Animation for Games

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Preface

The work for this bachelor’s thesis was performed between the 2nd of April and the 31st of May in 2007, at Sweden’s largest game-developer Digital Illusions Creative Entertainment, hereafter known as EA Dice. The objective of the work that was conducted was to aid EA Dice in the development of a facial rig that is going to be used in the animation-pipeline of an upcoming game-title.

I would like to thank the people responsible at Dice for giving me this chance and employing me as an animator.
Abstract

This report will revolve around two things. What makes up a good facial rig, from an animators point of view, and the difference in workflow, and principles, between animation for games and animation for film and/or commercials.

The main part of the thesis is concentrated around the facial rig-task given to me by Dice. What they wanted me to do was to aid one of the technical animators, in charge of actually building the rig, in finding out what actually makes a good rig, in terms of UI. Having an animator present to help out in conveying the interests from animators, in terms of improving the workflow, will greatly enhance and improve the rig from start, instead of finding out later if the rig is sufficient or not.

The way I achieved this was mainly to research different kinds of rigs, whether they were free rigs downloadable from the internet, or retrieved from books on the subject. Once my research was complete I would then distill it down to a couple of points and features that I liked and that would be incorporated into the rig itself.

As an appendix to this thesis I will try and convey the difference between animation for games and animation for film, pointing out the major departures in terms of the classic animation principles as well as the differences in teams and workflows.
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Facial Rigging

Introduction

Background
Dice is Sweden’s largest game-developer, owned by Electronic Arts, with over 240 employees. They’re most known for the internationally acclaimed Battlefield-franchise. The company is situated at Katarinavägen, near Slussen, in Stockholm.

I was hired by them as an animator, and one of my first tasks was to help them in the development of a facial rig, that is going to be used in the animation-pipeline of one of their upcoming games. As an animator I would give input and ideas for the user interface (UI) so that workflow could be at an acceptable level.

Since I’m under a non-disclosure agreement I will not reveal the nature or content of the game being developed, in this report. I will however explain the research and methods of how I went about finding an acceptable solution for a user-friendly yet powerful facial rig.

Potential problems
One of the demands from EA Dice was to keep the level of complexity of the rig down, while still maintaining a high level of flexibility. The point of this is to allow new employees to quickly become comfortable using the rig, and still give them the tools to produce high-end animations.
Methods and Theories

Research
The research I performed to accomplish the task at hand, mainly consisted of looking at existing rigs, both on the internet and from books on the subject. The two major sources was www.highend3d.com and the book Stop Staring written by Jason Osipa. The first of the two has some of the most popular free rigs that can be found online, available on their site, and downloading and investigating some of these became one of my key areas of focus.

Free rigs
Three distinguishable types or groups of rigs was apparent; pure facial rigs, made specifically for facial animation; rigs that concentrated only on body movement; and all-round rigs, trying to satisfy both previous kinds.
All of them, more or less, accomplished being functional but very few of them had a good, or even half-decent, user-friendly interface. Confusing and excessive controls were common for most of them. What I ended up doing was to write down the few golden nuggets of features that I liked about the rigs.
The most interesting features was the ability to turn the visibility on or off, as can be found in the Generi “blue guy”-rig made by Andrew Silke (www.andrewsilke.com), and an interface constructed in the shape of a stylized face, found in the Ollie-rig created by the Jugglers animation team (www.jugglersanimation.com). [1]
Figure 1: The gray arrows, above each UI-element, switches that element off.

The ability to turn controls on and off, allows the animator to concentrate on one aspect of the animation at a time. Usually expressions in the face are animated first as a part of the posing of the character, and once that is done lipsynch is put in. The reason for this is that if the synch is put in first it can detract attention from the rest of the body. Another reason is that, when a producer or director sees lipsynch in an animation, they subsequently believe that the animation is complete and not in a work-in-progress phase, which can lead to unwanted and unnecessary misunderstandings and discussions.
Figure 2: Having the UI in the form of a face is usually a sure way of ensuring the clarity of the setup.
The other area of focus in my research was Jason Osipa’s book Stop Staring. His book is generally seen as a fundamental handbook for facial rigging. It covers modeling, rigging and animation. Listing the entire bulk of useful information that can be found in this book is impossible so I will just touch on the main points. [2]

Important to note at this point is that Osipa uses blendshapes to build his rigs and the same technique is used by EA Dice’s in-house riggers. Another technique is bonedriven deformations, which I will not address in this report.

Two important things can be extracted from Osipas rigs. The UI, and his lipsynching setup. The UI is constructed so that the number of controls are objects existing in the workspace rather than numbers in the channel box (Figure 3). These controls consists of multiple squares with a controlobject in the middle of each square. These controls drive the blendshapes with the use of driven keys and expressions. Each extreme point within the square represents the extreme blendshape that can be shown without it becoming distorted or unrealistic. This is important because if the control ceases to power a blendshape somewhere in the middle of a square, and if the f-curves in the graph editor accidentally overshoot, it will result in a facial equivalence of the ik-pop. Since the control will still be within the control-square, in this case, the animator won’t necessarily understand where the pop is originating from.
This UI is very powerful, when the animator is familiar with all of the controls, but it can take some time to reach that point.

The lipsynching-system Osipa uses is different and powerful. Instead of using what he calls phonemes, ie blendshapes consisting of pronunciation of letters and sounds, like ee, a, oo, m, f etc, he uses fewer controls to operate the jaw and lips. Jaw open/close and left/right, and individual controls for the lips, like upper lip up/down and in/out, to create for instance, f and m mouthshapes. This is both fast and intuitive.
Various solutions

At first we had the eyes on a control, similar to the rest of the face, but we found out that getting the eyes to look at a certain spot in space became difficult and tedious, and that having a look-at control would be better. Another aspect often overlooked when it comes to eyes is the “fleshy eyes” blendshapes. When someone looks around the room, the eyelids, and the portions around the eyes, moves in conjunction with the eyes. This is extremely important to include in cg-faces to help sell it.

When it comes to the lips there’s another thing people tend to forget. It’s something we call “sticky lips”. When a person talks, the corners of the mouth rarely separate entirely. This control makes the lips go towards each other while the mouth is open. This can come in handy when the character is chewing gum for example, and is essential to eliminate the feeling of a ventriloquist-dummy.

A thing we did with the eyebrows was to put them on the same control, because when a real human moves one eyebrow up, the other tends to rise a slight bit with it. Very few people can move them completely independently of each other and even then they probably wouldn’t do it when they were in a normal conversation with somebody. A common mistake some animators do when animating the eyebrows is to over-animate them. In a normal conversation people don’t use the eyebrows much, and they are more a result of the overall body-language, and should be used like such. Accentuations can always be used of course, to enhance a sentence or emotion.
**Result**

At the time of this report the rig has not yet been built but here’s the solution we will finally go for. We will have the UI in the representation of a face that consists of curves and similar controls. We will place the entire UI in a separate window apart from the main workspace to avoid cluttering of the scene. We will also implement a turn on and off function for certain controls.

Here’s a list of the controls we decided to implement:

- Eye brows
- Brow emotion
- Eyelids
- Eye Squint
- Lips (purse and in/out)
- Mouth emotion (smile/frown)
- Top lip (up/down)
- Bottom lip
- Left/Right Mouth (moves mouth side to side)
- Jaw control (up/down left/right)
- Lip close (“sticky lips”)
- Touunge (left/right up/down)
- Flare/Blow (flare the nostrils, or blow out the cheeks)
- Eye look-at control

We originally set out to do a rig consisting of no more than 12 controls, and we came pretty close with 13 not including the eye look-at control, since that is usually not a part of the face-rig itself.
Discussion

Strengths
Having the UI in the representation of a face, makes the controls understandable, intuitive and instantly readable. The separate window makes having multiple characters, in a cutscene for example, more easily animatable since you won’t have to deal with a separate interface for each of the characters in the scene. It also makes the workspace less cluttered.

As far as the actual functionality of the controls, we have all the controls we need to make the animations believable, yet they are few enough to make it comprehensible.

Weaknesses
The solution with the separate window also lengthens the iteration-time marginally, since you have to move out into the main window to change frame and set keys etc. It’s a minimal problem but can still potentially cause some frustration later on in the project.

Possible changes
A problem like the one mentioned above can easily be fixed by putting in a “set key”-button somewhere in the interface itself so that one doesn’t need to go into the main workspace constantly just to set a key.
Summary

One conclusion I have drawn during this assignment is that rigs can basically look anyway you would like. What it all comes down to, is how fast you need to become acquainted with the rig, and how much time you want to spend animating it. Some rigs I looked at had so many controls, organized in such a chaotic fashion, that it was hardly worth the effort of even trying to understand it. That’s why user interface is really important. When it comes to games you really need a fast and small, yet complex rig, since the production time is fairly short in comparison to film. Someone spending three months on a scene in a movie-production has the time to delve into a large rig, but sometimes it can cause a problem even there.

On the production of King Kong for example, the facial setup of Kong had something like 96 controls, and in the hands of an experienced animator, the animation can become marvelous. This is not only because he is a good animator, but he knows he doesn’t have to animate every single control. In the hands of a less experienced animator, the result can be atrocious, simply because they over-animate the rig.
Referenser

[1] Highend 3d
http://www.highend3d.com


[3] Principles of Traditional Animation Applied to 3D Computer Animation
http://www.siggraph.org/education/materials/HyperGraph/animation/character_animation/principles/prin_trad_anim.htm
Appendix A

The difference between game- and film-animation

For the casual observer animation for games and for film can seem similar, but one who has observed both worlds, knows that this is not always the case. The workflow and techniques are the same but everything around the animation itself has changed, and even within the animations things are starting to differentiate. I will now give you some examples of these differences.

The Team

Naturally the teams are different from each other. From my own experiences, working at a game-developer, I’ve noticed that when working on a game the animator is dependant on more people, and you have to rely on other members within the team, that can take your animations and put them to good use within the game. A constant collaboration between audio-artists and programmers is necessary. Both useful discussions and outright verbal battles are fought on almost a daily basis.

In the supervision-structure things change as well. The lead-animator is the crucial link between the animators and the producer along with all of the designers. This usually gives the animator a greater chance in affecting the animations themselves, since direct contact with the designers is a possibility and the chain of command is generally shorter. In film however, the director has a very clear vision and between him and the animators is a long line of supervisors, with their respective supervisors, that all have opinions on your animations. I spoke to an animator that worked on both King Kong and Gollum in Lord of the Rings, and according to him, at the end of production he felt he could no longer claim to have animated at all, since so many people interfered with his animations. The exception to this is in commercial work where more direct contact with the director is possible, thus extending the opportunities for affecting the end-result.
Methods

In games you work with clips, tracks and curve-files, while on feature films you work in scenes or shots. One exception to this is of course that in games you can also work with cutscenes which makes it similar to film.

This seriously affects the time spent, animating each section. While an animator working on a film can sit with a single scene for three months or more, a game-animator spend a couple of hours on each iteration of a clip. This is mainly because the latter depends on more people and more importantly the code and system to get the animation into the game, where it can be tested more thoroughly. The animations are usually created in a mock-up fashion so that the coders have a placeholder with which the code can be created. Later on in the production-timeline iterations are made an the animations become more refined as the project progresses.

In film the scenes that are animated needs to go on to receive lighting, effects and ultimately rendering. Thus it is necessary to finalize it as soon as possible so that the production-process isn’t halted.
The elimination of principles

In computer-games there’s a wholly different approach to animation when it comes to the classic animation principles written down at Walt Disney Studios. These are as follows [3]:

1. **Squash and Stretch** - defining the rigidity and mass of an object by distorting its shape during an action
2. **Timing and Motion** - spacing actions to define the weight and size of objects and the personality of characters
3. **Anticipation** - the preparation for an action
4. **Staging** - presenting an idea so that it is unmistakably clear
5. **Follow Through and Overlapping Action** - the termination of an action and establishing its relationship to the next action
6. **Straight Ahead Action and Pose-to-Pose Action** - The two contrasting approaches to the creation of movement
7. **Slow In and Out** - the spacing of the in-between frames to achieve subtlety of timing and movement
8. **Acrs** - the visual path of action for natural movement
9. **Exaggeration** - Accentuating the essence of an idea via the design and the action
10. **Secondary Action** - the action of an object resulting from another action

Points number 2, 6 and 8 are general animation techniques and are always present in any kind of animation, so I will not cover them. Some other principles are almost omitted entirely though.

**Squash and stretch**

This is a principle that hasn’t really made it’s presence known in many games, though it’s starting to pop up in more cartoony games mainly aimed for a younger audience. I imagine some of the old 8-bit games used it quite a lot since they weren’t dependant on the limitations concerning computer graphics but instead relied on pixilated art.

**Anticipation**

Anticipation usually cannot exists in game animation since gameplay is involved. If the player presses the jump button he wants the action to be instantaneous and not wait around for the character to bend his knees before he jumps. The same thing applies to a weapon being fired. In a classic 1st person shooter for instance, on frame one of the firing animation the gun has already kicked back, to create the feeling of instantaneous response.
Staging

Staging becomes rather difficult in games as well since most of the time the characters can be seen from all angles. What one tries to do instead is to make the action clear from all angles and from quite a long way away.

Follow through and overlapping action

This is another gray area, since every action the player makes is up to him, and every action has its own animation. So overlapping and follow-through can prove to be difficult to implement. Gameplay affects this as well, since you rarely want to wait around for an animation to finish in order to be able to do the next action. Of course sometimes this is exactly what you want, like in a reload-animation for instance.

Slow in and out

Making the action slow in and out is not a good thing in games since most of the animations are dependant on the previous ones. If the animations are slowed in and out constantly it would interrupt the flow of the animations. A walk-cycle loop is a good example of this.

Exaggeration

Same thing applies here as in squash and stretch. You could do exaggerated movements, like in a very stylized game for example, but it is rarely seen to any extreme extent. In multiplayer games some forms of exaggeration are made so that one players actions can be interpreted from a long ways off.

Secondary action

Another thing that is entering more and more in games is secondary action. These can be done either in the animations or with the help of physics. For example, grenades hanging off belts can be animated, while blowing up a building would be done using a physics-engine.
## Appendix B – Wordlist

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blendshape</td>
<td>A collection of duplicate models, that drives a second model.</td>
</tr>
<tr>
<td>UI</td>
<td>User interface.</td>
</tr>
<tr>
<td>Rig</td>
<td>A modeled surface affected by a skeleton or blendshapes</td>
</tr>
<tr>
<td>IK-pop</td>
<td>When a joint is being pulled out to its extreme and suddenly snaps back into place.</td>
</tr>
<tr>
<td>IK</td>
<td>Inverse kinematics</td>
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