

8-2011

# INTEGRATING PIXOLOGIC ZBRUSH INTO AN AUTODESK MAYA PIPELINE

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INTEGRATING PIXOLOGIC ZBRUSH INTO  
AN AUTODESK MAYA PIPELINE

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A Thesis  
Presented to  
the Graduate School of  
Clemson University

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In Partial Fulfillment  
of the Requirements for the Degree  
Master of Fine Arts  
in Digital Production Arts

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by  
Micah Carter Richardson Guy  
August 2011

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Accepted by:  
Dr. Timothy Davis, Committee Chair  
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## **ABSTRACT**

The purpose of this thesis is to integrate the use of the relatively new volumetric pixel program, Pixologic ZBrush, into an Autodesk Maya project pipeline. As ZBrush is quickly becoming the industry standard in advanced character design in both film and video game work, the goal is to create a succinct and effective way for Maya users to utilize ZBrush files. Furthermore, this project aims to produce a final film of both valid artistic and academic merit.

The resulting work produced a guide that followed a Maya-created film project where ZBrush was utilized in the creation of the character models, as well as noting the most useful formats and resolutions with which to approach each file. A concrete method of moving files back and forth effectively from Maya to ZBrush was documented. Given the short time that ZBrush has been in use, such a consolidated guide may prove useful to anyone producing a small-scale production while maintaining quality visuals.

## **DEDICATION**

For my parents, Randy and Yvette, to whom I owe more than I know, to my steadfast friends for putting up with my sarcastic weirdness, and to Angela, the comfort on which I have fallen back for three years.

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## CHAPTER I

### INTRODUCTION

Pixologic's ZBrush is a particularly powerful program that gives the classically trained artist a powerful tool to craft three-dimensional design work. ZBrush represents a three-dimensional mesh as a canvas. The sculpting tools are interpreted as brushes in a way similar to Adobe Photoshop.

Unfortunately, ZBrush is still largely underused in many facets of design due to a lack of familiarity by traditional computer graphics artists with more technical backgrounds. Additionally, ZBrush often does not have a set place in a production pipeline due to its relative freshness to the industry. This thesis aims to rectify these issues by refining, analyzing, and determining a suitable point for ZBrush to fit into a standard production pipeline.

Given ZBrush's rising popularity thanks to the recent successes of films such as James Cameron's *Avatar* and video games such as Epic Games' *Gears of War* series, ZBrush is becoming the wave of the future in both movie and game artistry [Petr07]. Sadly, in many corners, ZBrush is largely ignored in favor of solely standard Maya sculpting methods and texturing [Wade05]. In terms of pipeline, the program simply has no set place, alienating those with stronger arts backgrounds. The situation is a pressing problem and displaces artistic talent from which the industry as a whole could benefit.

This project attempts to rectify the noted problem by documenting the author's process of creating a short film that utilizes ZBrush as a critical part of the pipeline, and by also documenting some variations thereupon that may prove useful in the future. The chapters that follow provide a step-by-step walkthrough of defining and utilizing ZBrush files in Maya, as well as a related description of the film itself, including its development and inspirations. Chapter II gives an introduction to the tools used to produce the film as well as the origin of the film, while Chapter III covers the workflow itself. Chapter IV reviews the ZBrush process, Chapter V documents the results of the project, and Chapter VI details the conclusion as well as possibilities for expansion.

## CHAPTER II

### RESOURCES AND BACKGROUND

Even a small computer animation project requires a plethora of resources including traditional pencil, ink, and paper. The two main software packages used were Autodesk's Maya 2008, the industry standard for creating computer imagery, and Pixologic's latest edition of ZBrush, version 3.5. Adobe Photoshop CS3, a remarkably powerful paint program, was also used in conjunction with a Wacom tablet to achieve the painted backgrounds of the film. Post-production called for two more software tools, Acoustica Mixcraft 5, a Windows music creation program equivalent to Apple's Garage Band application, and Adobe After Effects CS5, a film editing suite.

This project made extensive use of normal maps, for which no concise guide exists, and displacement maps, which are explained thoroughly in *The ZBrush to Maya Displacement Guide* [Spen09]. While the latter guide is highly useful, it is largely written from a ZBrush perspective and does not address many minor issues within Maya. The guide is also written on the assumption that the user has much more familiarity with the deeply nested and more technical features of ZBrush, which is simply not the case for most. Further, the displacement guide deals with UVs in more of a cursory way than with exact specifics in Maya or ZBrush, which can prove problematic. Finally, while a less developed Maya pipeline guide existed, it has been off-line for quite some time

as of this writing. Our project, however, aims to address these issues and to construct a competent guide with the documentation of a full production as framework and inspiration.

## CHAPTER III

### DESIGN AND WORKFLOW OF *TERMINUS*

To show exactly how ZBrush can be integrated into a pipeline, the entire production process is presented below. The entire pipeline as utilized in *Terminus* is described, from story staging to technical design to post-production. Finally, challenges of the production are covered.

#### 1) *Story concept*

The idea for this thesis originally arose from a story pitched in 2008 revolving around the reimagining Dante Alighieri's Divine Comedy [Alig03], where each car of a train represents a circle of Hell. The nameless protagonist, an analog to Dante, ventures forward through the cars in pursuit of a shadowed figure that passes just by the edge of his field of view. This figure is a representation of Virgil, who leads the protagonist in an indirect manner, as opposed to direct guidance in the original. This "Virgil" is a much darker figure that belongs to the train itself rather than some other plane of existence. The climax of the story is the protagonist's sudden view of the classical Divine Comedy rendition of the monstrous Lucifer from the window of the final car, as revealed by a seated "Virgil."

While the Divine Comedy ends on the note of Virgil and Dante scaling Satan to escape the depths of Hell, a recreation of this act is not an option

due to the ambivalent nature of “Virgil” and the distance from which Lucifer is viewed. This outlook originally led to a more metaphorical ending.

The script itself was originally written in the form of a screenplay and expanded upon over time. Roughly three iterations were created before being pared down during storyboarding due to length and technical concerns.

## 2) *Manual Design Work*

This step entailed the creation of the actual visual design of the entire piece. In terms of character design, some guidelines were set before proceeding. The protagonist himself had to have expressive features as the film is silent (see *Figures A.1-A.6*). The “Virgil” character must have an air of foreboding and darkness about him (see *Figures A.7-A.10*). Lucifer must have the basic characteristics outlined in the Divine Comedy, such as impotent wings and three faces.

Lucifer’s appearance was expanded upon by making his body asymmetrical and his faces representative of something outside of humanity. The exact species from which these designs were extrapolated remains vague, aside from the required humanoid visage. The mammalian head is a combination of a canine profile with bovine features, while the avian head is a cross between something saurian, reptilian, and bird-like (see *Figures A.11-14*).

### 3) *Storyboarding*

Storyboarding commenced in the standard fashion with general thumbnails created first. These thumbnail sketches were fleshed out into full frames and then a finalized sequence. The ending was an issue from the start of the project. The original draft of the storyboards was drawn as an experiment as to the type of ending the film might support. The sequence was intercut with scenes of surgeons slowly coming into focus throughout the film, as if the train were representative of the protagonist's journey back to consciousness on an operating table after a catastrophic event. Ultimately, these boards were left unfinished as they were overly optimistic and did not match the tone of the existing idea. As the protagonist is heading towards worse events on the train, it only seems logical that his wellbeing should be in a state of decline.

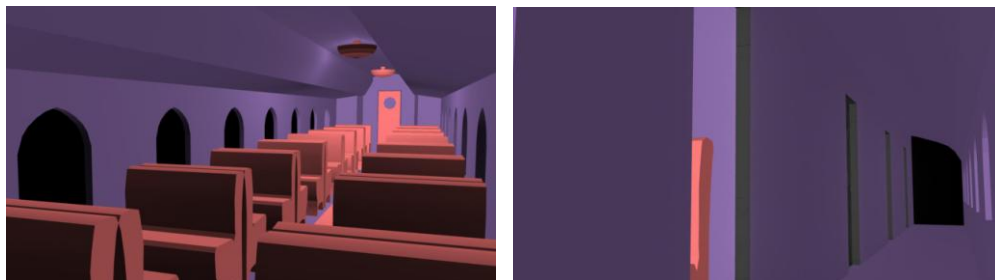
The near-final boards put forth the idea that the protagonist was travelling down a dark path ending in a chemical overdose in reality with hallucinations. The drug on which he overindulged was contained in a bottle bearing a logo suspiciously similar to "Virgil." As production proceeded, that finale was deemed overly complicated. The final ending is more literal and showcases Lucifer's design and model work.



#### 4) Method and Visual Design Decisions

The first concern pertained to the three-dimensional character designs. In keeping with a stark, Victorian artistic style, the figures' limbs, digits, and facial features were long and angular. The best way to utilize ZBrush in creating this style would be to draw out a harsh contrast on exposed flesh. A painterly approach was deemed best for the film.

The project shifted from the idea of sculpting and rendering everything between Maya and ZBrush to utilizing only those two packages for the character models while painting the backgrounds in Adobe Photoshop CS3. Furthermore, rough environments composed of simple boxes and shapes in Maya were built to model how the light would fall across the characters (see *Figure III.1*). A high resolution screenshot was taken and moved directly into Photoshop for use as a canvas.



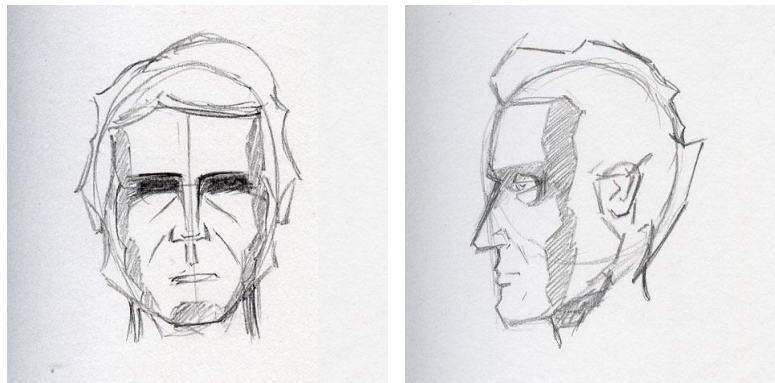
**Figure III.1** – Proxy sets for the train cars, color-coded to aid in painting.

A selective grayscale approach allowed for efficiency and created an appealing yet foreboding atmosphere. Only certain objects would feature color, such as the protagonist's eyes, "Virgil's" hat ribbon, and Lucifer.

## 5) Character Model Works

Basic humanoid bodies were modeled for both the protagonist and “Virgil.” The protagonist had a slim and stylized build, while “Virgil” was of a more exaggerated, but concealed, build. Lucifer was far more complex, featuring multiple limbs, heads, and wings, with only a vague resemblance to the humanoid form.

Sketches depicting forward-facing and profile views were used as templates in Maya for sculpting the polygon models (see *Figure III.2*). In Lucifer’s case, the process referenced only the main concept drawing as well as three revised head sketches. Efforts to keep the polygons as quads with as few triangles as possible aided in the creation of simpler UVs. While the majority of the model work for the protagonist and “Virgil” was Maya-based, Lucifer was handled differently. Lucifer’s basic model was built in Maya to maintain correct proportions and limbs, then imported into ZBrush.



**Figure III.2** – Original forward and profile sketches of the protagonist.

## 6) ZBrush Method Usage

ZBrush was used only on the exposed flesh of the characters. The face, hair, and hands of the protagonist were painted within ZBrush, but only the face and hair of “Virgil,” since his hands are gloved. Lucifer was largely created in ZBrush, with the original dummy model exported from Maya as an OBJ file, then sculpted at a high subdivision in ZBrush. Ultimately, the Lucifer model was reduced to a low polygon count and exported from ZBrush as an OBJ file with a normal map that captured all of the high-resolution details. For more detail, refer to *Chapter IV*.

## 7) Rigging

Two different character rigging methods were performed given technical limitations noted later in this chapter. In the first method, the rigging was initially split into facial and body categories depending on the shot required. A version of the protagonist’s face was created specifically for use with a Maya facial animation plug-in. This model was posed according to the guidelines provided by the plug-in, which then processed and automatically set up joints and weights. The resulting facial rig was then used for close shots that necessitated emotion or reaction from the protagonist.

In the second rigging method, the body was rigged manually using the skeleton and inverse kinematic tools provided by Maya, with skin weights

painted manually. All three models used the manual method, including Lucifer's more complex skeleton. As these models were created primarily for posing instead of regular animation, correct weight painting was critical.

### *8) Animation*

The majority of the film was animated in still frames, which allowed for attention to detail in the painted frames. Full animation was utilized only in places of high impact, such as those times where setting a mood was important, or at the film's climax. Employing a still-frame format, in turn, led to the incorporation of certain silent film tropes, such as dialogue cards and heavy use of shadows.

### *9) Final Compilation and Sound Design*

A final total of twenty-eight shots were created and compiled into separate folders, which were then imported into Adobe After Effects CS5 and set up on a timeline. A movie file with standard high-definition format of 1280 by 720 resolution was generated. With timing established in the finished file, a musical score could be created. Using Acoustica Mixcraft 5's virtual instruments and chorus, a soundtrack was composed and imported into Adobe After Effects to complete the film. Finally, the film was exported in high definition with completed audio.

## 10) Challenges

The models themselves invoked many limits due to the inherent difficulties of modeling a humanoid figure. The humans were difficult to model using traditional methods; therefore, a two-dimensional profile was used as a template and the vertices were dragged into three-dimensional space [Patc09]. The head and limbs were created in the same fashion.

Two third-party Maya plug-ins, Anzovin's Setup Machine and Face Machine, while useful in certain situations separately, could not be used together on a single model due to peculiar conflicts in weighting. The Setup Machine, a plug-in that automates the body rigging process, is based upon the concept of placing a prefabricated shell of tubes around the existing model, which calculates weights and joint placement accordingly. Unfortunately, the shell was a drastically different size from the models in this project and functioned incorrectly if resized or repositioned. Specifically, carrying out such an action resulted in miscalculation of the skin weights on the character model of the protagonist. Additionally, the Setup Machine plug-in only accommodated symmetrical figures and a limited number of extremities, which prevented its use for the extremely asymmetrical Lucifer model.

The Face Machine, on the other hand, is remarkably useful for humanoid faces such as those of the protagonist and antagonist. The plug-in operates by overlaying a mask of curves on top of the face that

must be rearranged to fit the features underneath, then calculating the appropriate weights and joint systems. On its own, this process worked suitably, but when it was applied to a model before or after it had been run through the Setup Machine, the model's head was locked in place at the origin. This unfortunate problem restricted the weighted and rigged faces to close-up shots, while a separate model rigged via conventional Maya methods was used for all others.

Additional problems arose in exporting the appropriate files from ZBrush and importing them into Maya. The most prevalent was the severe drop in file resolution from ZBrush to Maya. The default resolution for exported normal maps from ZBrush was 256 as opposed to the more modernly conventional 1024. Unfortunately, the option used to increase the size of the texture was listed under UV options as opposed to the normal map or other texture options. Fortunately, the resolution could be increased to 4096 and beyond, which handled all detail well and removed pixelation errors that appeared in lower resolutions. The bare minimum for a satisfactory ZBrush normal map in Maya was 1024, although loss still occurred in subtle details like fine skin wrinkles and papery textures, hence the working resolution for this project's textures was set to 2048 and eventually to 4096, as rendering memory was not an issue. While producing fairly large files at roughly seven to twelve megabytes per PNG formatted texture, the latter resolution worked excellently.

Once the normal map was imported into Maya and set up as a bump map, the rendered detail was wrong. The cause was eventually determined to be in the differing ways ZBrush and Maya handle the red, green, and blue channels in a standard normal map. Maya reads these channels in a different order than ZBrush does under normal circumstances. A single button within ZBrush, which switched the red and green channels before exporting the normal map, proved to be the solution.

## CHAPTER IV

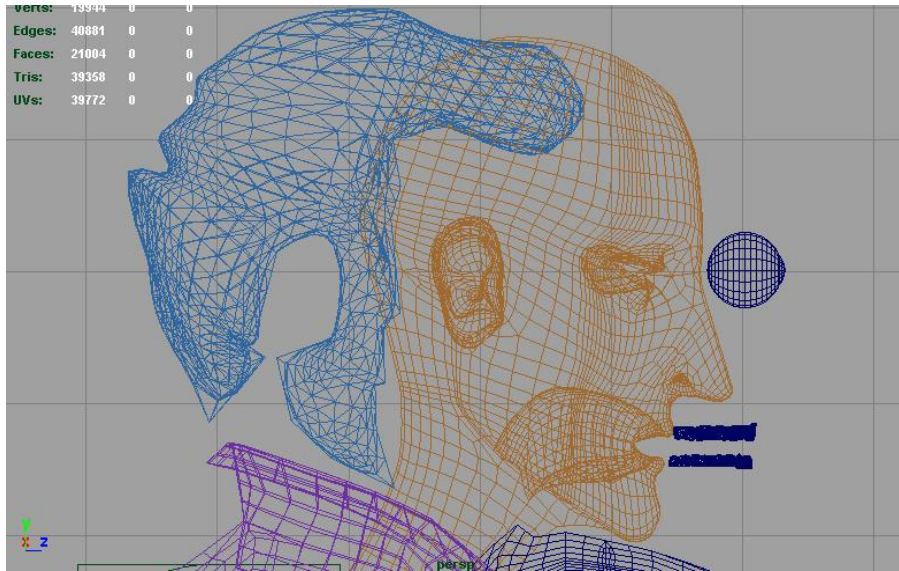
### ZBRUSH PROCESS

A major portion of any production is modeling characters in an efficient and effective manner. Care must be taken to achieve the proper form, along with the supporting structures necessary for testing and lighting. These efforts can be handled well with a ZBrush process, as described in the following steps.

#### 1) *Model Preparation*

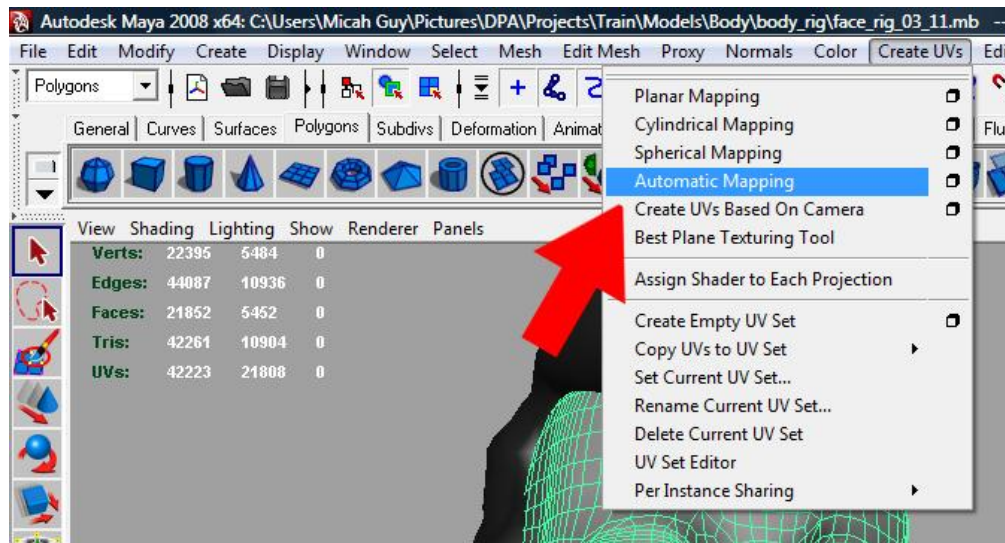
In Maya model creation and preparation, parts of the model using different textures or styles should be separated (see *Figure IV.1*). For instance, hair should be either sculpted as a separate object, or the faces that form the hair be detached from the main object. This separation greatly simplifies the UV mapping, ZBrush sculpting, and texturing further down the pipeline. For models that are entirely sculpted, such as the Lucifer character, creating separate meshes is not required.





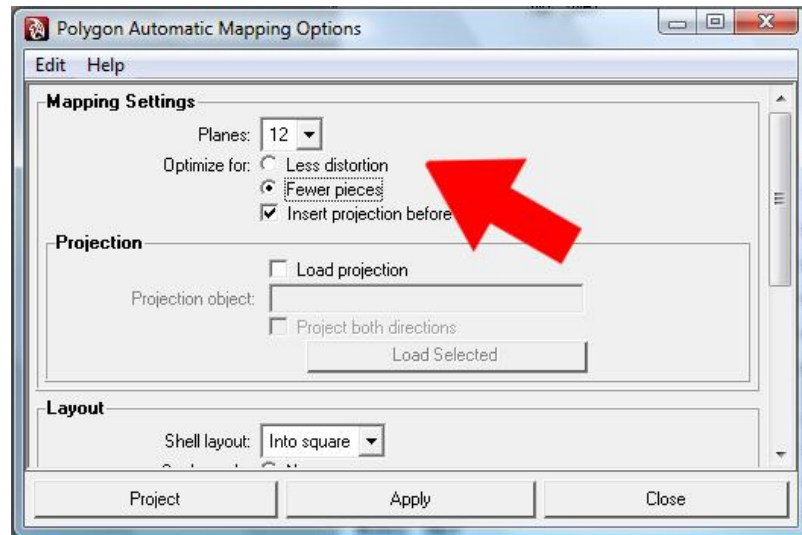
**Figure IV.1** – An illustration of the separation of meshes on the protagonist.

A minor aspect that also warrants attention is that the model be composed of strictly quads and triangular faces. When imported into ZBrush, any non-standard face may be split in ways that are potentially undesirable, although ZBrush provides notification first. After the base character model in Maya is complete, the UVs must be handled next. Modelers tend to handle UVs differently, but for the purposes of this project, “Automatic Mapping” will be used (see *Figure IV.2*).



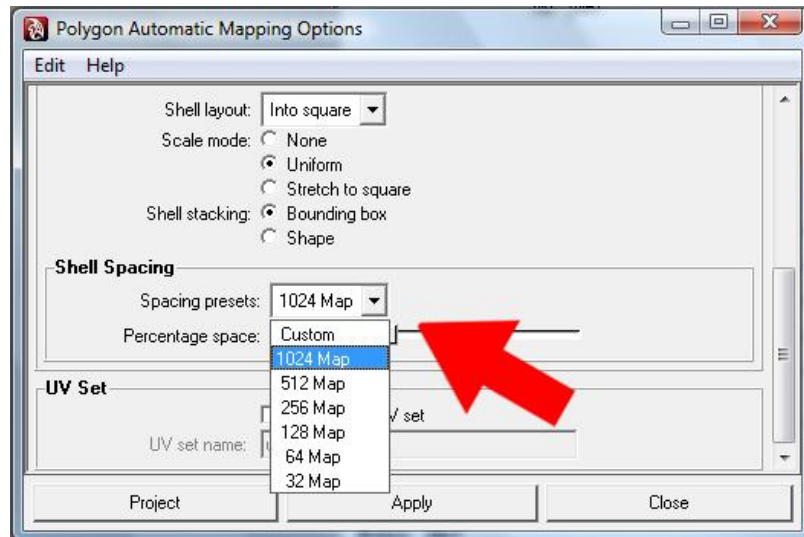
**Figure IV.2** – Automatic Mapping is found on the Create UVs menu.

Clicking on the option box next to Automatic Mapping brings up the full options menu for the feature in question. This section contains two extremely important options for preparing a model for its journey to ZBrush. The first is the “Planes” option under “Mapping Settings,” which determines the number of planes across which UVs should be divided. The normal setting is usually “6,” which is fine for less complex models, but in the case of Lucifer’s multiple limbs and heads, or smaller components such as the protagonist’s ears and mouth, the setting should be a higher value, such as “12.” Additionally, the “Optimize for” attribute should be set to “Fewer pieces” to reduce the possibility of UV seam visibility in final renders after ZBrush normal maps have been applied (see *Figure IV.3*).



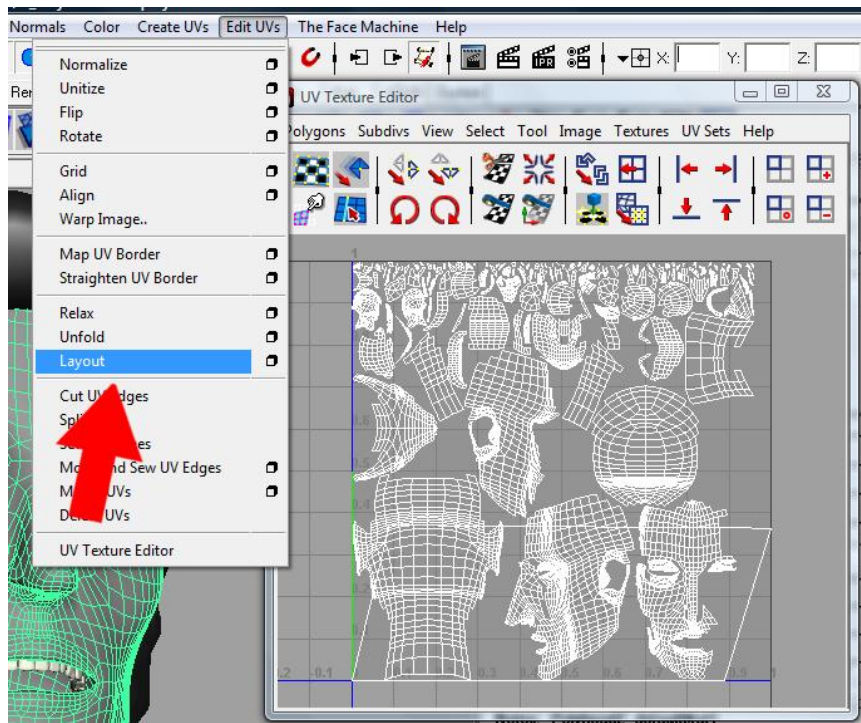
**Figure IV.3** – The Automatic Mapping Options menu found under Create UVs.

The second important option is “Spacing presets” under the “Shell Spacing” set, which is actually not necessary for exporting to ZBrush, but is helpful in terms of reducing the number of UV seams [Gam10]. The default setting is “256 Map,” but the UVs sometimes benefit from either the “512 Map” or “1024 Map” settings, which pack the UV shells together more tightly (see *Figure IV.4*).



**Figure IV.4** – Depending on the model, higher Shell Spacing settings can be better.

The next step is to arrange the UV shells properly for ZBrush, since ZBrush deals only with UVs that are situated in positive space, which is not a default setting within Maya. Clicking the “Layout” option under “Edit UVs” automatically sets up the UV shells inside positive UV space in the most efficient configuration possible and prevents UVs from overlapping (see *Figure IV.5*). ZBrush does not use overlapping UVs, meaning any normal map written with overlapping UVs will be useless [Zbrs10].



**Figure IV.5** – The Layout option is important to fix overlapping UVs, such as above.

The final step is to export the model in OBJ format so that ZBrush can read it. The OBJ export feature may have to be activated through “objexport.mll” in the Plugin Manager.

## 2) ZBrush Preparation and Processing

The mesh created in Maya can be imported in ZBrush by using the “Import” button to the upper right, then scrolling down the sidebar to “Geometry.” The “Divide” button in the Geometry tab subdivides the mesh within ZBrush such that high-resolution detailing and sculpting can be performed. Most models should be subdivided to four or five levels depending on the model in question. The more the model is subdivided,

the larger the Z-tool, or ZTL, file becomes; therefore, if the model is large initially, subdividing it to five levels may not be advisable. After subdividing, sculpting can be performed by the artist.

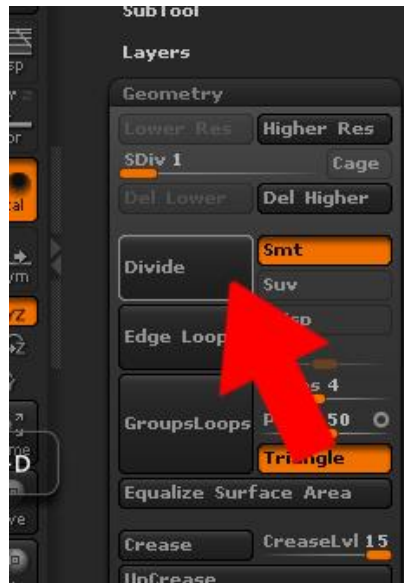


Figure IV.6 – The Geometry menu on the tool sidebar in ZBrush.

Once sculpting has been completed, the next step is to prepare the model for its journey back to Maya. Referring back to the Geometry menu (see *Figure IV.6*), the subdivision, or “SDiv,” slider must be reset to “1.” This attribute setting is critical, as ZBrush cannot create normal maps at high subdivision levels.

“UV Map,” between “Polypaint” and “Texture Map,” is extremely important, as it determines whether the normal maps render in full detail or at low resolution [Zbru10]. The default “UV Map Size” is usually set to

“256,” which registers far too low for the models used here and produces poor normal maps.

Setting the wrong size for the UV Map is one of the most common user problems and not usually directly addressed for reasons unknown.

Raising the UV Map Size to at least “1024” often produces satisfactory details. Pushing the size higher produces larger normal map file sizes, but retains details. For this project, the size was set at “4096” to retain as much detail as possible (see *Figure IV.7*).



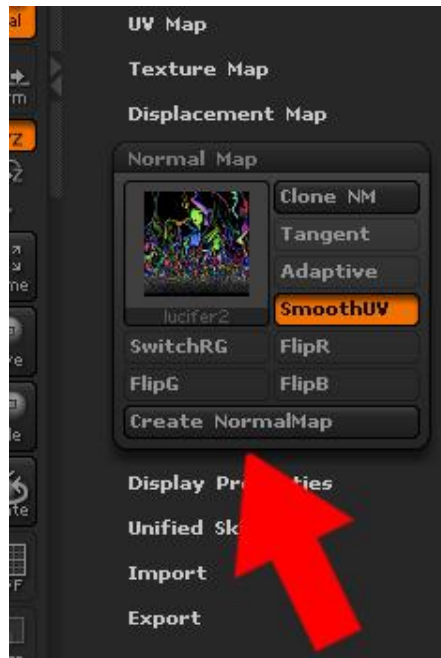
**Figure IV.7** – The UV Map menu. Note the UV Map Size option.

The next stage is to create the actual normal map using the “Normal Map” menu tab in the same toolbar as above. Opening the Normal Map tab reveals several options, the most important of which are “Adaptive” and “RGB” settings. “SmoothUV” is active by default, but does not result

in significant difference when exporting or importing models due to the way ZBrush handles OBJ files. Adaptive, or rather adaptive scan, is quite important, as activating it allows the normal map to capture minute details such as scratches and hair style sculpting. Enabling Adaptive, however, may result in slower normal map creation and may not be necessary depending on the sculpted details in the mesh.

ZBrush handles the RGB settings of the normal maps differently from Maya; therefore, appropriate actions must be taken to compensate. Writing the normal map file without using any of ZBrush's built-in options produces a map that appears somewhat inverted and fails to match the mesh as shown within ZBrush. This problem is easily remedied, however, by clicking the "FlipG" button, which aligns the RGB channels to the order in which Maya processes them (*see Figure IV.8*).





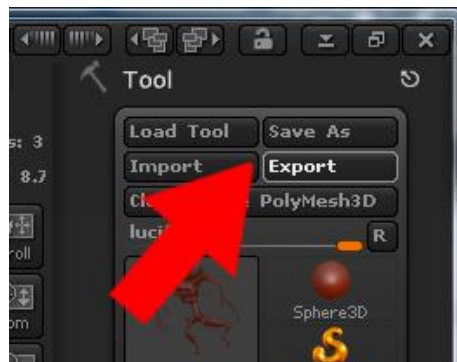
**Figure IV.8** – The Normal Map menu, including the needed Adaptive and FlipG buttons.

Writing the actual normal map is accomplished by clicking “Create NormalMap” on the Normal Map menu. This process can take anywhere from two to ten minutes, depending on the UV Map settings and the complexity of the model.

### 3) ZBrush Exporting

The final step within ZBrush is exporting all of the working files, including the model. The model is always geometrically augmented by ZBrush, even at the lowest subdivision level. This change must be taken into account to produce a completely functional normal map in Maya. The model must be exported out of ZBrush as a new OBJ file upon completion.

The model should be set to its lowest SDiv level in the Geometry menu; otherwise, the number of faces will not match the number of faces accounted for in the normal map. The “Export” option at the head of the tool sidebar will bring up the file export window, where the model can be exported in OBJ format to the desired location (see *Figure IV.9*). The normal map must also be exported to accompany the OBJ file. The normal map can be previewed in the small image pane shown on the Normal Map tab. Pressing the Clone NM button (see *Figure IV.10*) creates a copy of the normal map in the texture palette, which is found below the brush Alpha settings (see *Figure IV.11*).



**Figure IV.9** – The Save, Load, Import, and Export box on the tool sidebar.



Figure IV.10 – The Clone NM button is found on the Normal Map.

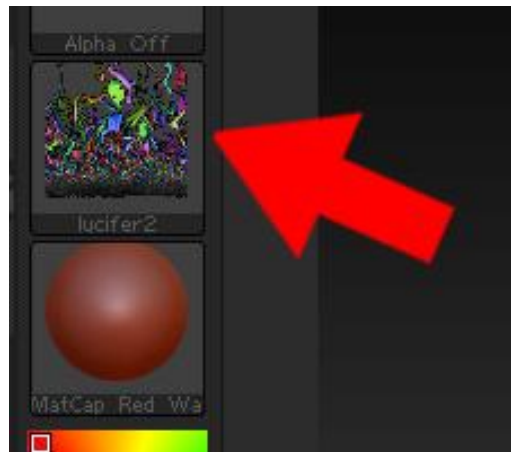


Figure IV.11 – The cloned normal map as it appears in the texture preview.

Clicking on the texture opens the full texture palette, showing all pre-loaded and user-created textures. The normal map texture should be selected by default; otherwise, it is available on the “Quick Picks” bar at the top of the palette. Selecting the normal map texture and activating the “Export” button at the bottom of the palette (see *Figure IV.12*) [Pixo10] causes the Export dialogue to appear as with exporting the OBJ model

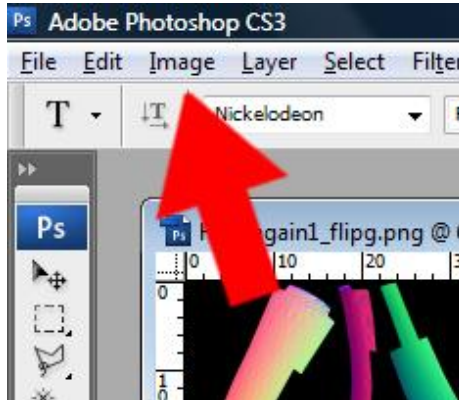
earlier. The texture file should be exported as a PSD, or Adobe Photoshop Document, file.



**Figure IV.12** – The texture Export button is located on the texture palette.

#### *4) Tweaking Files in Photoshop for Maya Importing*

ZBrush writes its normal maps and textures upside-down compared to Maya. An image editing program, such as Photoshop, can fix this quirk easily. Once the normal map file is opened in Adobe Photoshop, the “Flip Canvas Vertical” feature under the “Rotate Canvas” option on the “Image” drop-down menu should be activated (*see Figure IV.13*). The file is now corrected for Maya use. Saving a copy in a format that uses lossless data compression, such as PNG, works adequately as it does not risk losing minute details to compression.

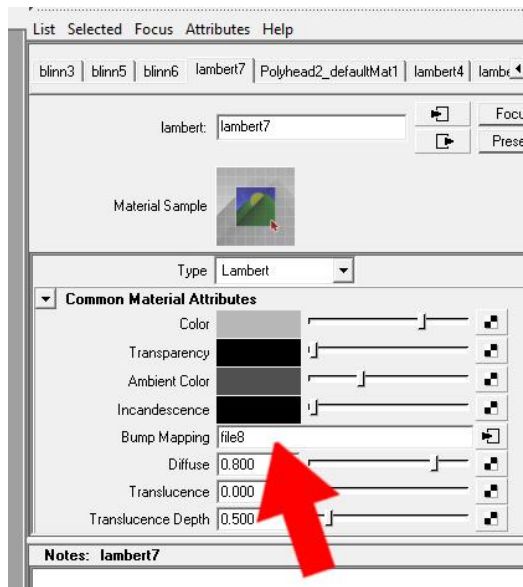


**Figure IV.13** – Adobe Photoshop’s Image menu option.

#### 5) *Applying the Normal Map in Maya*

After the new OBJ has been imported in Maya, a new material should be applied to the mesh via Hypershade. The “Bump Mapping” option can be found within “Common Material Attributes” (see *Figure IV.14*).

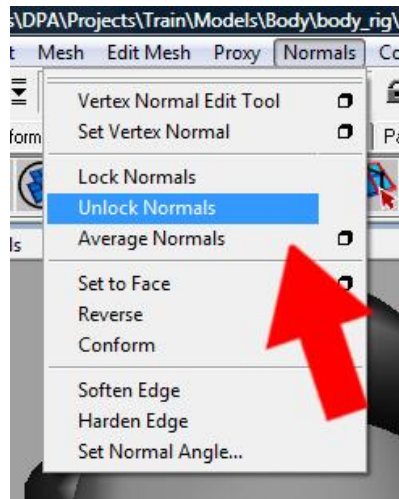
Selecting the button to the right of the Bump Mapping box reveals the “Create Render Node” window. Selecting the “File” option from under the “Textures” tab automatically adds a new node to the object’s material for bump mapping. Two tabs, “bump2d1” and “file1,” will appear. Under the file1 tab, the normal map texture file can be loaded through the “Image Name” attribute.



**Figure IV.14** – The normal map file must be applied in the Bump Mapping box.

## 6) *Tweaking Normals within Maya*

At this point, any normals of the model should be adjusted to ensure smooth transitions across polygonal faces. At this stage, the normals have not been averaged and should be unlocked through the “Unlock Normals” option on the “Normals” menu under the “Polygons” toolbar (see *Figure IV.15*). If a mesh were to be rendered at this stage, it would look as if it were made of flat planes instead of one continuous surface (see *Figure IV.16*).



**Figure IV.15** – Note the Unlock Normals and Average Normals options.



**Figure IV.16** – The protagonist's head model with unlocked normals.

On that same Normals menu, the menu box to the right of the “Average Normals” option attribute should be selected. Default Average Normals settings tend to be a bit too high for most models (see *Figure IV.17*); therefore, the settings need to be adjusted through the “Grouping Threshold” slider (see *Figure IV.18*). The ideal setting for this project is 0.0050; setting it higher interferes greatly with the way light interacts with the surfaces of the model and produces undesirable results (see *Figure*

IV.19). With a Grouping Threshold of 0.0050, an even surface is produced with no lighting imperfections (see Figure IV.20).



Figure IV.17 – The head model when normals are averaged using default settings.

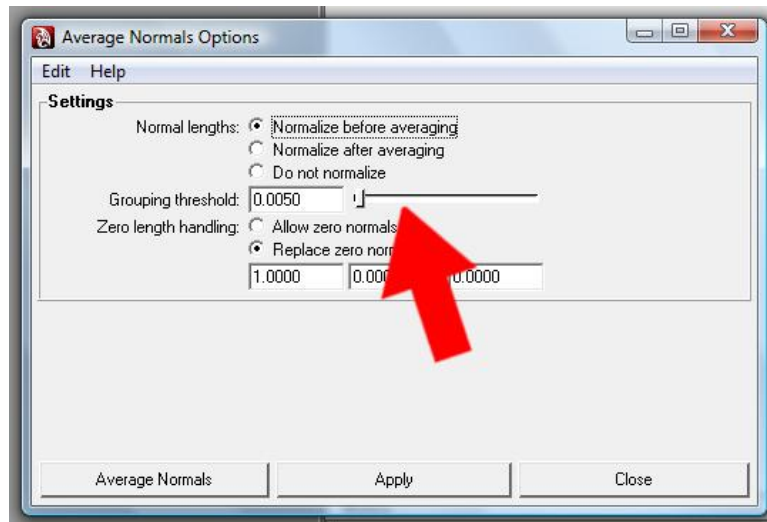


Figure IV.18 – The Average Normals Options menu.





**Figure IV.19** – The protagonist’s head with normals averaged incorrectly.

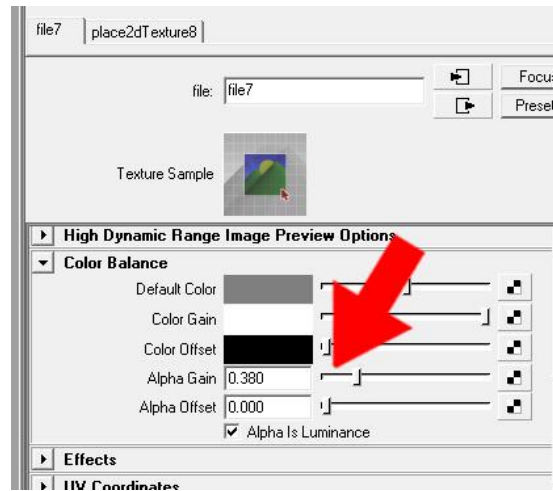


**Figure IV.20** – The protagonist’s head with normals averaged correctly.

### *7) Final Settings and Rendering*

The last setting to adjust before performing final renders is the material’s “Alpha Gain” setting, which can be found in the section under the tab where the normal map file was originally applied. Under “Color Balance,” “Alpha Is Luminance” should be activated; otherwise, the normal map will not be visible during rendering. Alpha Gain determines how the shadows fall across the material by changing the depths of the shapes in the normal map (see *Figure IV.21*). The default setting is “1.000,” which is

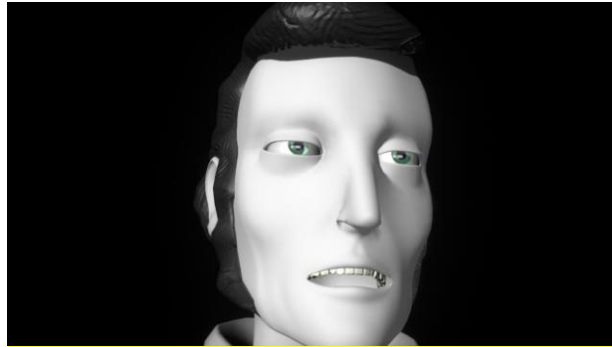
too deep for our purposes and makes the model appear mummified. Alternatively, setting the value too low loses detail and negates the use of a normal map (see *Figures IV.22 and IV.23*). Setting Alpha Gain closer to 0.500 or lower produces a much better result.



**Figure IV.21** – The Color Balance menu and Alpha Gain.



**Figure IV.22** – The protagonist's head with Alpha Gain set too high.



**Figure IV.23** – The protagonist's head with Alpha Gain set too low.

Achieving correct render settings is a matter of personal preference. The Maya software renderer does not deal well with normal maps; hence, mental ray should be used to render any normal maps derived from ZBrush. At this point, a final scene utilizing ZBrush resources can now be rendered.

## CHAPTER V

### RESULTS

Full results of the work presented in Chapters III and IV can be seen in the final film, *Terminus*. The meshes were the focus of this thesis and as such will be addressed here. Through the methods described earlier, the protagonist model ultimately matched the original concept drawings. In terms of ZBrush work, only the head and hands were touched, but as this model was also the first to be imported from Maya to ZBrush, the hair was updated over multiple learning iterations as UVs were sorted out and ZBrush tools were refined. Ultimately, the hair appeared to be the most natural looking part of the model (see *Figure V.1*).



**Figure V.1** – Hairstyling was achieved through brush work on a rough Maya mesh.

The skin was exciting to work with since it offered many opportunities to layer detail on the model. For instance, the first improvement to the mesh was

adding skin pores so that the light would fall more naturally, avoiding the plastic-like appearance symptomatic of so many computer-generated productions. The other advantage of this detail work was that creases, wrinkles, and skin folds could be added around the eyes and eyebrows to make the protagonist appear extremely tired, as well as having lived a rough life [Veoh10] (see *Figure V.2*).



**Figure V.2** – Lifelike skin pores, wrinkles, and stubble make ZBrush an incredible tool.

Modeling the hands was a bit more difficult given that each finger needed to be detailed at the joints and fingertips. Fortunately, ZBrush, unlike Maya, allows the sculpting of fingernails and veins of the hand without raising the polygon count significantly. Since the normal maps, however, are still limited by the number of polygons in the hand model, the fingertips remain angular. Overall, the basic changes ZBrush made to the geometry were quite nice, resulting in a much more realistic and natural hand (see *Figure V.3*).



**Figure V.3** – The hand is more rounded and less angular with ZBrush.

One of the problems that appeared in all three models was due to UV mapping. At close range, the models look fine, but as the camera moved away, UV seams started to become visible (see *Figure V.4*). Fortunately, this issue arose as a result of automatic UV mapping settings in Maya; it can be fixed by creating the UV shells manually to better hide the seams.

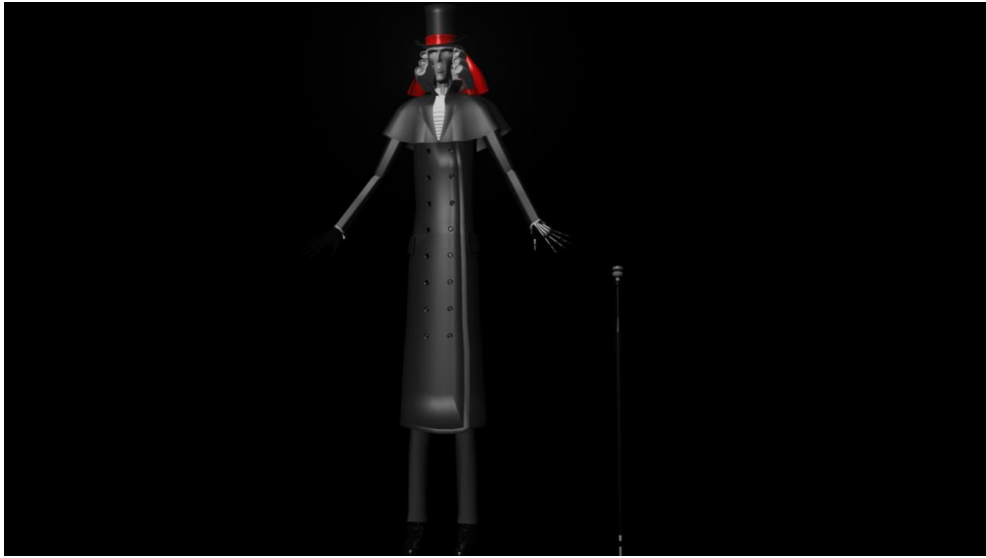


**Figure V.4** – Visible UV seams are on the right side of the face.

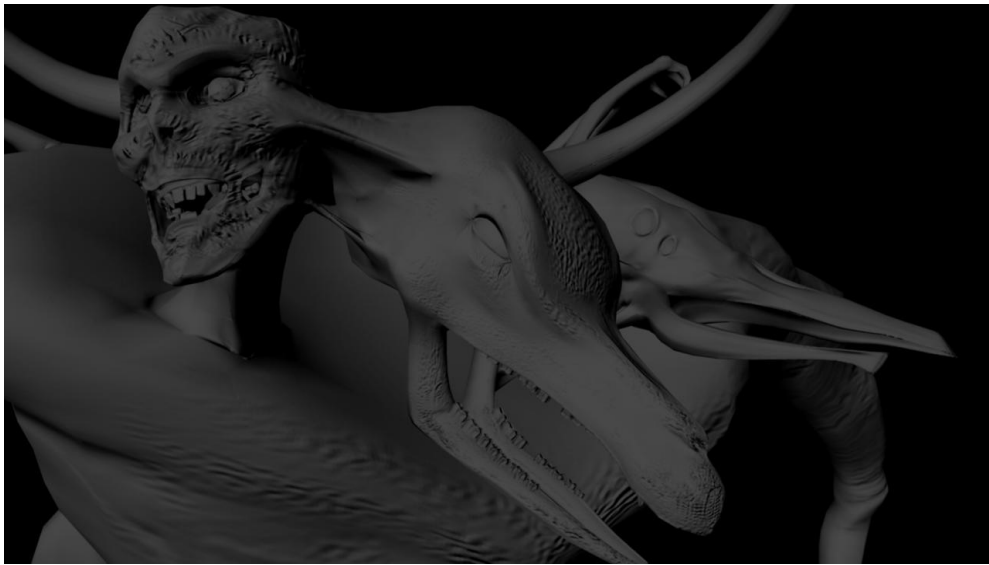
For further refinement, polygon smoothing was used on the first model (see *Figure V.5*), which increased the polygon count drastically and resulted in prohibitively large ZBrush files. The process of averaging normals, as mentioned in *Chapter IV*, was applied, however, which severely reduced the polygon count of Virgil and Lucifer (see *Figure V.6*). Lucifer could be considered the crowning achievement of this entire project, As the complexity of the model was great and relied on the power of ZBrush to manipulate geometry and incorporate detail (see *Figures V.7 and V.8*).



**Figure V.5** – Virgil with aged skin.



**Figure V.6** – Virgil utilized normal averaging instead of polygon smoothing.



**Figure V.7** – A close up of Lucifer's three heads.





**Figure V.8** – Muscle striations and skeletal indentations were created in ZBrush.

## CHAPTER VI

### CONCLUSION

In the field of computer graphics, artistry is sometimes overlooked in favor of technical engineering, when in reality, the two complement one another.

Thanks to applications such as ZBrush, artistry is given a clear showcase and a powerful new set of tools. The field benefits in the long run from the new heights of beauty unleashed by the creation of such artist-friendly programs.

This thesis was largely an attempt to highlight the value of integrating such a powerful tool into the existing industry standard. A sense of excitement permeated the project as creativity could now be unleashed without requiring hours of technical research beforehand. In truth, ZBrush is merely a digital pencil and paper that happens to possess that extra dimension that graphic artists have been trying to capture on canvas for centuries. Even though limits and hurdles appeared, the final film will hopefully appeal to a wide audience.

Opportunities always exist for additional refinement. First, the handling of UVs between Maya and ZBrush could be greatly improved. Defining attributes in Maya using parameters predefined by ZBrush would be helpful, possibly via a MEL script that can mimic ZBrush's light conditions to set appropriate Alpha Gain values. Also, investigating techniques for minimizing pixelation in maps exported for ZBrush would be worthy of further research. Second, adding fabric strokes to the character models in ZBrush could achieve a higher level of realism. Many

other refinements are obviously possible; however, one must move on to bigger and better things, much like Dante making his way out of the circles of Hell into the brightness of the world.

The computer graphics industry must always remember that it is, in a sense, codependent: The art cannot exist without the technology; the technology cannot exist without the art. Giving more access to artists via packages such as ZBrush only enhances the entire pursuit. The industry at large must strive to integrate such programs into their pipelines to create the best finished product possible.

## APPENDIX A

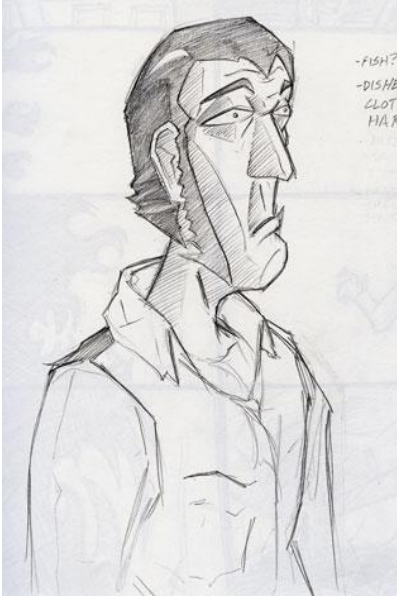
### CONCEPT SKETCHES



**Figure A.1** – The first sketch of the protagonist character appeared far too creepy. This draft would not garner any sympathy from an audience. The vulpine features and interesting Victorian dress were a good starting point, however.



**Figure A.2** – The second draft was much simpler in design and included more expressive eyes. The facial features and hair had been softened considerably. Heavy shadow was also considered at the time, but it seemed as though such shadowing would obscure too much of the character detail.



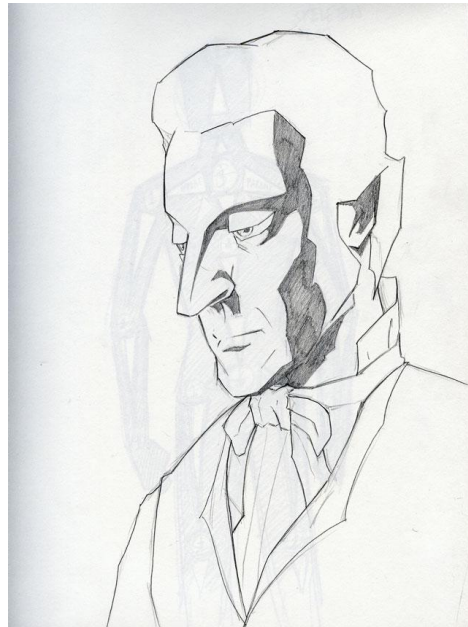
**Figure A.3** – This concept sketch intended to make the protagonist more relatable as sort of an “eternal loser” type with a “sad hound” sort of look.



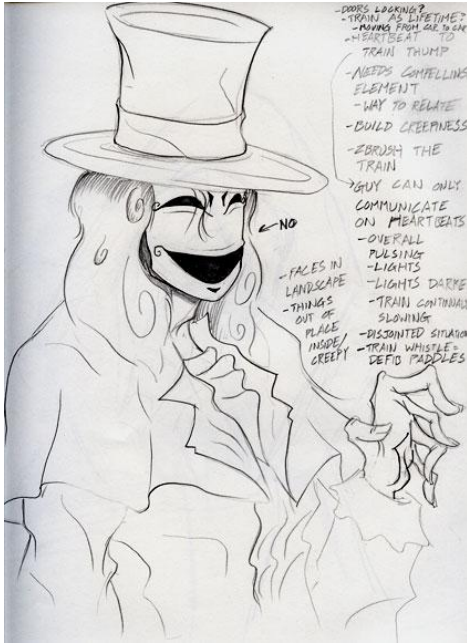
**Figure A.5** – This version kept the elongated features and reeled in the eyes. The look still did not achieve the angular feel desired.



**Figure A.4** – This version went a bit too far on the sympathetic side, making the eyes too large, the nose a bit too snubbed, and the build a little too heroic. The features have also become rounded. At this point, the design had gone too far in the wrong direction.



**Figure A.6** – This quick sketch resulted in the final design. The features were less cartoonish and more dignified.



**Figure A.7** – The original intention for “Virgil” was to make him faceless, revealing nothing behind the mask, as opposed to the larger Lucifer revelation.



**Figure A.9** – The first time Virgil was given a regular face, some ideas left over from the first protagonist draft were worked in: obscured eyes and pointed features. The blackened eyes were kept. Also, the idea that he was visually based on a Victorian mortician was locked in at this point. The actual 3D model also added hints of a classical barrister.



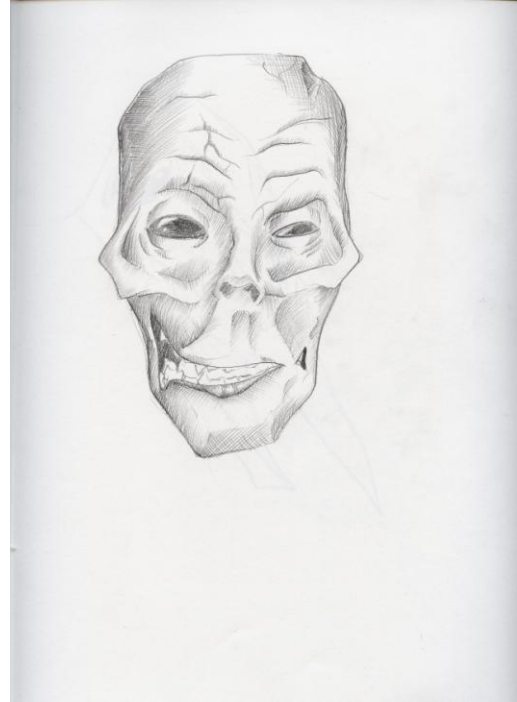
**Figure A.8** – Continuing with the idea of “Virgil” being more of a raw scare, he was made to appear undead and grotesque. These qualities would be hidden in shadow by his top hat and surrounding light sources.



**Figure A.10** – The final draft (or very nearly, as some liberties were taken on the character design when creating the actual model) included features reminiscent of the elongated heads on Easter Island. Since his features were more squared than pointed, like the protagonist’s, he appeared a good counterpart.



**Figure A.11** – Lucifer was conceived on the basis of Dante Alighieri’s description of a wretched beast with impotent wings and three faces. An asymmetrical look was used to exaggerate the more misshapen aspects of the figure. To simplify the creature, however, the fur that Dante described was omitted.



**Figure A.12** – Lucifer’s first head, from left to right, is the humanoid one, meant to remind viewers of anorexic persons, with a healthy dose of an “undead” feel to it. A certain degree of “Hollywood burn victim,” such as Darth Vader, was also inherent in it.



**Figure A.13** – As mentioned prior, the central head has a combination of bull and canine parts, meant to evoke reminders of the classic desert imagery of a wind-flayed bull skull, as well as the Greek three-headed hound, Cerberus.



**Figure A.14** – The final head was also the strangest. It was meant to conjure up images of birds and reptilian creatures. Hints of saurian features, something akin to a pterosaur, were also found mainly in the shape of the beak. Some fish features were also incorporated by giving it a flounder eye configuration with both eyes on the head's right side.



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