

Design Document – Mortal Engines Self-Portrait

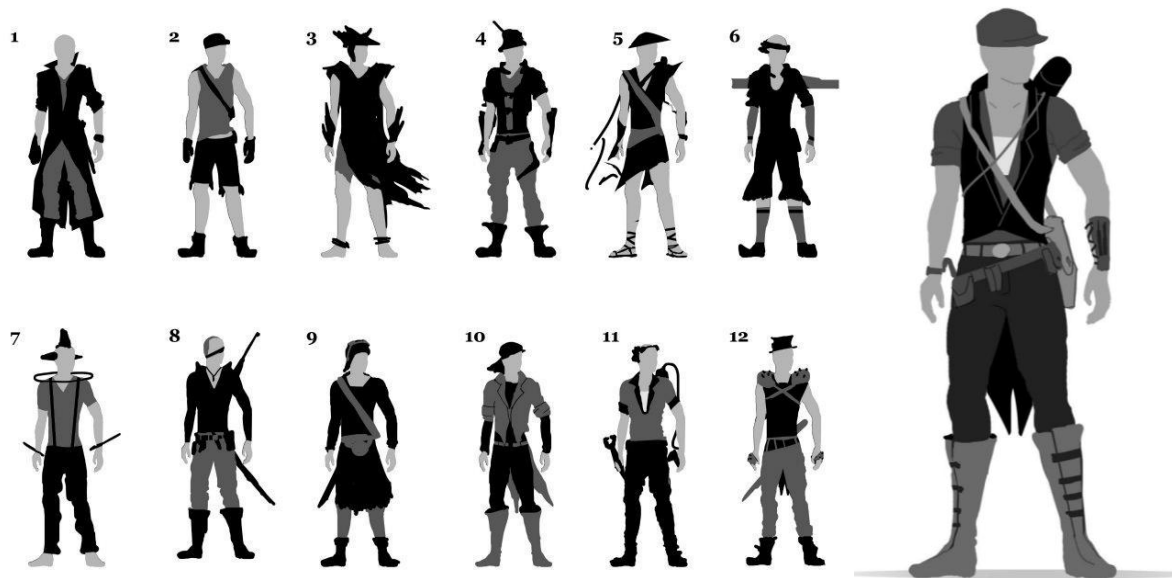
Objective

Create a character based on my likeness. The theme must fit with Mortal Engines book by Phillip Reeves.

Planning

Concept

I began by conceptualizing the appearance of my character. After drawing several thumbnails I settled on the theme of “historian guild acquisitions officer”. I chose elements from my concepts which I liked to arrive at a final concept (right).



The final design uses a mixture of materials, specularities and surface textures and the silhouette is readable with distinct characteristics.

Method

I plan to create a rough base mesh proxy in 3ds max with sufficient, accurate geometry to sculpt in ZBrush. From there I will correct proportions and work from reference to create an “undermodel”, showing the correct shapes of the body. I will then bring the model back into 3DS Max to create models for all the accessory and clothing elements, finalising some inside of Max, and sculpting additional details inside of ZBrush as appropriate. I will then retopologise the model and unwrap it inside of Max. Textures will be handpainted in Zbrush and Photoshop.

Process

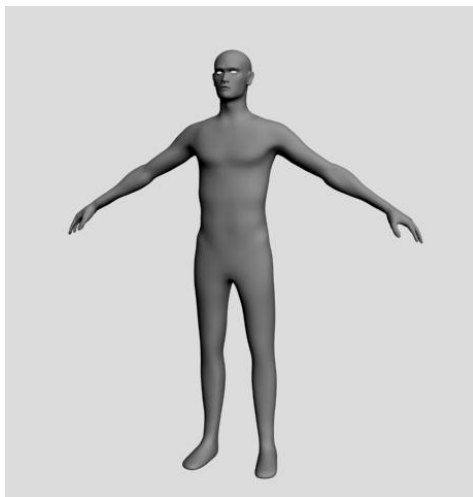
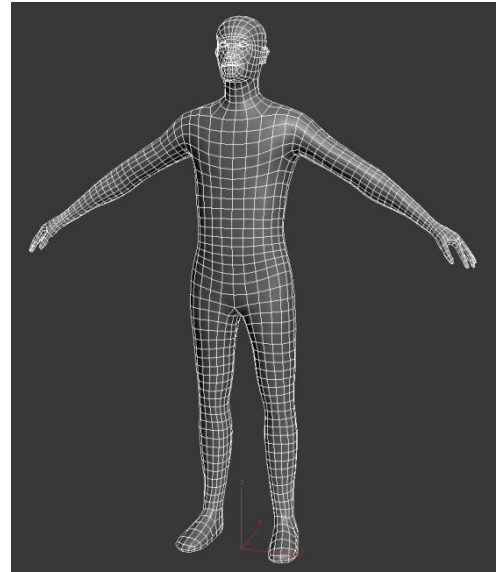
Modelling

Base Mesh

The base mesh was created in Max by referring to reference pictures.

The mesh was entirely quadded to avoid sculpting problems. The mesh density was kept roughly even, but most dense in the face and hands where I would need to add high-frequency sculpted detail.

The final base mesh is pictured right.



Sculpting the undermodel

After frustrations with ZBrush I chose to proceed using Mudbox as my sculpting package.

The sculpted “undermodel” is shown left. Attention was paid to ensure anatomically correct proportions . Detail was not added at this stage

Adding Clothes

Objects were created inside of max using the Graphite Modelling tools to ensure the fit of the clothes was tight to the underlying geometry.

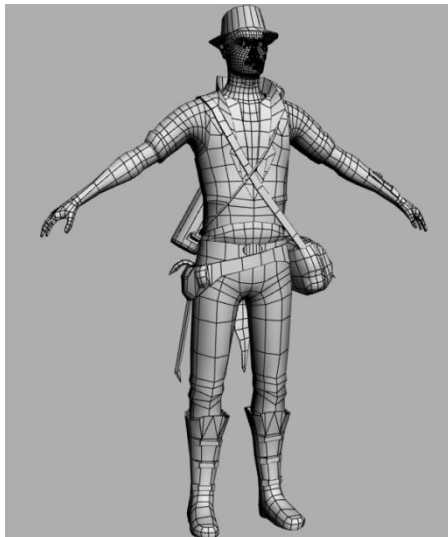
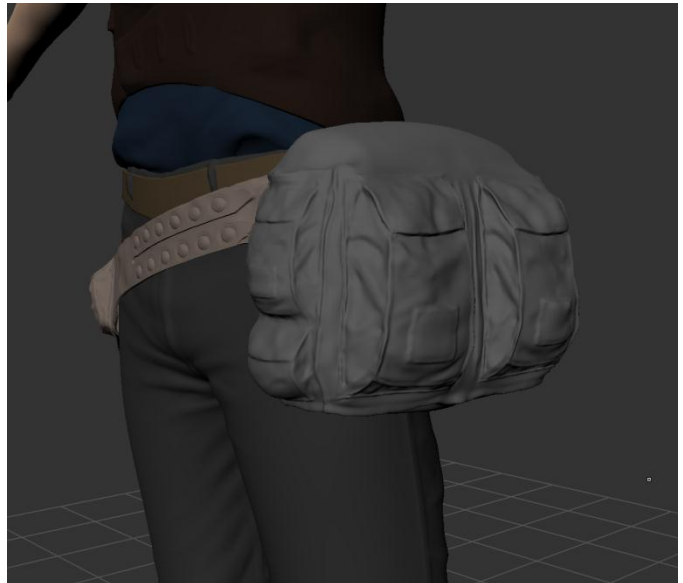
Again, clothing meshes were kept in evenly spaced quads ready for sculpting.



Sculpting the clothes

Clothes which required natural folds and other sculpted details were taken into Mudbox.

As a bit of an experiment, I made use of the vertex displacement map feature to sculpt a single pouch and recreate it on other parts of the clothing (the utility belt and bag). I found the tool to be pretty buggy so only used it for a couple of features.



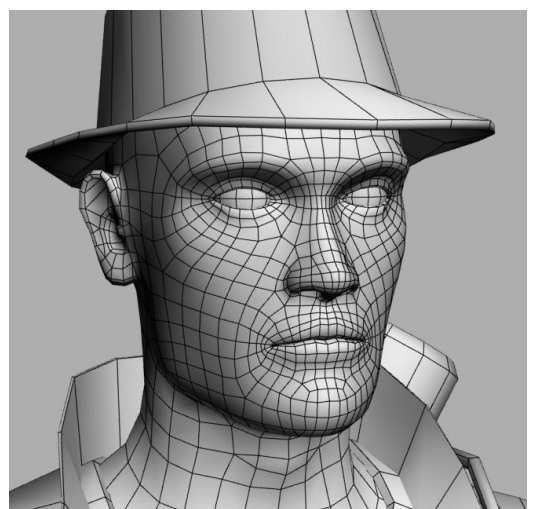
Retopologising the mesh

After all sculpting had been done, I took all sculpted objects back into 3ds Max to retopologise. I used the Graphite Modelling tools to quickly and accurately create an approximately 9000 triangle mesh. I also created high poly versions of non-sculpted features like the hat and document tube.

Retopologising the Face

Particular care was given to the topology of the face. Although the brief did not expect the face to be rigged or animated, I wanted to ensure that his face would deform well if he was.

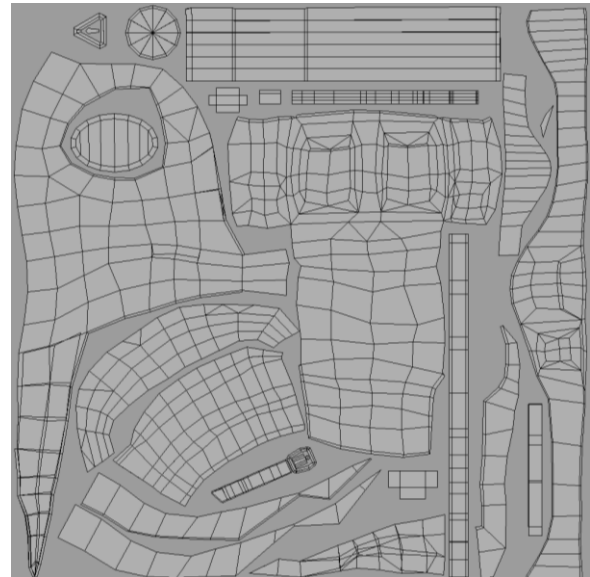
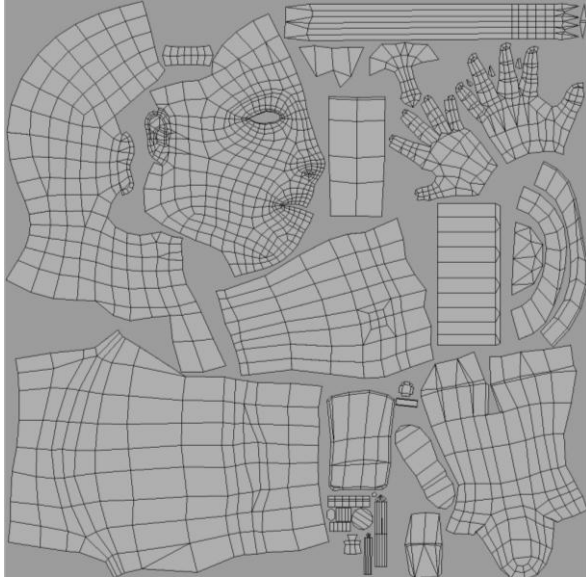
I did research on face topology for animation and combined parts of several examples into the topology pictured. Although a little costly (about 2,500 triangles or 28% of budget) I am satisfied that the topology will deform well in facial animation.



Texturing

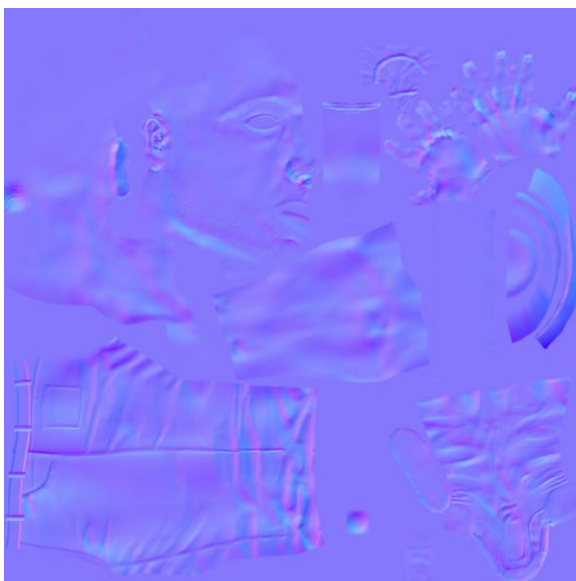
Unwrapping UVs

When unwrapping, I was keen to avoid unnecessary edges. I wanted to maximise the use of my texture space so chose to use symmetrical texture information wherever possible. From an artistic point of view, I knew I could get away with this because the asymmetrical accessories would break up the monotony of the symmetry.



Baking the normal maps

I baked the normal maps using 3ds Max. Tweaking was required in complex areas and also to fix the seams. As I painted the diffuse maps, I also created height maps for some details. I also added noise to most surfaces. The final normal maps are shown.

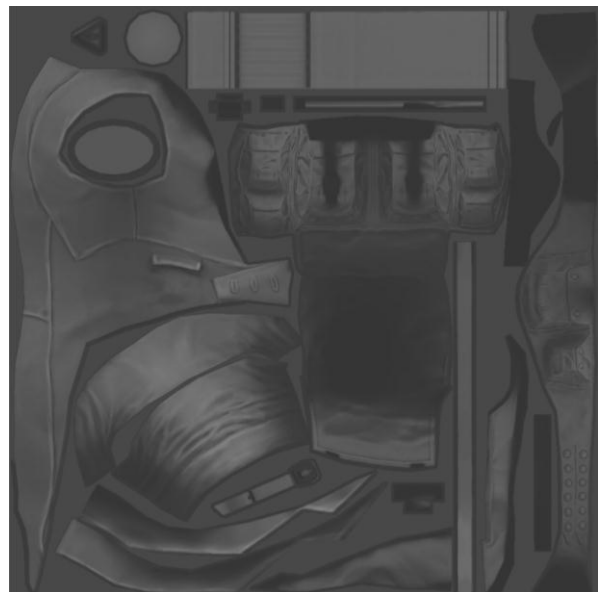


Baking the Ambient Occlusion

I wanted to include some ambient occlusion in my diffuse texture. I used three types of ambient occlusion:

- Surface occlusion – generated using CrazyBump from the normal map
- Non-directional occlusion – generated by baking in 3ds Max with a skylight
- Directional occlusion – generated by baking in 3ds Max with a skylight and ground plane and walls to simulate top-down lighting

Due to my symmetrical texturing, and because I wanted the accessories to be optional, I was careful to avoid baking the shadows of the asymmetric accessories into the texture, so I had to do my bakes in several goes. After combining all ambient occlusion bakes, tweaking and a little dodge and burn, my final result was this:



The Beard

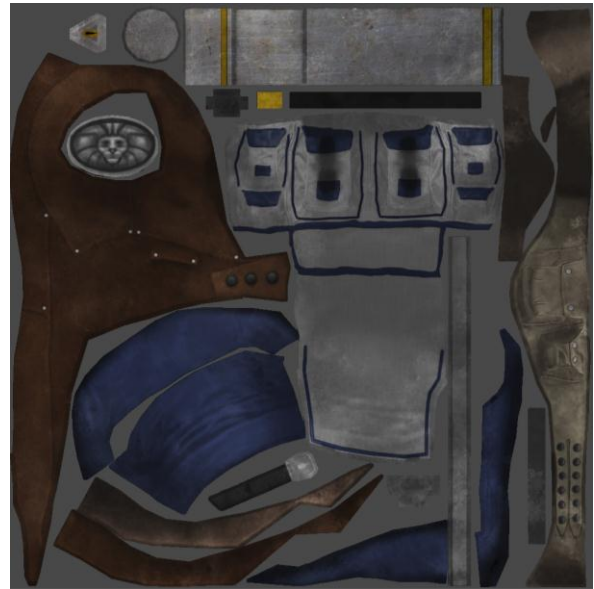
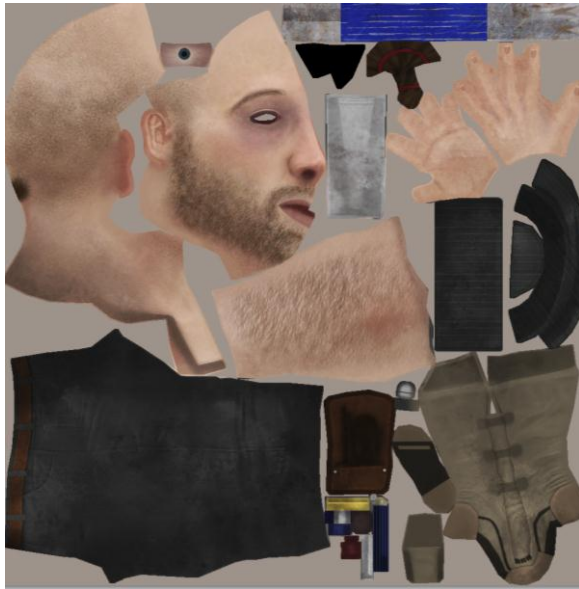
I did not want a bushy beard so deemed it unnecessary to use alpha planes. It was therefore a challenge to create a very convincing beard on an entirely flat surface. Having read a technique used in industry was to use the Hair and Fur modifier in 3DS Max, I had an experiment with it. The left picture shows the result when rendered inside 3DS Max, and the right picture shows the best result I could get by baking the hair into a texture. I was not happy with this result so it was abandoned.



The Diffuse Texture

The remainder of the diffuse texture was painted pretty conventionally. The skin texture was entirely hand-painted. Some use of surface texture photographs were used to create believable surfaces for metals and cloths.

To paint the facial hair and arm hairs I created my own brushes. Grunge was added with a variety of custom brushes to break up the flatness of textures. The diffuse and normal maps were adjusted in tandem, to ensure they worked harmoniously.



The Specular Texture

I used the diffuse textures as a base for my specular map and to allow me to easily make similar selections. This enabled me to make the specular maps quickly and match them to the diffuse texture. Because of the variety of surfaces, it seemed appropriate to use a gloss map.

Because of the limitations of the targa file format, I chose to save as two separate textures, each of 8 bits, rather than using a single 32 bit texture just to keep the gloss and specular maps together. This technically breaks my budget, but it is much cheaper this way, and I can always save them as one, more expensive texture if required.

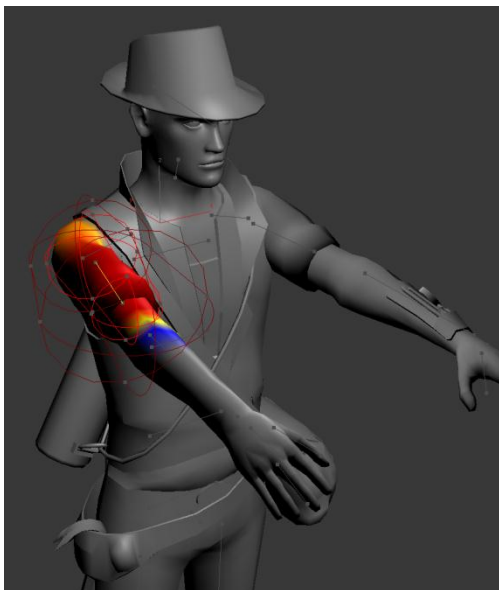
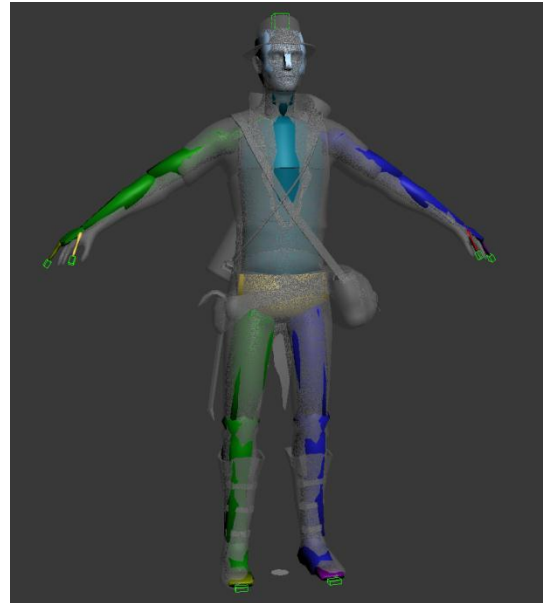


Rigging the Character

Structure

I chose to use the Biped structure. Our brief limited us to just 28 bones, which only afforded an absolute minimum of bones. I would have liked two links in the thumb and finger bones and ideally two finger bones at least, but it simply could not be afforded.

I animated the bones in such a way that would test the extremes of movement for the character. This was particularly helpful during the rigging process to test the rig.



Skin Modifier

I chose to use the skin modifier to rig the character instead of Physique. The skin modifier afforded additional features, better stability and more flexibility. This meant I could adjust the model beneath the skin modifier without causing major problems. This was particularly useful for modifying joint geometry. I also wanted to use the rig from my 9000 triangle model and transfer the weights to the low LOD model, to prevent me needing to rig that again. This would also ensure consistency.

I began by tweaking the envelopes to get those working as best as I could. I then used the weighting table and paint blend weights features to fine-tune the rig. The

symmetry allowed me to copy across the symmetrical details from one side to another without “damaging” the asymmetric details.

Finally, I tested the rig on a motion-captured animation. I was satisfied with the result, though the finger animations are a bit clunky on account of only having one bone for all four fingers.

The only problematic area was the elbow. This is because I positioned the elbow at its natural position when palms are face down, but the biped expects the elbow to be in a different position at this point. Because it is not possible to twist the forearm, I was unable to rectify this problem.

Lowpoly Character

Geometry and Unwrapping

To create the geometry I used the graphite modelling tools to rework almost every part by hand. Some of the simpler assets were created by edge removal.

The unwrapping was done again so as to fit onto a single texture sheet. Again I made use of symmetrical texturing where appropriate.

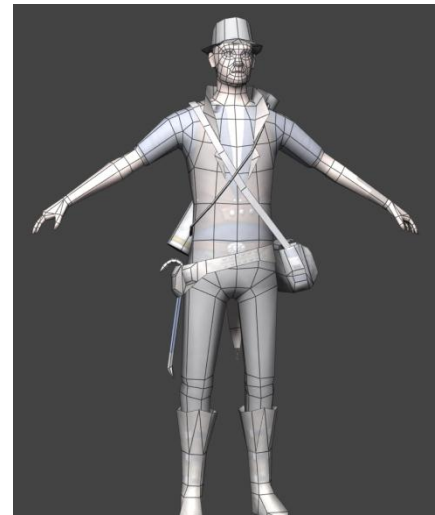
Transferring the rig

Rigging the low LOD model from the high LOD skin was very straightforward. A little tweaking had to be done on the fingers, wrists and elbows, all of which are still poorly rigged, but this is as much a factor of the bone and geometry restrictions as anything.

Baking the Textures

The textures were baked from the highpoly geometry. Although the process had to be done in three passes because of the amount of closely-packed geometry, there were very few tweaks required afterwards. All maps (diffuse, specular, gloss and normal) were baked to the lowpoly model.

The result was so good that I deemed it extravagant for the low-LOD model to use a 1024 texture – the sharpness of the texture just wouldn't be of benefit from a distance. See the comparison of models/textures below.



Final Renders



8,999 tris
2x 1024x1024 xDSGN

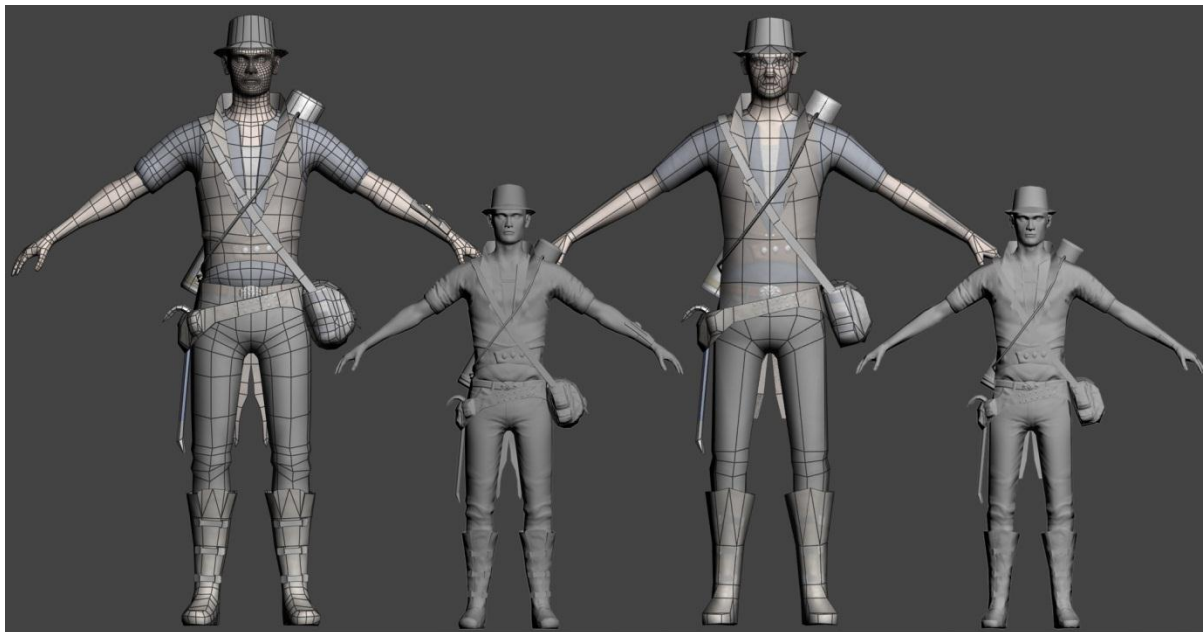
High Poly Textures



Low Poly Textures



Body Topology



Head Topology



Conclusions

Likeness

The likeness is pretty good, but not perfect. If I knew what was causing it not to look quite right, I'd try and rectify it. I could get more people's opinions on how the likeness can be improved. It is possible, however, that I'm being a pretty harsh critic since I am very familiar with my own face, where most viewers may see the general likeness and be less aware of small discrepancies.

Choosing not to use photographs of myself in my textures may have been a bit of an unnecessary challenge and possibly a better result could have been achieved with their use.

Model

The edging on the clothing (so that each item had "thickness") was probably a bit unnecessary, and caused some unnecessarily fiddly bits of texturing, unwrapping and rigging. I would probably keep items like the vest, shirt and jacket part of the same mesh and just rely on normal and diffuse maps to fake their depth and separation.

Rig

Overall, the rig is pretty good. The hands and fingers were by far the biggest problem, for both levels of detail. This is largely due to having so few bones. In industry I would probably ask for two more bones to afford a joint in the fingers.

Facial rigging

I may choose to extend the brief when I have some free time to experiment with face morph and bone facial rigging methods. I feel the topology is suitable for these experiments and it would be nice to demonstrate this.

Texturing

I am satisfied with the "macro" appearance of the texture – only close inspection reveals areas for improvement that I can see.

Even more time could have been spent detailing the texture, but as with all things, there comes a time to say "enough", and I had already spent a lot of time on this project. If this were to be the main character in a game, the extra attention to detail might have been warranted, but otherwise probably not.

Low LOD

As already mentioned, I decided the 1024 texture was really a bit overkill for a low level of detail model. Only when the character fills more than half of the screen is any difference particularly noticeable, and at this distance one would expect the high LOD version to be used.