able to apply what I have learnt to my current work.

While not aiming to create a completely traditional piece of animation for a final product, I will still retain the element of computer animation through the use of a CG background and animated camera move which my hand-drawn character will fit into.

2. Production Methods and disciplines

2.1 Exploring 2D Animation Techniques

In order to embark on this animated project, it seemed the only logical thing to do was explore the various methods used to animate something - from both traditional disciplines and computer aided, before trying to implement them into my production pipeline.

Although methods are continually changing regarding the production of animated films, the essence of the process still remains much unchanged. Tony White brings up the point that both traditional 2D animation and more modern 3D animation, and even live action filming in general all start with the 'same crucial stages of production'. (The Animator's Workbook 1986).

These crucial stages, highlighted by Tony White, consist of,

----Scripting

This stage is probably the most important stage of any film production. Without a good script, a project is destined to fall flat, no matter how flashy or clever it may be in other aspects.

'...the most important factor in the success of an animated feature has always been its story...the medium is absolutely the least important.'

(<http://www.mouseplanet.com/david/dk030814.htm>)

Animated films in particular rely more heavily on the visual scripting at this stage where as a live action film would be more concerned with dialogue.

----Storyboard

At this stage, the actions dictated in the script are visualised graphically. A lot of changes take place during this early stage before getting too far into the production to correct anything easily.

----Designs

Every character, background and prop from the script must be assigned a visual interpretation. At this stage they are by no means final however. A few preliminary character sketches later turn into character 'model' sheets portraying the character from every angle and in a number of different 'action' poses, adding an element of life to the initial sketches. These model sheets make it easier for the team of animators to be consistent with regards to the character's appearance.

----Animatic

An animatic is basically a filmed version of the storyboard which has been edited to give an impression of the final cut film. It serves as an excellent test of not only the script, but also the timing, action planning and soundtrack of the animation prior to starting the costly process of final production. This is the stage where the director will make most changes.

----Animation Layout

Producer / Director Raul da Silva summarizes this stage,

'This step is used in setting up extremes for character to be used by the key animator...It conveys different information to the storyboard as it gives you an idea of the action required in the sequence of motion and shows the most extreme character poses in the sequence.'

(The World of Animation 1979, p.37)

It is at this point during the production stages that the more traditional methods of animation are no longer adhered to with the introduction of computer technology to the field. The computer pipeline will be explored shortly. However, continuing with the stages of a 2D production,

----Pencil Tests

After the animatic is approved and all animation layouts completed, work is passed on to the animators to begin this two-stage process. The first stage involves a key animator who must first decide which method of animation he or she will be using. There are three key methods,

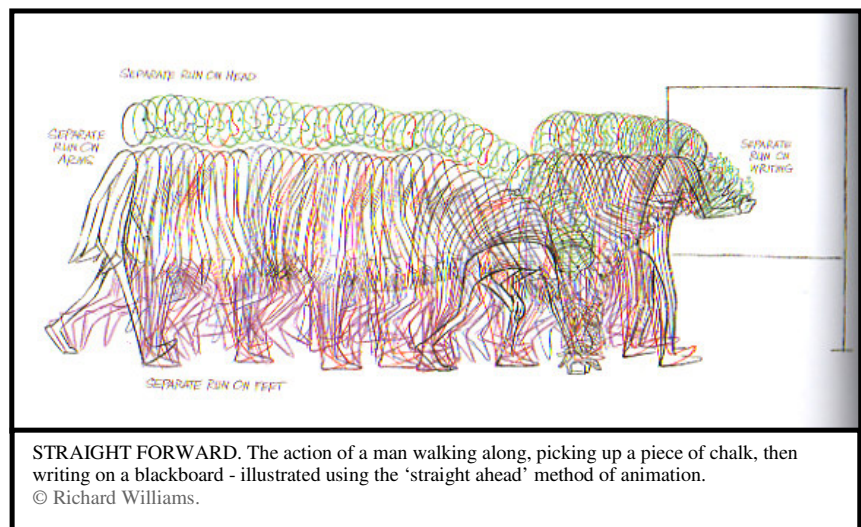
STRAIGHT AHEAD

The director for *Sleeping Beauty*, Woolie Reitherman describes his view on animating 'straight ahead',

'When I didn't know what I was doing in an action, I always went straight ahead. I'd just start on ones. Half the time I didn't know what I was doing. To me, it's fun. You find out something you wouldn't have found out otherwise.'

(The Animator's Survival Kit - page 61)

It is basically the idea that you just start drawing and see what happens. It is a natural progression from frame to frame without much forward planning.



Richard Williams describes the advantages and disadvantages of this approach,

Advantages:

- Produces a natural flow of fluid, spontaneous action
- Has the vitality of improvisation
- It's very creative to 'go with the flow' taking all the action as it comes along
- The unconscious mind kicks in
- It can produce surprise 'magic'
- Its fun

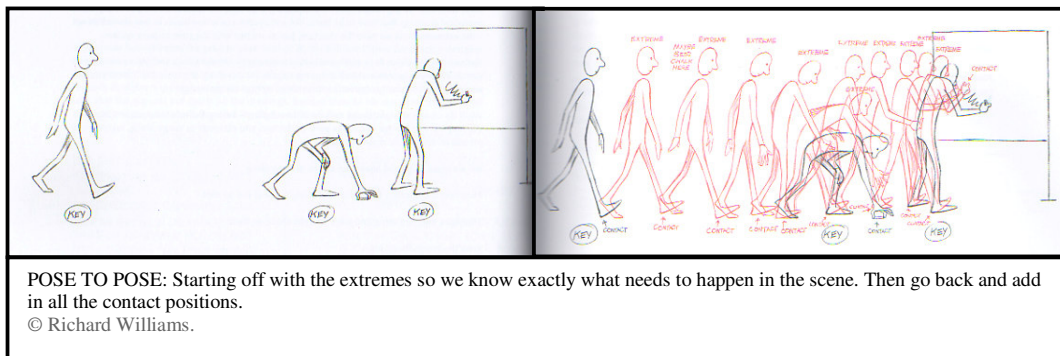
Disadvantages:

- Things can start to wander
- Time stretches and the shot consequently lengthens

- Characters may unexpectedly grow and shrink
- Can miss the point of the shot and not arrive in right place at the right time
- The director can't see what's happening
- There is a lot of clean up afterwards and so the process is hard to assist
- It is an expensive way to work
- It's also hard on the nerves

POSE TO POSE

In this approach, one first decides the most important drawings, or the story telling drawings, then puts them in. Then one must put in the extremes or contact positions and any other important poses. Then it is a case of working out the nicest transition between two poses, known as the breakdown or passing poses.



It is also advisable to make clear charts to ease in and out of positions and add any finishing touches or indications for the assistant before any inbetweens are created, as Grim Natwick, creator of Betty Boop, reminds us,

'Bad inbetweens will kill the finest animation.'
(The Animators Survival Kit. page 52)

Again Richard Williams does well to describe the advantages and disadvantages of this approach,

Advantages:

- Clarity

- *The point of the scene is nice and clear*
- *It is a structured, calculated and logical way of working*
- *Produces nice drawings and clearly readable positions*
- *It's in order - the right things happen at the right time, in the right place*
- *The director likes it*
- *It is easy to assist*
- *It is a quick way to work*

Disadvantages:

- *Misses the 'flow' of animation*
- *The action can be choppy and unnatural*
- *It can be too literal, having no surprises or no 'magic'*

COMBINATION OF STRAIGHT AHEAD AND POSE TO POSE

This method involves first planning out what one is going to do in thumbnail sketches. Then making big key drawings and big extremes, placing in all the important poses along the way. This forms the structure of the animation but is only there to act as a guide for things and places to aim at. It shouldn't be adhered to rigidly. It is then time to do several straight ahead runs on different parts. This may mean having to revise some keys and extremes along the way. The point is to keep adding to the detail; continually adding more runs (e.g. legs first, then body, then arms, then head, then hair or drapery bits).

The advantages and disadvantages of this approach, according to Richard Williams,

Advantages:

- *Combines the structured planning of the 'pose-to-pose' method with the natural freedom of the 'straight ahead' method*
- *Creates a balance between planning and spontaneity*
- *Creates an important balance between cold-bloodedness and passion*

Disadvantages:

- *None*

(Richard Williams - The Animator's Survival Kit)

A quality animator has already given the character 'life' at this stage, even through just a few keys and extremes. They want to make sure nothing is left for change when passing the work on to the inbetweener.

The second key task during the pencil test stage is that of 'inbetweening'. It is the inbetweener's job to draw the specified number of poses between the key and passing positions created by the key animator. It is also vitally important that they are drawn at the specified spacing. Given too much freedom, the inbetweener has the ability to completely flatten any quality animation.

This animation can be tested along the way either by 'flipping' the sheets like a flick-book or sending the frames off for printing and reviewing as a film clip. As Richard Williams illustrates,

'Pencil tests are our rehearsals'

(page 68)

----Clean-up

As no two animators draw exactly alike, the clean-up artist is required to make overall work from animator to animator consistent from a design and drawing point of view. It is their job removing some of the 'testing' scribbled lines that occur naturally when conveying a sense of motion through drawing. Through doing this, they ultimately reduce every drawing to single tidy lines. This process allows animators to be freer with their work without having to concentrate on the tiniest of details concerning the design of the character, as these can be corrected or picked up on during the clean-up stage. After cleaning,



the drawings are then re-shot to ensure no errors have crept in which may throw off the animation.

----Inking

After the director approves the cleaned-up animation, each drawing would traditionally be transferred to thin sheets of acetate known as cells, and then painted by hand according to the original designs. Using today's methods however, drawings are digitally scanned then coloured within a computer, cutting time and cost dramatically.

----Checking

The checker must catch any mistakes before the project enters the final stages of production. These might include broken lines, dirt on the acetate, painting mistakes or accuracy of written instructions for the compositor / cameraman.

----Compositing

Once the checker is satisfied, all the artwork and camera instructions are passed on to the cameraman or the digital compositor in more modern day productions, who's job it is to bring together all the digital elements including animation, backgrounds and special effects.

----Final Edit

Unlike with live action filming, the animation final edit isn't very creative, in that the director has essentially made all the timing and filmmaking decisions during the animatic stage. It serves more as a technical compilation process. Simply slotting all the finished scenes into the initial animatic framework and replacing the pencil tests with final prints ready for viewing on the big screen.

2.2 Exploring 3D Computer Animation Techniques

As described previously, there are a number of stages that must be included regardless of the animation discipline, be it 2D or 3D. In exploring the production processes undertaken in the creation of a computer animated feature, I looked towards the most established company in that field, Pixar animation studios.

'The Pixar process' is described quite effectively on their website,
(<http://www.pixar.com/howwedoit/index.html#>)

Pixar films go through four key stages;

Development - creating the storyline

Pre-Production - addressing technical challenges

Production - making the film

Post-Production - 'polishing' the final product

1 - First a story idea is pitched, like a sales pitch. The challenge is to get the audience to believe in the idea and see the possibilities in it.

2 - Next the text treatment is written. This is a short document that summarizes the main idea of the story. A few treatments may be made on the same idea to find the best balance between solid ideas and open possibilities.

3 - Storyboards are drawn. Each storyboard artist receives script pages and / or a 'beat outline', which is essentially a map of the characters' emotional changes that need to be seen through its actions. Using these actions, the artists design their storyboard panels and pitch them to the director.

4 - The first temporary 'scratch' voices are recorded by Pixar artists for storyboard reels. When the story and dialogue are closer to being finalised, professional actors begin recording character voices, reading from a script and improvising. Actors must record their lines several different ways. This is so the director has the ability to use the best vocal take to eventually be animated to.

5 - Editorial begins making the reels. A reel allows the cleaned up storyboard sequence to stand alone without having someone stood alongside pitching the story. It is an excellent tool in reviewing the timing of the sequences.

6 - The art department creates the 'look and feel'. Based on the text treatment and provided storyboards (and of course their own imagination), characters, sets, props, surface textures and colour scripts are designed.

7 - Taking the designs from the art department, characters, sets and props are first either sculpted by hand, then scanned in three dimensionally, or modelled directly in the computer in 3D. They are then rigged with a skeleton ready for animators to animate with.

8 - After the virtual sets are built in 3D they must be dressed with prop models such as furniture or just random objects in order to create a believable world.

9 - The layout crew then choreographs the characters within the set and uses a virtual camera to create effective shots that capture the emotion and story point of each scene. Often multiple versions of shots are provided to the editorial department giving them choices for cutting the scene in order to gain maximum storytelling effect. Once the scene has been cut, the final version is sent to the animators.

10 - The shot is then animated. Unlike 2D animation, computer animators are like puppeteers. They are provided with the character models in various sets and have to choreograph the movement and facial expressions for each scene. Like with traditional animation, firstly key poses are defined allowing the computer to fill in the in-betweens, which the animator then adjusts as necessary to get the look they require.

11 - The sets and the characters are then shaded. While the shape is determined by the model, the surface colour and texture is determined by the shader.

12 - Lighting is then employed to complete the look. Using digital light, every scene is lit in much the same manner as stage lighting. Key, fill, bounce and room ambience lights are all defined and used to enhance the mood and emotion of each scene. Lighting is inspired by the moody colour scripts created previously within the art department.

13 - All the computer data is then rendered. The process of rendering translates all of the information in the files that make up the shot - i.e. the sets, colours, character movement, lighting etc - into a single frame of film incorporating motion blur as and when it is needed. Each frame represents 1/24 of a second of screen time and at Pixar, takes on average about six hours to render - though some frames have taken as many as ninety hours!

14 - Final touches are then added. The editorial team oversees the completion and addition of the musical score and any other sound effects. The effects animation team will then add any special effects. The Photoscience department then records the digital frames to film or to a form appropriate for digital projection.

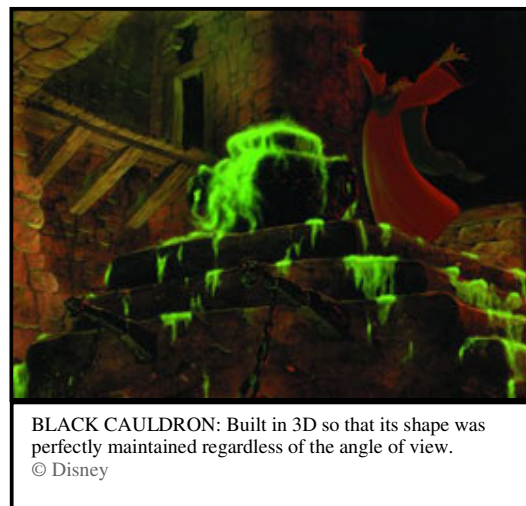
3. Combining the two methods

3.1 So why use computers?

When was it decided that computers should be used and what was the first step made in using 3D to extend or add to a predominantly 2D feature animation?

In 1982, Disney animators Glen Keane and John Lasseter experimented with combining 2D and 3D animation with a 90-second test on author Maurice Sendak's 'Where the Wild Things Are.' Unfortunately due to costing issues, this project never made it past the testing stage. However it did serve as an effective exercise in inspiring the two to experiment further and later go on to revolutionize the medium at Pixar Animation Studios and consequently direct several landmark computer-animated films.

The big breakthrough was in 1985, where 3D imagery was starting to be implemented into a predominantly 2D film. Disney's 25th animated classic, 'The Black Cauldron' was the first hand-animated feature film to incorporate elements of computer animation in it, and was used for several inanimate objects, including the cauldron itself.



'The dimensions and volume of objects were fed into a computer and then their shapes were perfectly maintained as their movement was generated by

programming.'

(<http://disney.go.com/vault/archives/movies/blackcauldron/blackcauldron.html>)

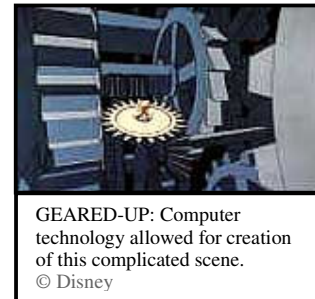
While this film was technically advancing into new grounds with regards to animation production and practice,

'The sheer lavishness of the production, did not guarantee huge grosses, and the film was a box-office failure.'

(<http://disney.go.com/vault/archives/movies/blackcauldron/blackcauldron.html>)

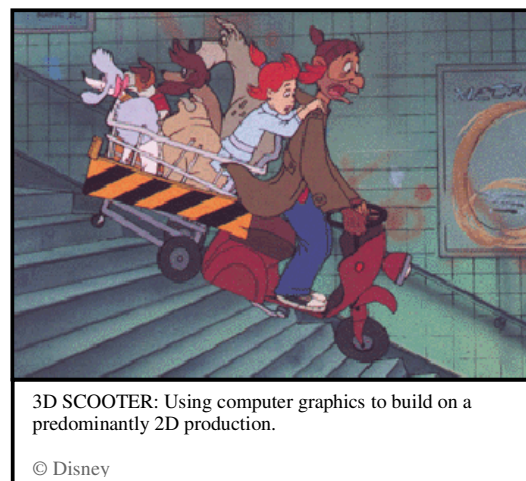
This illustrates perfectly the point that adding flashy effects doesn't make a story or a production entertaining. Computer graphics should be there to enhance an animation, not take precedence over it.

The next major step into three dimensions for Disney was with their subsequent animated feature, 'Basil the Great Mouse Detective' in 1986. Here 54 moving gears, winches, ratchets, beams and pulleys inside the clock tower of Big Ben were animated using the computer,



which although was only a small element of a big picture, the idea had already served its purpose for adding otherwise overcomplicated detail to enhance the original animation, which would otherwise have not been attempted.

The first Disney feature animation to make heavy use of computer animation, since these previous films 'The Black Cauldron' and 'The Great Mouse Detective' had used it only for special sequences, was 1988's 'Oliver and Company'. Computer graphics were used for making the skyscrapers, the cars, the trains, Fagin's scooter-cart, the climatic Subway chase, even the Brooklyn Bridge, adding an extra dimension and an extra excitement into the picture. It proved to be a success and,



'...was the first film to have its own department set up expressly for the purpose of generating computer animation.'

<http://disney.go.com/vault/archives/movies/oliver/oliver.html>

Subsequent Disney film releases followed suit, each adding that little bit more using computer technology. A prime example of arguably the best use of mixed animation methods in any Disney feature animation is 'Beauty and the Beast'. Most noticeably is the 'Ballroom sequence' where Belle and the Beast are dancing together. Here, the characters are hand animated within a computer generated room, being filmed by a moving virtual camera and reacting to the continually changing perspective with incredible accuracy. In a February 2002 interview for 'www.bigmoviezone.com', director Kirk Wise explained,



BALLROOM SCENE: Quite possibly the best piece of animation done on any feature film. An incredible feeling for perspective.

© Disney

'...we had an incredibly talented animator, James Baxter, who just had a knack for moving characters in 3-d space. He had this chip in his head that enabled him to perfectly match his drawings with a moving background.'

<http://www.bigmoviezone.com/articles/index.html?uniq=84>

It is scenes like this that capture the 'magic' of hand-drawn animation. Although this scene could easily be recreated entirely using computer animation, would it still have had the same captivating effect, and be remembered as,

'...an important milestone in animated films'

<http://www.animationusa.com/wd02/wd155n.html>

3.2 Creating my own mixed-discipline animated short

Having explored both 2D and 3D production methods, one can deduce that essentially, 3D animation is more an extension of traditional 2D animation, than it is a separate entity, as they both rely on the same basic principles and methods, only differing in practice and performance.

Using this research I went about formulating my own methods and working styles.

3.3 The Story Idea

My main inspiration was the ballroom scene from Disney's 'Beauty and the Beast'. For me it had the perfect mixture of 2D animation within a 3D computer generated environment. I wanted to create a similar shot with a moving virtual camera inside a 3D scene then hand-animate a character following the same rules of perspective as governed by the scene. Having no experience with traditional animation, this was a very daunting prospect. Richard Williams' 'Animator's Survival Kit' was excellent reference for getting to grips with animation and finding out where to start and how to plan out what it was I wanted to achieve. I also found that Walt Stanchfield's Animation class notes (found on www.animationmeat.com) provided a useful starting point for my work.

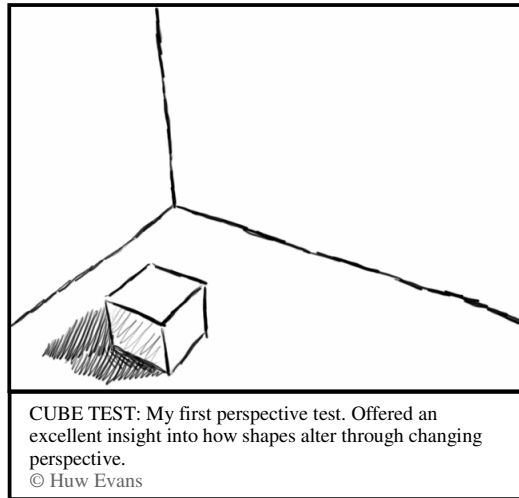
My initial thoughts were to keep things simple. With my lack of experience it would be hard enough animating a character, let alone animating a character and a changing perspective simultaneously. For this reason I firstly concentrated on getting a 'feel' for hand drawn animation with a few perspective tests.

3.4 Initial Testing

Using a 3D animation package (Maya), I created a basic room containing a single cube. Then, adding a virtual camera, I plotted out a basic camera move - moving from a 'bird's eye' shot smoothly to a 'side on' shot. From the results of this

test, I had a satisfying camera move at an appropriate speed and so it was decided to use the same length of shot for my final piece - 100 frames (or 4 seconds at 25fps).

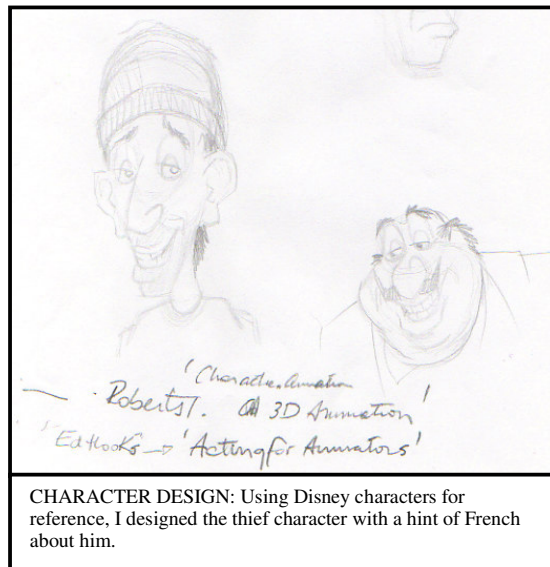
Each of the 100 frames were rendered out of Maya and brought into Photoshop as layers. I then altered the opacity of the rendered frames and traced out every 10th frame using a graphics tablet. Then, hiding the rendered frames, I tried to create the inbetweens by hand and compared them to the renders as I went. This served as quite a good exercise as it got me into the 'feel' for changing perspective, especially concerning the cube and how much it changed with each consecutive drawing.



3.5 Design Stage

On completion of this test, it was then time to sketch out a rough 'storyboard' of my final scene and the camera move to be used. I wanted some kind of scenario where I could incorporate a 'sneak' and the first thing that sprang to mind was a bank robber creeping up to a valuable item he wishes to steal.

For designing the character I looked primarily at Disney artwork and sketches, as that is where my inspiration comes from. I wanted a hint of 'French-ness' about his character for some reason and so took inspiration from not only the Chef from 'Lady and the Tramp', but also Gaston from 'Beauty and the Beast' and Clayton from 'Tarzan'. With regards to prominent features, I was interested in



giving my character a strong jaw and a large nose with a hint of mischief in the eyes. Always peering through them half closed.

My initial character designs came up with quite a long looking character with thin legs and arms but very large hands and head. I thought the large hands would be useful to express his character as he really wants this object and he knows he's not allowed to take it. His oversized head would allow for expressive facial animation, and also leave me with some room to be untidy with my drawings. I later refined the character to be a lot shorter though as I thought it provided a better contrast with the large head.

With regards to creating the environment, I decided to use a very simple set, just a room with a cube in - similar to my initial test - which will later act as a table or a plinth with an expensive object displayed on it, as if in a museum.



3.6 Animatic

I firstly pencilled out a rough falling camera move which circles the character and lowers perspective significantly. I wanted to keep it closely related to the camera shot in my previous example as I thought it served its purpose well through testing.

I then created a basic 'stand-in' model of my sneaking character so I would have an idea of where he should roughly be at each moment in time as he moves closer to the 'jewel'. This helped me work out basic timing and to ensure I kept within the 100 frame limit I set myself.

Being a part of my animatic stage, it was here where I adjusted the timing of both the character and the camera too see if the shot felt too rushed, or wasn't focussed on what I had intended.

It was at this stage when I realised I was ready to start planning my animation and

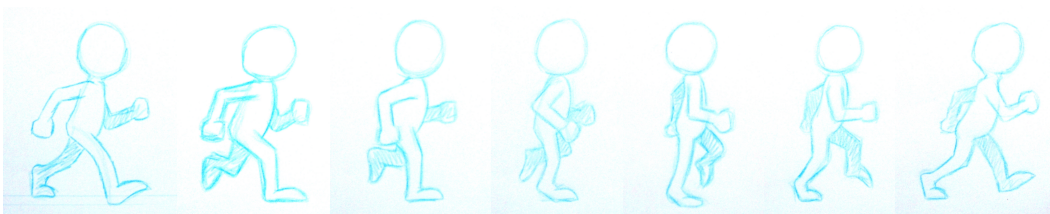
mapping out the key positions. However, I thought it wise that I try some more basic animation tests, such as a character doing an action, while having no changing perspective to confuse me. Not yet anyway!

3.7 Hand-drawn testing

The very first thing I tried whilst sat at the lightbox was to draw my own hand clenching into a fist. I just wanted to sample the benefits of having the ability to see through to your previous drawings and my hand was an easy to find subject. Having no idea about a reasonable length of time for a convincing clench, I decided to use only about 5 frames and just alter the timing of the playback - just as a test to see change of position and shape rather than timing. The results were moderately successful, while not creating an animated masterpiece, it did get me into the habits of flicking back and forth between drawings and adjusting sections as required until I thought it looked correct.



For the next step I decided to move onto a walk cycle, both as a means to practice the art of animation, and to figure out a feeling for time scale. Having no idea how many frames it takes for a two step cycle and what the effects are of adding or subtracting frames, I decided to use some reference from Richard Williams' book.



WALK CYCLE: The first step of my 12 frame walk cycle. A pretty successful animation exercise.
© Huw Evans

I explored the benefits of pose-to-pose animation through setting out the contact poses and key-frames before adding the 'in-betweens'. This felt like a good way to work

and produced successful results. My first test was animated with 12 frames for two steps and proved to be quite a success timing-wise. Although the resulting animation is an on the spot cycle, it was animated travelling across the paper and later adjusted in Photoshop to create an on the spot cycle for repeated viewing purposes. Very useful in helping me spot mistakes as you can visually track points on the character and see how smoothly they flow.

Through doing this, one quickly learns the importance of arcs of movement whilst animating, and how without a smooth arc, movement looks incorrect or jumpy.

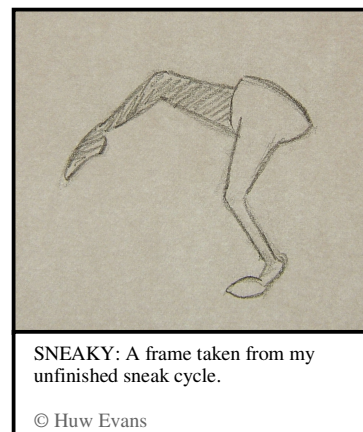
Steve Roberts explains,

*‘When somebody looks to the side, their head will bob down through an arc.
When somebody jumps in the air, his or her trajectory will describe an arc.
Almost all movements made by any living thing will follow an arc.
If the character doesn’t follow arcs with its movement, your animation can look stiff and robotic.’*

(Steve Roberts - Character Animation in 3D. page 53)

In order to ensure I had smooth flowing arcs while I animated, I overlaid a sheet of paper on top of my animation, and used it to track various points moving from frame to frame - points such as the knees, or the wrists etc. On joining up these points, if the resulting curve was smooth, then everything was ok. If a few points lay off the main line, then I could easily tell which frames needed adjusting.

My next step was to advance from a walk cycle into a sneak cycle in order to understand the timing required for this slower movement. For this test I decided to focus solely on the legs and the hips, keeping it a bit simpler so as to not confuse myself with too much information at once. I worked out a rough timing for a sneak step by performing the action myself. I timed it at around 21 frames for one leg, or 42 for a two leg cycle. This timing was a little unconventional as Williams describes that for a traditional sneak the,



“Average version [is] 24 frames for each step. Fast version [is] 16 frames per step. Slow version [is] 32 frames for each step.” (page 167)

I knew my sneak had to be between the average and the fast versions as I had a certain distance to travel over 100 frames and wanted to stick to that.

From contact to contact with one leg it seemed to only take about 12 frames, then the remainder of the 21 frames were used to adjust the centre of gravity and become balanced again before stepping out with the other leg. This gave me a good insight into otherwise unknown aspects of this action and in that sense was very useful. However, I unfortunately ran out of paper for use with the lightbox at frame 13 (how unlucky!) and so could only partially complete my sneak cycle. I could tell from what I had though that the timing I employed would serve well in a completed cycle so was not overly concerned.

3.8 Final Animation

It was at this point where I had no other option but to start animation on my final scene. The idea of this was very daunting as still I didn't know where to begin. My first port of call was to take my rendered images from Maya, and print each of the 100 frames out onto A4 paper. I then decided on the arduous task of hand-tracing very lightly, the outlines of the room walls, the cube, and even the rough character stand-in model onto animation paper using the lightbox - all 100 frames! This was very tedious work but provided me with an excellent reference framework for my changing perspective without having to take my eyes off the page. It also meant I had target positions for my animated character to reach in order to complete his actions within the set time frame. This gave me a bit more confidence.

I decided quite early on that initially, I would need to be quite geometric about my drawings as I find it a lot easier to visualise basic geometric shapes turning around in 3D space and altering in their perspective, than I do more complicated natural shapes. This was evident from my cube in a room test which I found quite comfortable to visualise.

My plan of action was to animate using these geometric based shapes in a number of layers (although not actually using separate pieces of paper, just doing one run right through, then going back over the top with another). My first layer would be the legs and hips, as it worked well with my previous test. The next layer would be the main torso section and a rough head positioning. The following layer would be rough arms and improved head, leaving the final layer for finished arms/hands and facial expressions. Splitting it up like this made it a lot easier to focus on the separate parts before it all getting too crowded and complex.

I firstly decided to use the pose-to-pose method of animating and plot out each of the contact positions taking into account the increasing size of my character as the perspective shifts. Having the rough outline of both the cube and the character stand-in became invaluable as a means of checking perspective and apparent height changes in my animated legs. I found it quite difficult to visualise how the animation was working through only 'flicking' the pages, especially when I had about 6 or 7 frames or more. For this reason I decided it wise to scan my progress in so I could play it back repeatedly. As original Disney animator Bill Tytla once said,

'If you do a piece of animation and run over it enough times, you must see what's wrong with it.'

(Animators Survival Kit. page 69)

Upon reviewing my work, I noticed that there was something fundamentally wrong with my character's perspective. It became apparent that for each contact position, I had been keeping the foot in the same position on the page rather than animating it relative to the changing floor plane. This mistake took me quite some time to spot as it seemed so unobvious that the characters second foot hitting the floor, would land in exactly the same space on the paper as the previous foot was. I had assumed that the second foot would progress a short distance ahead from the first which is where my mistake arose. It was at this point I knew it wasn't going to be as easy as I had previously thought.

My aim was to animate every frame of the 100 I had decided upon (this is know as animating on 'ones') as I was hoping to employ a lot of detail in the hands and the face which animating every other frame (animating on 'twos') would possibly miss.

For my first animation pass (consisting of the legs and the hips), I used a mixture of pose-to-pose and straight ahead. I plotted out my two extremes for one leg first (frames 1 and 21) then my second contact position (frame 13), then went back and broke up my first step into leg passing (frame 4), knee high-point (frame 7) and extended leg (frame 10). Frames 13, 16 and 19 were used to shift the body weight back from the back leg to the front leg to regain balance. This method naturally made a three frame stagger for my drawings, so I inadvertently decided to animate on threes for my first pass.

My main focus whilst animating was keeping a close eye on the arcs of animation as I had recently learnt of their importance in achieving a realistic, aesthetically pleasing piece of work. Picking points like the knees and the ankles and tracking them over a few frames helped me achieve the smooth curves I required.

This stage of the animation involved a lot of re-scanning in order to give me the easiest method of viewing what I had done and noticing any errors early on. One error I found occurred quite often was the over-lengthening of limbs. The problem being that once I had made the mistake in one frame without noticing, I would only add to the mistake in every frame afterwards until I got to a point where the character was almost double the size he should have been. Mistakes like this were very time consuming and involved a lot of backtracking and re-drawing of frames.

Another problem I noticed was that my character was moving a little too slowly for the distance he had to travel. Either that or his steps could have been a bit longer. This was shown in my first pass of my pencil test as my animated legs quickly began to lag behind my dummy character's position. To remedy this, I decided to add another method of sneaking to the second half of the piece, the tip-toe sneak. Richard Williams describes this as a very 'contained pose' where the body stays quite rigid and the legs kind of bounce from toe to toe. I liked the idea of this as it would give a different side of character to my thief. His initial cautiousness while entering the room, causing him to start looking around feeling a little nervous, until he gets so close to his goal that desire and need consumes him and he is just focussed on his prize, speeding up his movement and directing him more closely to this object. I think it creates a nice variation in the animation.

After continually adjusting my first pass until I was satisfied that it looked correct, I began to think about my second pass, the torso and basic head positioning. The torso part was relatively easy as by animating the hips as a half sphere, I had already worked out the angle the torso would be pointing in and basically had to add a larger bendable cylinder growing out from the hips.

Blocking out the head position proved a bit more difficult, especially with my character looking in different directions through an ever changing perspective. Again I decided on a geometric approach and drew the head as a glorified cube shape with an extended rectangle for a chin and a curved top for a hat. This made visualising the object in three dimensions a lot easier as I now had corners I could track the arcs of. My first few passes of the head position didn't turn out too successful as I again had trouble with increasing and decreasing scale as the animation progressed. These problems were remedied however after reviewing the animation repeatedly and checking scale against the rest of the body.

Moving on to the next animation pass, roughing in the arms and improving the head shape and position, involved a little bit more personal performance. By sneaking around the house myself, it helped me to figure out where my arms needed to be in order to maintain balance while the rest of the body leaned back during each stride. Again it became vitally important to check the arcs of motion throughout each frame, ensuring a smooth curve. As far as improving the head shape, I basically used the geometric framework from my previous pass to contain my cartoon drawing of the head shape. This framework provided an excellent reference for where I would need to draw the ears and the nose whilst the head was turning. Similarly the chin could just be drawn inside its geometric equivalent making the whole process a little bit easier. Even though things started to take shape at this point, there were still mistakes made that I would have to backtrack. For example after adding the nose in its correct position on the head, giving it half a face, it became apparent that in my earlier frames, the head was trailing too far back and being a 'bird's eye' view, this looked incorrect having the character facing straight up. Problems like these were quite time consuming to correct at this stage but I'm glad they were identified and not left until any further down the line.

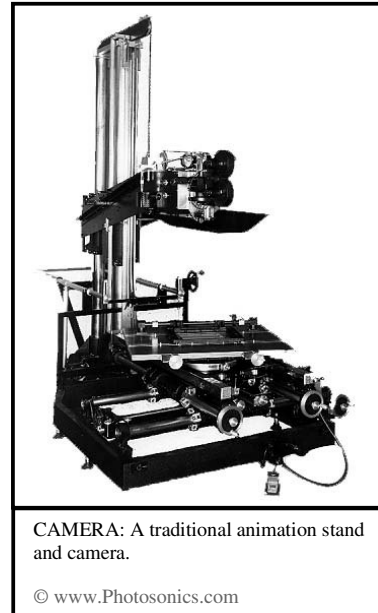
4. Compiling the Animation for Viewing

4.1 Digitizing Images

Combining the production pipelines of the two disciplines, 2D cell and 3D computer animation, I soon realised I had just a couple of options for getting all the animation together for viewing.

Hand animated cells were traditionally photographed by a cameraman using an animation stand and camera, Raul da Silva explains that,

“...one can use a normal camera on a tripod but this is infinitely more stable and professional.”
(Butterworth & da Silva, 1979, p.55).



I had indeed tried using a digital camera during the early stages of animation testing as working at home without a scanner warranted no other method. Lacking a tripod of any kind, my methods were rather primitive and involved trying to frame up markers on the paper with the corners of the viewing screen on the camera. Obviously this method had limited success but did serve well for shorter tests.

The more modern day option was to use a scanner which would give me both higher resolution images and also far more stable ones being that each frame would sit in exactly the same position in the scanner. The only problem with this decision however was the fact that the paper being used to animate on was larger than A4 and so wouldn't fit completely into the scanner. Luckily this problem had already been overcome by the fact that I was working within an A4 space on the paper anyway due to using the traced templates from the printed renders.

4.2 Clean-Up

Once the images had been scanned in they were imported into Adobe

Photoshop where I could begin the clean-up process. I ensured that whilst scanning in, I had adjusted the contrast levels accordingly so I had the best visibility of each frame before even having to make any further adjustments.

The clean-up process primarily entailed removing the template lines that had been traced in the beginning, and tidying up my hand-drawn lines a little, but not so much as to remove from the free-flowing nature of the animation. It gave me the chance to fix any broken lines, or lines I had drawn too lightly and so didn't scan in very successfully.

Once this was complete, I created alpha channels for each of the frames so that I was just left with a cut out of the actual character, the remainder of the page being transparent. This was to aid in the compositing stage as I could then import my previously rendered background frames into the compositing software (Shake), and overlay the character frames in their appropriate position, thus completing the merger.

5. Conclusion

5.1 Critical Analysis of my work:

My major criticism of my work is that I think I played it a bit too 'safe' with regards to the animation of my character. Because I was concentrating so hard on getting the movement and the perspective right at the same time, I think I was quite constrictive with my animation. It lacks a good feeling of squash and stretch - although I did implement it, I should have exaggerated the movements far more than I did. I think I have used a far more realistic style of movement than I had originally intended. It lacks the 'magic' that emerges when you are comfortable with your work and feel more free than constrained like I did - although I guess that improves with experience.

I also should have spent more time on the 3D production side of things, such as creating a far superior environment where the action takes place. I ended up using my very basic block model in the end which looks very amateurish and not at all what I had in mind for a finished product. Spending a little time on a more detailed model, a good use of textures and well positioned lighting would have added so much to the finished piece. Coupled with a little more time spent cleaning up and adding colour and detail to the 2D side of production I think the end product would have turned out a lot more satisfactorily. Also it was a real shame not being able to include all the inbetweens to the animation. I had hoped for the ability to add plenty of subtle movements and gestures through consecutive frames, however, the result I still find pleasing.

5.2 Regrets

Although not what I had originally intended to achieve, it would have been a fantastic experience to complete all processes of the traditional animation pipeline, including as previously mentioned the pen and ink stage after clean up, and possibly even adding soft shadows onto the character. Just to create a really polished piece of

work while still having all the rough workings to show how I got there. Similarly with the 3D side of my animation, I would have loved to get through each and every one of the stages of production, including texturing the scene, lighting the scene dynamically and rendering each frame out to a far higher quality. Possibly even add ambient music and sound effects to really give the scene a sense of completion.

5.3 What I've learnt about both disciplines

Forward planning is critical for 2D animation - it is much more time consuming and can also be far more frustrating finding mistakes than involve a lot of work to fix. When working in 3D one can start an animation with a far more haphazard approach. Although planning is still required in the early stages, when it comes to actually animating the subject matter, testing and reviewing your progress is quick and easy - errors can just be backtracked with a few clicks and undone, speeding the correction process up significantly. Also since the inbetweens are generated automatically, in an instant, keys can just be thrown in and moved around until it looks right, allowing animation to be created simply through trial and error which granted, does sometimes turn out acceptable but isn't strongly advised.

I can see the incredible effects that the introduction of 3D computer software has had on the field of animation already, and being familiar with computer animation after studying it for 3 years, whereas traditional animation is still new to me, automatically gives me some bias towards favouring animating with computers. However, (and it's a big however!) personally I still see a lot more 'magic' and captivation in traditional animation, than I do with CG. Granted computer animation and effects have a significant place in films today and so they should - the impact that the age of computer animation and digital effects has had on the film industry is incredible, giving the opportunity for so much more to be done on screen than was ever thought possible without the help of a computer. Although technology is constantly improving, it is still a long way off the spontaneity and liveliness of animating by hand. The charisma and over exaggeration of movements, the way bodies change shapes, the way characters are held by no boundaries other than imagination - computer technology cannot yet come close to that. Maybe one day it will? Does this bring the end of an era? The end of traditional animation?

I don't think it will, and I certainly hope not. If it can last from Disney's first animated feature, 'Snow White' made in 1937, and still be watched and enjoyed by both adults and children today, nearly 70 years later, then I think it will still be around for a good while yet. This is proven by the fact that the Disney classics range on DVD still sell amazingly well.

I think that now computer animation is around to be used, it is used a bit too freely. Just because a film has computer animation in it, doesn't make it a good film. Just because it looks really nice, doesn't make you want to watch it again, and again, and even again. I'm all for combining the two disciplines as I think it creates fantastic effects - otherwise unfeasible without. Take Disney's 'The Lion King' for example. The wildebeest scene where Simba is being chased down the canyon was an incredible scene, and the merger of 3D generated animals fit so effectively with the hand animated main character. Michael Eisner once said that "2D animation was dead" - I sincerely hope he is wrong, but the way things are going, I wouldn't be surprised if he were right.

Disney's use of computer graphics in their 2D feature films slowly but surely increased with every subsequent release, up to their relatively recent film 'Home on the Range' which was announced to be Disney's last fully 2D feature film. Steve Goldberg (who worked on some of the first CG characters Disney ever produced in the film Aladdin) stresses during a conference at Siggraph in 2005,

'...that Disney's changes are not about abandoning a medium, they are about embracing the elements that are integral to animation. These elements include story telling, art and direction and design. It is possible to celebrate the elements of the past and continue to apply them within a new medium.'

<http://reports.siggraph.org/articles/the-legacy-of-disney-animation>

The Legacy of Disney Animation - Caitlin Winner

This has propelled Disney on into the world of fully 3D computer generated films starting with its release of 'Chicken Little' in 2006. My personal opinion is that it lacks the imagination of the traditional Disney's. It becomes 'just another cartoon film'. One unnamed long-time animator expresses his opinion that,

'Disney will never do hand-drawn animation again. Or at least not for a very, very long time and to the qualities and standards they have already established so far.'

<http://www.mouseplanet.com/david/dk030814.htm>

I think this statement has an element of truth about it, as Ron Miller (executive head of production at Disney Studios) admits, *'...there just aren't that many people capable of doing animation in the Disney style.'* (The Illusion of Life: Disney Animation, Johnston & Thomas.1981) Frank Thomas and Ollie Johnston, two long-term Disney animators go a step further to explain,

'There is a special ingredient in our type of animation that produces drawings that appear to think and make decisions and act of their own volition; it is what creates the illusion of life. No other studio has been able to duplicate this most important (but least understood) element in our films. It cannot be produced with money alone.'

(The Illusion of Life: Disney Animation, Ollie Johnston and Frank Thomas.1981)

Even though it is still the Disney team producing these fully 3D productions, I think maybe they have been bitten a little by the bug of computer technology. I think after seeing the success of child company Pixar in the industry, Disney have decided they want to get back in the game, and the only way to stay in it, is to 'update' their style. However, as explained in Animation World Magazine,

'There is still lots of room for collaboration between 3D and 2D animators. At DreamWorks, 3D and 2D artists are working side by side in every department, from layout through animation. As software developers and animators continue to work towards a more classical approach to digital animation, the future also looks bright for hybrid 2D/3D productions.'

(Animation World Magazine. Issue 2.5, August 1997)

My personal belief is that these hybrid 2D/3D productions need to make a come-back. I think the market doesn't need another fully computer animation based company, it would do much better bringing in new innovative mixtures of current styles and styles gone by. I believe this innovation will put them back on top.

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Disney Erases Hand-Drawn Animation

BY JOHN CANEMAKER

Tuesday, August 9, 2005 12:01 a.m. EDT

(http://www.computerarts.co.uk/in_depth/Opinion/bad_omen_for_cg_features)

Bad omen for CG features

([Animation World Magazine](#), Issue 2.5, August 1997)

2D and 3D: Together For The Better

by Sean MacLennan Murch

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7. Appendix