Innovations Report

Resources aimed at Head Creation

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Abstract

The overall goal of this project is to create resources aimed at artists that will improve their ability to create believable photoreal heads and try and cut the amount of time taken to do so.

To achieve this goal the project has been split up into two distinct parts, the first part is the creation of an extensive workflow tutorial which looks at an overview of the techniques necessary to produce high quality facial character work and makes recommendations aimed at artists based on which workflows may work best for them for a given project. As a testbed for research and as a tool for testing the validity of the techniques used a photoreal head will be created alongside the tutorial document.

The second part of this project is a head creation tool which aims to automate and provide high level controls of some of the more tedious and repetitive tasks involved in head creation, providing a flexible anr powerful system for quickly generating content, freeing up artists to use their time more creatively and efficiently.

How I approached this project

The development of this project has been quite a fractured one due to the way it was initially structured. My original intention was to focus on a blendshape plus displacement based head generation system but after a relatively short period of time I decided to shelf this idea and instead work on writing a tutorial on head creation. However, after working on the tutorial for a while I decided to try and briefly finish off the work I had started on my head generator and have it as a side project. Despite these intentions I discovered that if I dropped the displacement component of my head generator the tool actually became feasible to develop and then I found myself in the unenviable situation of running two projects in parallel.

My reasoning for doing an in depth tutorial on head creation is that I have spent a large part of the last two years looking into character creation and have done a lot of research in this field. The main problem I have found is that although there are a lot of very experience and talented artists out there sharing their techniques there is a distinct lack of a centralised resource. It is perfectly possible to spend time visiting many different bulletin boards picking up various nuggets of information here and there but I always felt surprised that no one had tried collecting it all in one place and writing an in depth document on it. It's from this prolonged period of frustrated research that I decided that if no one else was willing to put the information together then I might as well try and do it myself.

The idea for creating a displacement based head generator was largely inspired by this image:

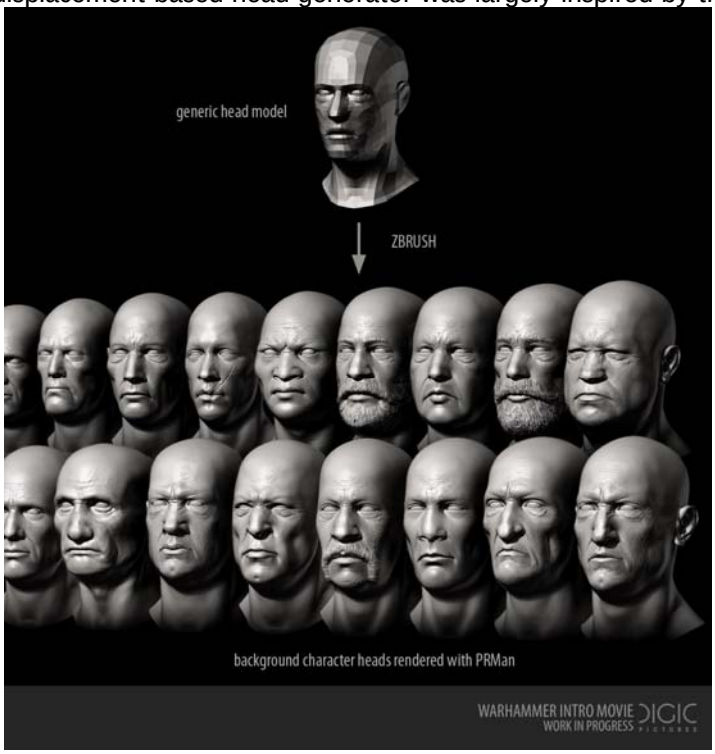

Figure 1.1 *Example of multiple background character sharing the same base mesh*

This, combined with some reading up into how Pixar created all their background characters out of one "Generic Man" in *The Incredibles* led me on the path of a head generation tool. The main thing that intrigued me about such a tool was the way that a seemingly infinite range of output characters could be made from a given set of inputs. I was interested to see what base shapes were required and how many output heads could be created from a given phase space of base heads. However, the main initial stumbling block with this project was the creation of high resolution displacement maps per face type which greatly slowed down my workflow. I instead decided to go for a purely blendshaped approach to head generation which removed a lot of the bottleneck on content creation. At the time I was doing a lot of research into head topology for my tutorial document so I was able use the knowledge I was gaining there to create a highly flexible base mesh for all my blendshapes.

Using this base mesh I was then able to go back to my tutorial document and begin creating my reference head, for this I chose to do a photoreal female head as it is good stress test for accurate modeling and texturing, to create a female that appears attractive requires a great deal of subtlety and control in all areas of the pipeline. While doing the character modeling most of the techniques came from prior experience or from scattered/lost sources, one of the only real sources that I can confidently say was a large influence in the work I was doing was a topology research thread with spawned many different opinions and contributions: http://forums.cgsociety.org/showthread.php?t=108412. By and large though the majority of decisions I was making were based on my own experimentation rather than extensive academic research.

From this point I experimented with adding different face types to my head generator and trying to work out what kind of shapes combined together in usable ways. I created a base set of shapes for parameters like age or fatness and then began adding tweak level controls which operated solely on smaller areas of the face allowing the user to make fine adjustments. Once I had a sufficient amount of blendshapes created I implemented a simple but functional GUI system in MEL which allowed the control of all attributes in one easy window.
With my tutorial I then proceeded to experiment with texturing and shading techniques. I successfully managed to implement a workflow I had planned for quickly and easily creating bump, colour and specular textures without the use of any photo resources. From here I then began reading up on different approaches to rendering skin, I found that some of the realtime approaches to skin were of particular interest and found whitepapers of nVIDIA and ATi skin implementations to be very enlightening. I tried many different approaches to rendering skin including conventional layered shading and Mental Ray Sub Surface Scattering. After extensive testing I couldn't conclude a particularly superior technique so I decided to use a hybrid post heavy technique as the preferred choice for continuing my tutorial.

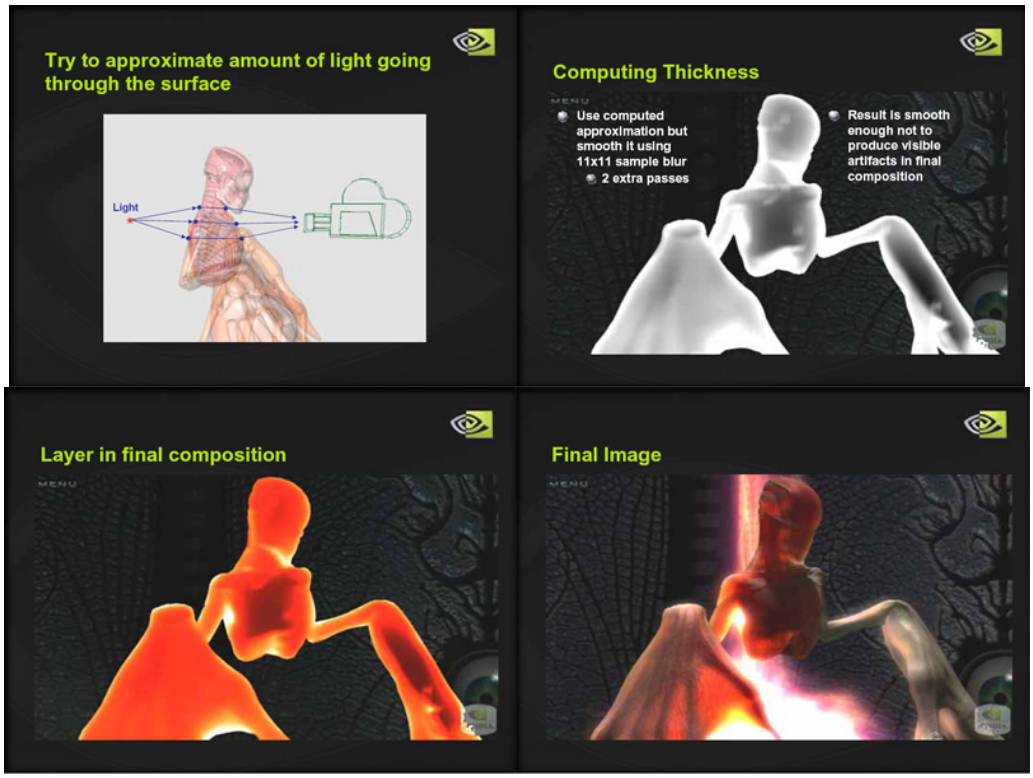

Figure 1.2 *- An example of a realtime based translucency approximation proposed on a nVIDIA white paper*

Based on some initial feedback of testers of my Head Generator tool the ability to blend between facial expressions became a priority. Theoretically speaking if all targets share the same mesh it should be possible to create one facial rig which can drive any morph target completely believably. I decided to stick with blendshapes for my facial rig and went for a very similar approach to that outlined by Jason Osipa in his book *Stop Staring*. Implementing these facial shapes took a fair bit of work but the animations dropped in fairly painlessly. Coupled with some improvements in GUI control and the addition of elements like eyes and teeth my head generator tool was now completely functional and fully supported animation between different head morphs which should be considered a bonus based on my initial goals for the tool.

The final stages of my tutorial ended up being more hurried than I would have liked and due to the extra time that my head generator was taking up I had to cut numerous sections from my tutorial. On reflection this was probably for the best as despite having an initial target of 8,000-10,000 words my tutorial ended up being 19,000 words despite missing large sections of planned content.

One important thing to note about both my Head Generator and my Tutorial is that both items are intended as resources for artists rather than computer scientists. As such the emphasis is on practicality and ease of use for the head generator and a rather less formal and more direct writing style in my tutorial than would normally be expected for an academic research paper.

Feedback Received

An important part of my project as a whole is the fact that I am making resources for other people, therefore the only real way to gauge the success of the project is to see how people use and react to these resources.

With regards to my head generator feedback has been generally very positive, generally there have been a lot of feature requests, some of them feasible which I have accommodated and some a bit grander which I have been forced to ignore. Amongst these are multiple requests for a full body generator which is something I am going to ignore for now but possibly consider looking at after graduating if I find I have enough spare time. One problem I did have when trying to get feedback was some initial confusion caused by me moving the goalposts of the tool, at first it was just a tool for speeding up the initial modeling stage, then it was a tool for fine detailing and tweaking heads, then it was a tool for animating them too. A lot of people didn't seem too sure exactly what the tool did which is something I should have made clearer.

Assessing feedback for my tutorial is somewhat harder as it was finalized at a later stage in the project and at the time of writing I haven't been able to collect a great deal of feedback. However, what I have received has been greatly positive and has confirmed that I have accomplished my initial goals for the document.
" You seem to cover just about everything, and in a huge amount of detail. An excellent resource for anyone who knows about the buttons but wants to know more about the art of using them."
This quote is very satisfying for me as not only does it indicate that the breadth and depth of material covered is appreciated but also that the majority of content is pitched at the right level, it was never my intention to explain in detail how tools work, more just indicate tricks and techniques to make the most of them.

How I would take it further

I am in the reasonably fortunate situation that both of my products have been well received and both have plenty of scope for being expanded upon as and when I see fit. As part of the time constraints I was under I had to cut a lot of material from my tutorial on things like hair systems and creation of eyeballs and teeth. These could be reinstated at a later date and I have the option of expanding the modeling to areas like the neck, the torso or maybe even the full body and then if it is appropriate I can always go more into facial setup and animation. As the tutorial will be displayed as a series of online HTML pages the updating process should be relatively painless and I am under no real time constraints as to when it should be done.
With regards to my head generator there are two real options for expansion. The first would be to refine the system I already have, by and large I have more or less enough blendshapes to do just about anything, however some of these could be made quite a lot better and would benefit from some fine tweaking. The other option is to really go for something big and try and implement new features like going for the full body or possibly looking at some kind of automatic shader/texture setup.

As I am currently only up to version 0.41 and have a reasonable amount of existing users there is a lot of scope for continual gradual adjustments, plus I can always ask around and see what features people believe are the most important.

Link to Head Generator development thread:
http://forums.cgsociety.org/showthread.php?t=319571

Conclusion

Due to the unusual origins of both of these separate projects my planning and structuring overall has been less than optimal. Both projects increasingly ballooned in scope and I had to make a few compromises in how far I could go in each area. However I am very happy and proud with the end result of both products and I believe that when both are considered together I have accomplished all of my initial goals.
The only real hurdles I've come across have been planning and time related, technically speaking both products have had a fairly smooth development. The only real area of disappointment was the brief time I spent looking into Maya Hair for my character, after a relatively short period of initial testing I decided it wasn't worth taking it any further as I couldn't see any useful results being achievable without investing a lot of time into something that was a secondary goal.

If I was to attempt the project again then I would definitely try and plan my time more effectively, and if I was to do another 2 product hybrid project then I would definitely try and limit one to give me more time to work with. Although I feel I have been able to complete both to a satisfactory level I am aware that it has had a negative knock on effect to the time I have been able to spend on my major project. Hopefully this is a recoverable situation though.

Despite all this I am glad that I have been able to complete two products to a high level of polish and I am genuinely hopeful that other people will be able to put the work I've done here to good use. It's been satisfying to try out techniques I've been thinking about for a while and bring lots of ideas together in one place, there's also the bonus that a large chunk of these approaches worked pretty well. The end result of my head for my tutorial is about as well polished as I could have hoped although I still intend to take this further, animate her, add hair and then write about my experiences. I am also pleased that as it stands both products could still be expanded more or less indefinitely.

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Figure 1.1

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Figure 1.2

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