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CREATING A 3D GAME CHARACTER MODEL

Thesis
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OPINNÄYTETYÖ
TIIVISTELMÄ

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Opinnäytetyössä käydään läpi videopeli projektiin soveltuvan low poly 3d-hahmon mallintamisprosessi aloittelevan mallintajan näkökulmasta. Päämääränä oli saada aikaan tyylitelty, vähäpolygoninen malli jossa olisi alle 6000 kolmiota. Hahmo suunnitellaan valmiiden designien ja olevassa olevan henkilön pohjalta. Projektin toteuttamiseen käytettiin 3Ds Max-ohjelmistoa. Projekti alkaa referenssikuvien luomisella 3Ds Maxiin ja käy sitten läpi rautalankamallin luomisprosessin, mallin unwrappauksen teksturointia varten ja itse tekstuurien valmistamisen Photoshop-ohjelmistolla.

Opinnäytetyö aloitettiin keräämällä valokuvia henkilöstä johon hahmon ulkoasu perustuisi. Näiden kuvien ja aiemmin valmistettujen piirustusten avulla luotiin uusi todellisuutta ja aiottua tyyliä yhdistelevä luonnoskuva, joka puolestaan toimi mallina 3Ds Maxin referenssikuville. Suunniteltu peli tulisi olemaan visuaalisesti enemmän sarjakuvamainen kuin fotorealistinen, joten hahmon muodot tulisivat olemaan sekä liioiteltuja että yksinkertaistettuja. Tästä johtuen myös tekstuurit tulisivat olemaan varsin minimalistisia ja yksinkertaisia.

Mallinnustyön eri vaiheet taltioitiin muistiinpanoilla ja ruutukaappauskuvilla, joista muodostui eräänlainen työn etenemistä kuvaava päiväkirja. Useita verkko-opetusaineistoja ja joitain fyysisiä kirjoja käytettiin apuna mallia luodessa tarpeen mukaan. Kiitos kuvien ja kirjoitettujen selvennysten, aloittelevat 3d-mallintajat voivat käyttää lopullista opinnäytetyön tekstiä itsessään tutoriaalina.

Opinnäytetyön lopullinen aikaansaannos oli teksturoitu low poly 3d-hahmo joka voidaan rigata ja animoida, ja joka soveltuu suunniteltuun peliprojektiin. Lopullinen hahmon ulkoasuun tulee suuresti vaikuttamaan itse pelin varjostin- ja valoefektit.

Tällä opinnäytetyöllä oli kolme päämäärää. Ensinnäkin sen oli tarkoitus auttaa parantamaan omia henkilökohtaisia graafikon taitojani alan standardityökaluja käytettäessä sekä luoda itselleni toimiva 3d-hahmo henkilökohtaiseen peliprojektiini. Tämän lisäksi lopullinen opinnäytetyö voisi toimia sekä oppaana että kannustimena toisille visuaalisille suunnittelijoille ja graafikoille.

Hahmonluontiprosessi onnistui tyydyttävästi. Parantamisen varaa kuitenkin on. Seuraavan kerran kykenen parempaan lopputulokseen.

Kieli	Englanti
Asiasanat	3D hahmo, 3DS Max, video peli
Säilytyspaikka	☒ Verkkokirjasto Theseus ☐ Kajaanin ammattikorkeakoulun kirjasto

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THESIS
ABSTRACT

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This thesis goes through the process of modeling a low poly 3D model for a video game project from the perspective of a novice 3D artist. The goal was to prepare a stylized low polygon model of less than 6000 triangles, based on pre-made design and a living person. The program used in this project was 3Ds Max. The process starts with the creation of the guideline images for the 3Ds Max and goes through the process of modeling the wireframe model, unwrapping the model for texturizing, and creating the textures.

The thesis work began by gathering photographs of the living person the character was going to be based on. With the help of the photos and pre-made character design drawings, a new sketch mixing the real and fictional details and a quick set of reference images for 3Ds Max were prepared. The planned game would be visually more cartoony than photorealistic, so both exaggerated and simplistic shapes would be used. Because of this, the texture would also end up being fairly minimalistic and simple.

The different stages of the modeling work were recorded with notes and screenshots, forming sort of a diary that describes the work's flow. Various online tutorials and some physical books were used as an aid while creating the model when needed. With the images and written explanations of the various processes, the final text of the thesis itself can work as a tutorial for starting 3D artist.

The final result of the thesis was a texturized low poly 3D character, which can be rigged and animated, and is fit for the planned video game project. The final visual style will be heavily affected by the game-engine's shader and lighting effects.

There were three main purposes for this thesis. First, it was to help me hone my own artistic skills with the various industry standard tools and provide me a working 3D asset for my personal game project. After that the final thesis would act as guide and encouragement to other graphic designers and artist.
The character development process succeeded decently. There was still room for various improvements.

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FOREWORD

Better late than never, correct? Little did I know back in the late 2012 that it would take two years to finish a task that I felt so confident about. But here it is, sorry for the wait!

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LIST OF SYMBOLS

Alpha map: Black and white layer or variation of an image used to make certain parts of 3D model transparent.

Cel-shading: Non-photorealistic rendering method often used to mimic style of cartoons.

Edge: Line between two vertices.

High poly: Mesh that consists of a very high number of polygons.

Low poly: Mesh that consists of small amount of polygons.

Mesh: Surface or shape made out of polygons.

N-gon: Polygon with more than four sides, that is undesirable in most modeling tasks.

Plane: Flat, often rectangular 3D surface.

Polygon: The basic piece the 3D models are made of.

Quad: Polygon with four sides.

Shader: Program used to add various effects, such as lighting, on computer graphics.

Render: An image or video made out of 3D.

Texture: 2D image used to add color and details on the 3D mesh.

Triangle: Polygon with three sides.

UV mapping: Process of creating a 2D image representation of a 3D model's surface to improve way the textures are placed on top of the mesh. U and V are the model's X and Y coordinates on a 2D plane.

Vertex: Single dot in 3D space. When three or more of vertices are connected with an edge, a polygon is formed.

Wireframe: The bare mesh without textures or shading effects.

1 INTRODUCTION

The aim of the thesis was the creation of a low poly 3D character model which would be later used in a personal video game project. As I have always dreamed of becoming a game developer and spent countless hours learning various tools and techniques on my own, one of these tools being the 3Ds Max. Even if my studies were related to game development, I found the time I spent practicing 3D modeling insufficient. Thus the idea of creating a proper model with a real purpose as my thesis was a great way to hone my skills.

The theme of the 3D modeling is this cartoony human character, which would be later used as one of the main characters in my own video game project, known only as the "TS". The visual style of the game is planned to be heavily stylized and somewhat cartoon-like in general, thus the need for very high quality texturing and high polycount are not a necessity in the model's case. I also wanted to challenge myself with the idea of keeping the polycount fairly low, preferably less than 6000 triangles. This was decided as I wanted to see how much detail I could include in the final production with minimalistic approach in visual aspects, using effects like Cel-shading to make the graphics fit the overall look and feel of the game. Besides these personal self-imposed challenges, there were no other limitations for the 3D model, especially as the game itself is planned to be a PC exclusive. Thanks to the significantly stronger processing power of the PC, there is less reason to worry about technical limitations.

My thesis goes through the whole creation project of the 3D character, starting with the gathering and creation of reference material, continuing to actual modeling of the wireframe mesh in 3Ds Max, and the different phases of texturing. All the work stages have been recorded using screen capture images, showing how the model was slowly built up. Thus this thesis can be theoretically used as a tutorial for other starting 3D artists.

2 PREPARATIONS

Neither TS nor its character are new as ideas. The earliest prototypes I remember planning as early as late 2004, while the decision to go full 3D and scale things up happened a bit later. At that time I was still certain the game would visually be like your average mid 00's big game release: trying to look as believable and real as possible. The greatest change in style happened around 2006-2007, when it was decided to change the game's style into something much more cartoon-like. This choice was made after I realized that it would be very challenging to capture the seemingly wild and crazy look and feel of my early TS sketches. The more flexible, colorful and less serious art style would go perfectly hand in hand with the non-serious and fast paced action game TS was meant to be. I was even more encouraged to push through this major change when Valve released their visually very unique blockbuster online shooter, Team Fortress 2, in late 2007. (Steam store, Valve)

2.1 Planning the style

I didn't need to reinvent the wheel when designing our character, who I've dubbed "Jöre". Based on the looks and personality of my bit of a whacko friend who really likes leather jackets and sharp objects, Jöre is meant to be one of the two available playable characters in TS. His character offers fast movements and literally cutting edge action (Picture 1). Flipside of his is the weak health, which he tends to shrug off with positive attitude, or smokes.

The early visions of the TS' visual style were already visible in the early 2007-made concept art of mine (Picture 1). The characters' proportions are exaggerated while their bodies are only sparingly detailed. The shadows are hard edged and strong. However, their clothes and hair show a distinct contrast to rest of the character, seemingly working almost like portals into these endless walls of desired surfaces. This kind of effect has been more commonly used hand drawn animations, such as the Japanese anime Sayonara Zetsubou Sensei, where pretty much every character's clothing is like a set of cut and pasted pieces of static, patterned paper (Picture 2). This kind of effect has been used in games as well, such as in the studio Ghibli's and Level-5's collaboration, Ni No Kuni.

While this cut and paste visual effect still remains as one of my desires features for the TS project, it is yet unknown how many game engines support such effect. A simpler alternative choice would be using regular texture maps made shamelessly out of photographs, leaving organic parts be only Cel-shaded by the engine.

Picture 1. An early sketch of Jöre and the man himself.

Picture 2. Sayonara Zetsubou Sensei's main character and the show's interesting visual style.

As my previous sketches of the character started to show their age and transferring a 2D design into 3D is already a challenge, I needed to create new material to aid my modeling process. Using a recent photography as reference, I sketched a new, quick portrait freehand, copying the most notable facial structures while simplifying and recreating some details with the old hand drawn designs (Picture 3).

Picture 3. Inspirational photograph and the artistic vision sketch.

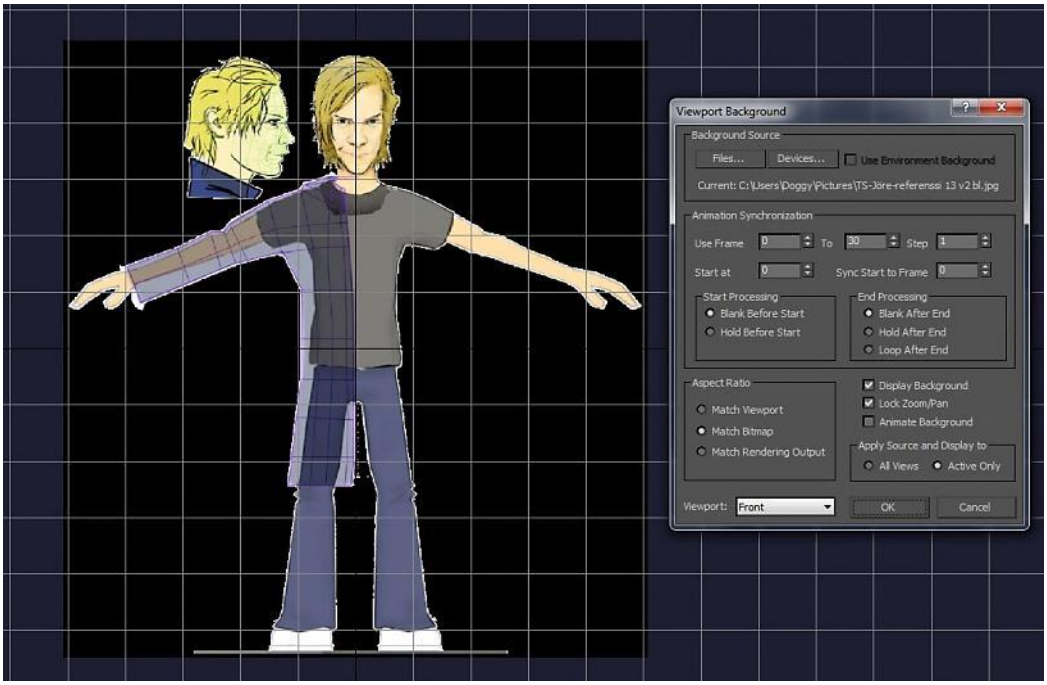
When I was happy with the frontal image, a quick side-shot was created the same way, without any major shading though. With these two head parts as the starting point I was able to start drawing the rest of the body. No reference images were used this time. The character would be wearing similar clothing as in the older drawings of mine, a half-long leather jacket on top of dark T-shirt and jeans. As the jacket would be open, it would be necessary to model the T-shirt covered torso and the jacket separately. To help myself with this task I drew a transparent layer of half the jacket on top of the character (Picture 4). The jacket piece was also roughly divided into parts to help me estimate the needed amount of polygonal subdivisions, thus speeding the 3D modeling process. The side portrait was also given a quick estimated wireframe overlay to help me recreate the facial structures faster. Only half of the face would be needed anyway, since the other side could be modeled very similarly.

After the frontal reference was done, a much quicker side reference image was prepared, using the side portrait as the starting point and the frontal image as the guide for location and length of different bodyparts. With these images I was ready to start preparing 3Ds Max.

Picture 4. Finished frontal reference image.

2.2 Setting up 3Ds Max

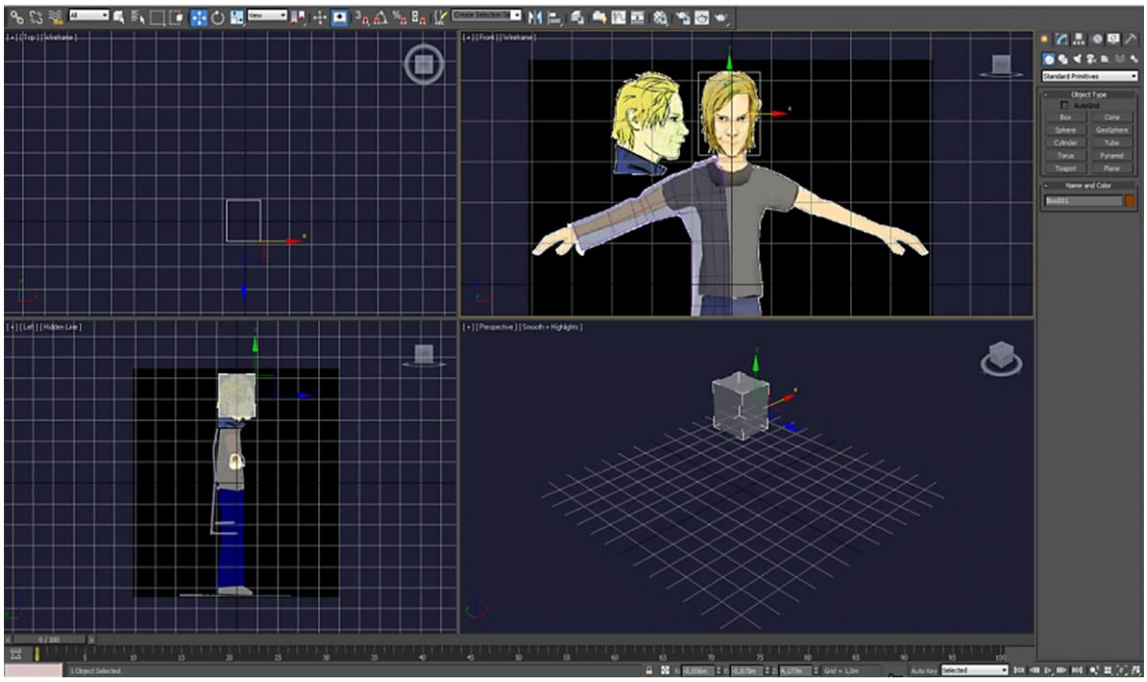
Many people seem to instruct using reference images in 3D programs by mapping them to two simple planes that are pushed through each other into cross-shape. This way you will have a three-dimensional reference at all times, but simultaneously you also obscure a bit of your view in the viewport. Because of this I prefer to use an old trick I learned years ago online, mapping the reference image into the viewport's background (Picture 5).



Picture 5. 3Ds Max's Viewport Background menu

I started by making sure that the Front and Left viewports are at same zoom level, which is easily done by comparing the size of the grid in the two views. Selecting the Front viewport, I opened the Viewport Background menu by pressing ALT+B. From the new window that pops up there is section called **Background Source** that lets me choose a file. The frontal reference image was chosen, and D**isplay Background** and **Lock Zoom/Pan** options were ticked. The reference image should now show in the viewport now and stay put in one position in the 3D universe as you move the view or zoom. I repeat the same procedure in the Left viewport, this time choosing the side-view image.

This setup of both images were tested by creating a box object roughly the size of the height of the character's head in one of the views. As the size and position of the box matched the images in both of the viewports, we could conclude that the pictures in both views were properly aligned and scaled (Picture 6). No distracting textured planes were needed, and you could only see the images in their own viewports. You could repeat this method in all the other views as well, assuming you have enough reference pictures.



Picture 6. Prepared scene with working background reference images.

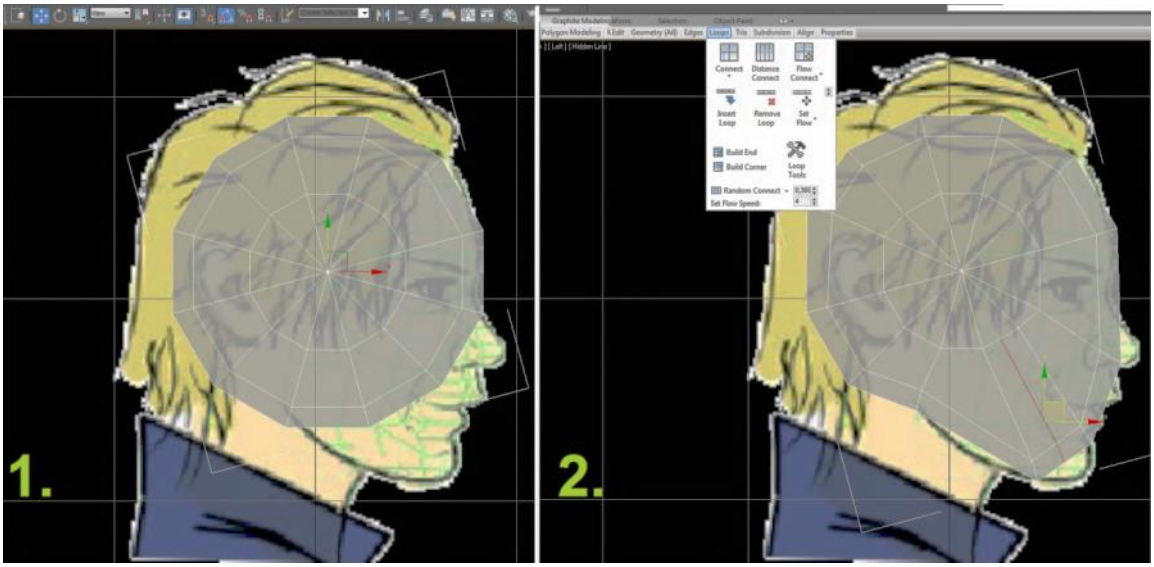
3 MESH

Perhaps the most common way for creating low poly 3D models is the so-called "box modeling" method. It starts with a basic primitive shape, like a box, which then is **subdivided**, **extruded** and shaped up bit by bit to match the desired looks. The idea is to mimic the rough silhouette of the reference image, using as little faces as possible or desired. (Athey Nansel-Moravetz, 2007)

3.1 Modeling the head

I started by creating a **Sphere** roughly the size of the character's head, and made it see-through by pressing **ALT+X** on my keyboard. The Sphere's segment number was set to 12 to drop the amount of the slices it is made out of. This made the sphere to sort of stand on this sharp edge, so on the Left viewport I turn the object 15 degrees on the Z axis, in order to have flat surfaces in the front, back, on top and at the bottom of the sphere. The sphere I also rotated 90 degrees on the Y axis, so the two sides with the numerous edges connecting into a single vertex were set to point at the sides of the head, around where the ears would be. You can rotate the objects accurately by enabling the **Angle Snap Object** setting from the tool bar, or just select the item using **Select and Rotate** tool and type the numeric values to the X, Y and Z fields at the bottom of the screen.

When the sphere was positioned properly, I added an **Editable Poly** modifier on it from the **Modify** panel. This allowed me to edit and adjust the vertices, edges and polygons of the shape, while still retaining the option of adjusting the primitive shape's values if needed. I started to shape the sphere into a head by selecting the bottom-right polygons facing forward from the character's point of view, and moved them downwards to form a rough shape of a chin. As this shape was obviously too blocky, I added a new subdivision by selecting two or more edges in the ball's loop, and then used the **Connect** function to create a new edge between these two lines (Picture 7). This function can be found both in the Modify > Edit Poly > Edge > Edit Edges menu and in the **Graphite Modeling toolbar**'s **Loops** dropdown menu.

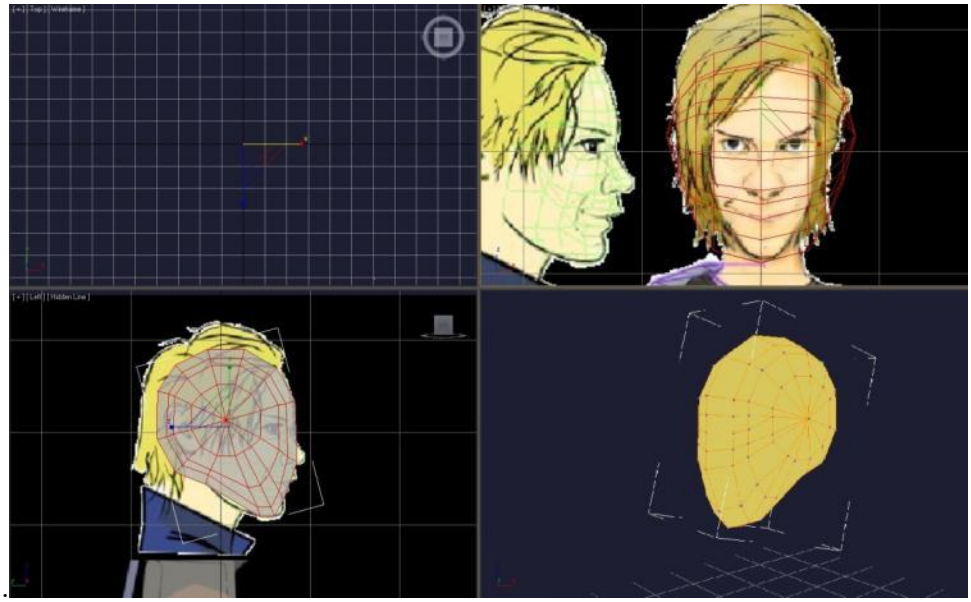


Picture 7. Sphere is rotated and then reshaped using Edit Poly tools.

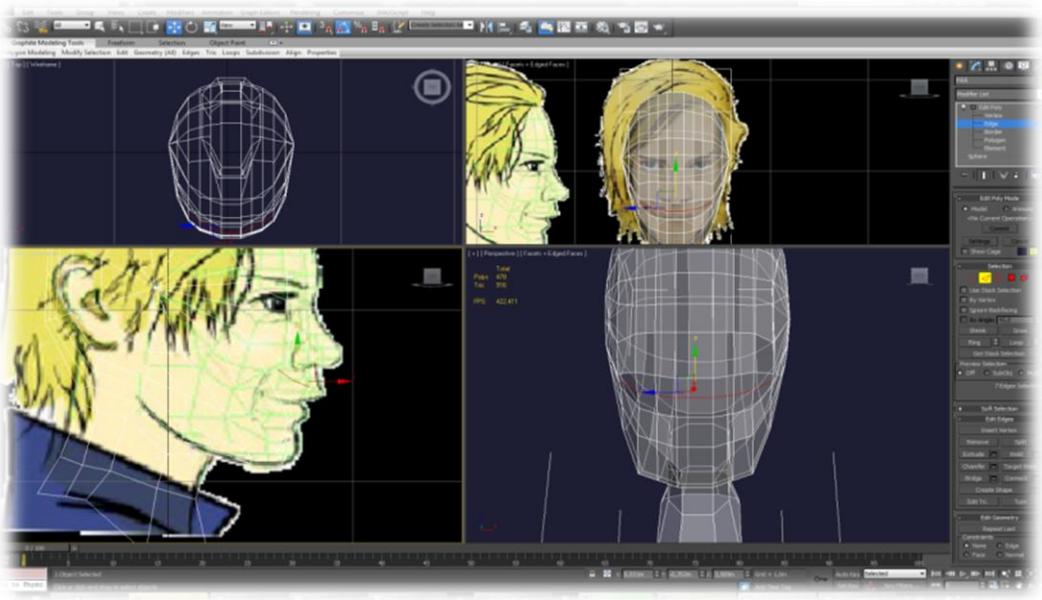
More edges were added and then moved around to improve the overall shape of the head (Picture 8), while I tried to make sure that no N-gons, polygons with more than four sides, were left. At this point many 3D modeling tutorials would have selected and removed half of the existing head and used the **Symmetry** modifier to create a constantly updated, mirrored duplicate of the remaining side, speeding up the modeling process (Autodesk, docs.autodesk.com.)

I decided not to use the symmetry method in this part of the project, as I had seen cases where this method caused a very visible seam at the part where the original and the mirrored half intersect. And since this seam would move across the character's face, it might have looked awful. Dozens of polygons would also be saved by keeping the middle part of the face all flat, so I instead chose to **Chamfer** the mid-most edge loop moving across the face, effectively splitting it into an all new face loop instead.

With the newly created polygons I could easily pull out the average shape of the nose and lips, which I kept refining with new edges when needed (Picture 9).

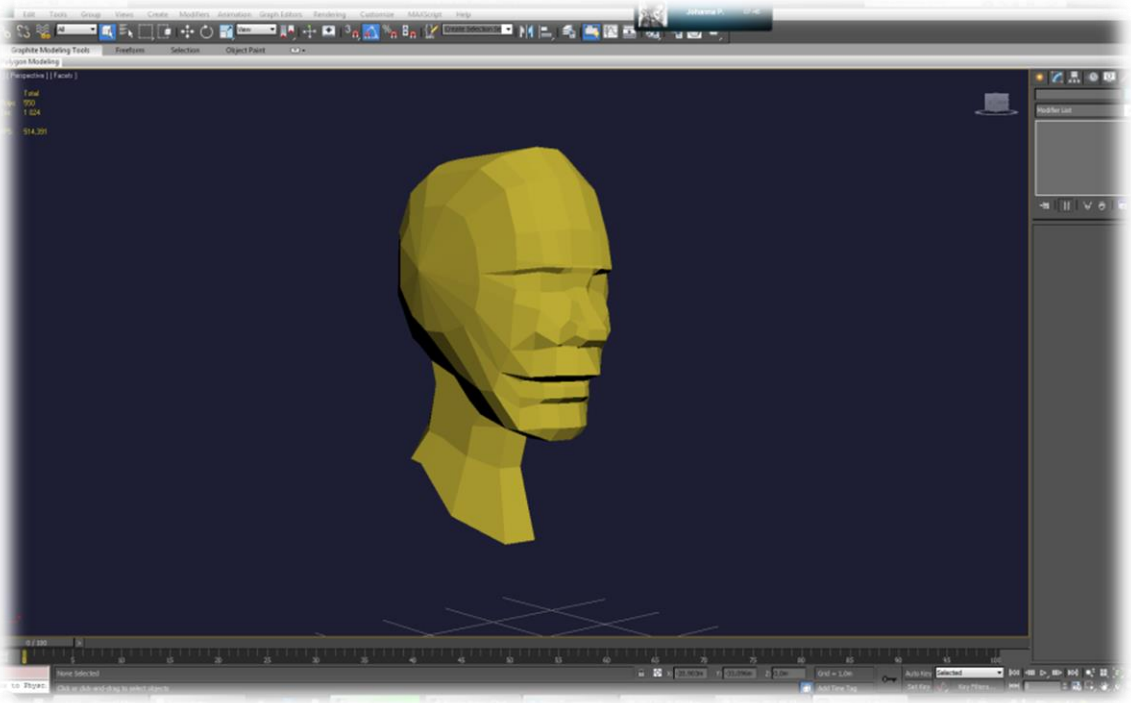


Picture 8. The sphere is refined with more details and shaped into a head.



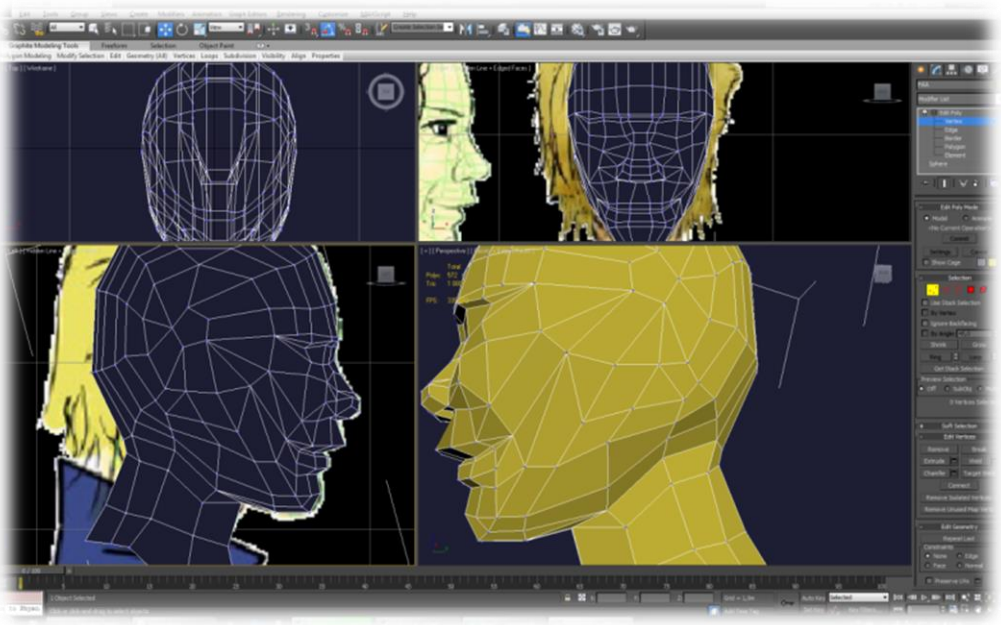
Picture 9. Shapes of the nose and lips have been formed and a new edge has been cut.

By selecting and deleting some of the polygons at the bottom of the head and then selecting the formed hole with the Edit Poly modifier's **Border** tool it was easy to **extrude** the basic neck shape. The areas around nose, eyes and mouth were given new edge loops and even straight cuts in order to form more details. The head already started to resemble the character (Picture 10).



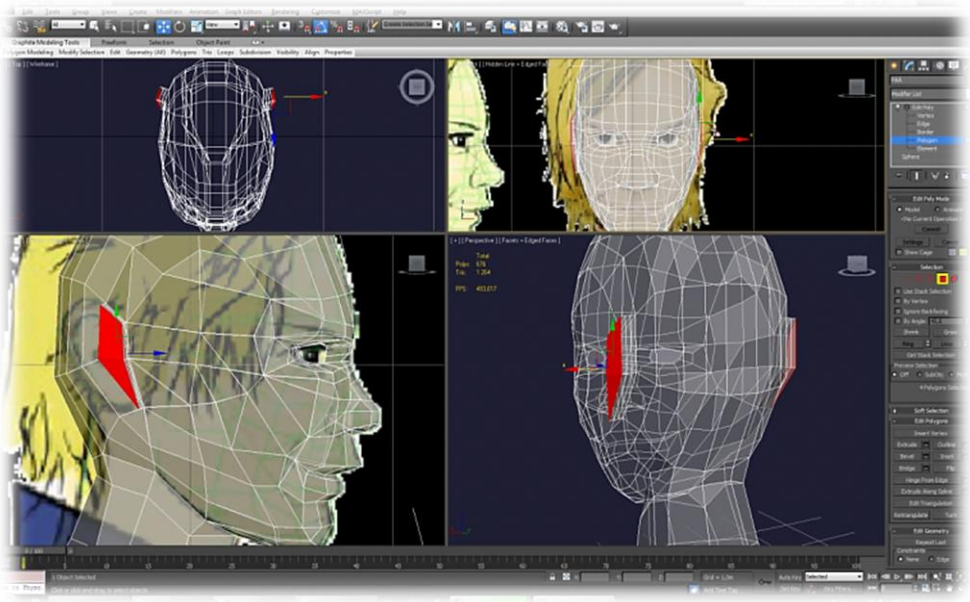
Picture 10. Head is gaining it's form with some clear facial details.

To add ears, I started by selecting the pointy corners at the sides of the head, and chamfered them into new planes, effectively smoothing these points into flatter areas. Using the **Target Weld** tool, I combined an efficient amount of this new plane's vertices in order to change the circular shape into a pentagon, again reducing a good chunk of polygons (Picture 11).

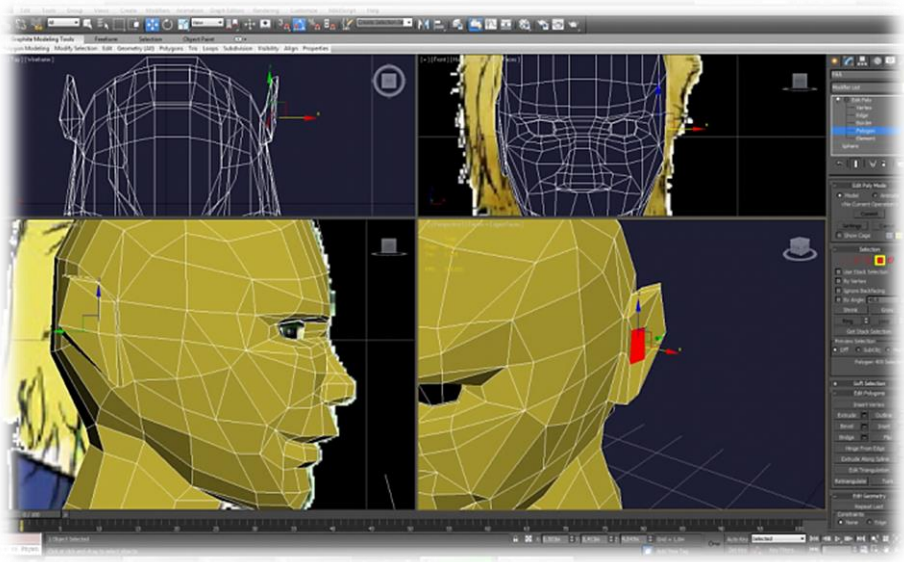


Picture 11. Sides of the head are flattened and optimized.

After the adjustment's to the shape and topology of the head's sides, I simply grabbed a handful of polygons around the parts where the character's ears should be on both sides of the head, and extruded them twice; first in order to get the ears to stand out of the skull, next in order to enough have material to form the auricle (picture 12). This was done by enlarging the outer extruded ring of the ear shape. The top-most planes of these ear tubes were then **Beveled** inwards in order to give them some basic three-dimensional form (Picture 13).

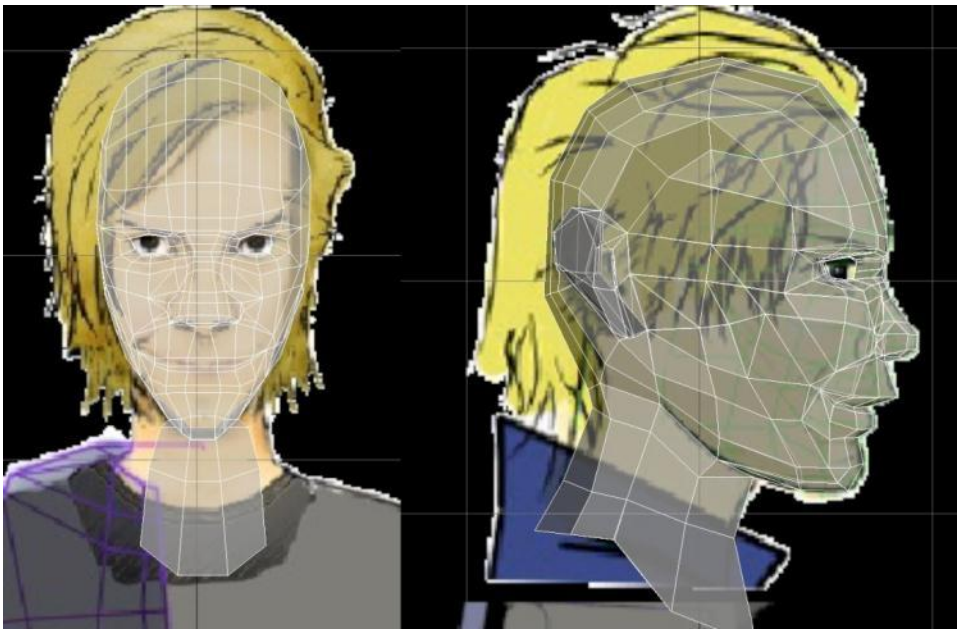


Picture 12. Ears are extruded out of the head.



Picture 13. Beveling the ear inwards to give it more cup-like shape.

The ears would go through various tweaks later on. The eye-sockets were made by creating and pushing new edge loop rings inside the skull, deleting the very base plane. This would give the character's eyeballs enough space to sit in and still be visible from the side like in the drawing (Picture 14). The head model was finished by placing a **Smooth** modifier on top of the object, using the **Automatic smoothing** with fairly high value of 90.



Picture 14. The shape of the head is finished and it matches the reference images.

3.2 Adding hair

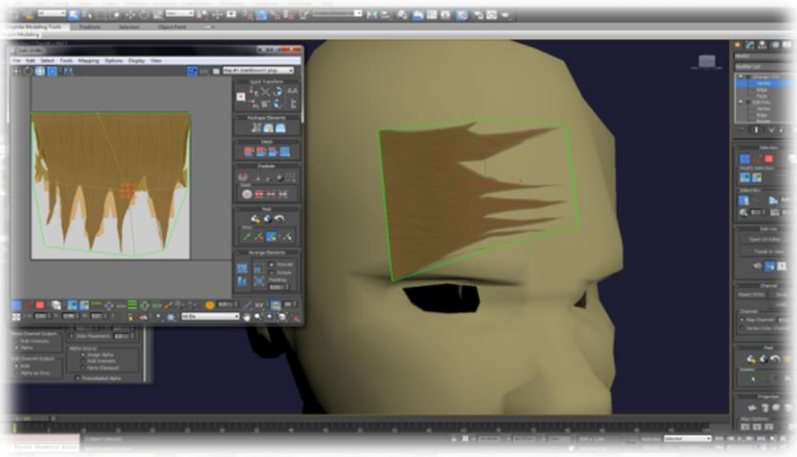
While some short hair types can be fairly nicely faked with just well-shaped skull and textures, our Jöre's long hair required more attention. For quite some time many developers have used individual two-sided planes with cut-out hair textures to give their characters a lusher and more detailed looking hair, and that is how I approached my character as well. Not to mention with the help of individual hair parts it is possible to animate moving hair.

My goal was to mix pre-painted hair textures on the skull with matching individual hair planes, making it hard to determine where the planes end and the base mesh begins. This same method can be seen being used even in many AAA games, one good example being Konami's Metal Gear –series (Picture 15).

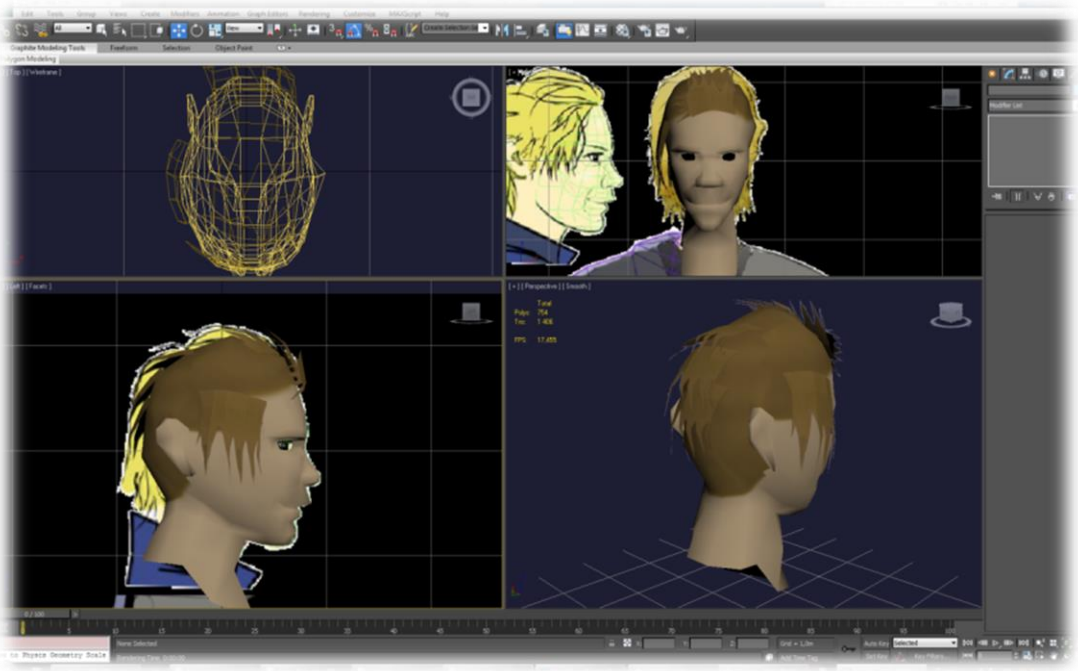
Picture 15. The model of Snake from Metal Gear Acid, with the hair planes separated.

The work began by deforming the very top of the head, simulating some basic fluffiness of the hair with the base model itself. In order to properly see how the hair would act on the model, a quick texture with an alpha map was created for it. The process was started by creating two simple **planes**, one with 2x3 and the other with 3x3 subdivisions, and curled them up a bit. I will go through the details of actual texturing in the later chapters, but for now let's keep things simple and say that I did the following procedure kind of backwards. In Photoshop I created a crude hair strip lookalike texture with rest of the image being see-through. The image was saved as **.TGA** to keep the picture's alpha, and imported it into one of the scene materials as a **Diffuse map**. To get the transparency to show as well, I copied the diffuse map to the **Opacity map**, setting its Amount value to 100 and setting its **Mono Channel Output** setting to **Alpha**. Finally, the material's **Show Shaded Material In Viewport** –option was enabled to get the end result show in the editor's viewport.

Next, I ran the hair planes and the head quickly through an automated Unwrapping process in order to get a fast UV maps. The hair texture fitted on the planes with little tweaking, thus the outcome of these ugly yet working pieces of hair (Picture 16). I also did paint a crude hairline and color on the scalp area, on top of the head's UV map. This texture was imported into the scene and assigned into the head, which helped blur the borders of the hair pieces and the base model (Picture 17).

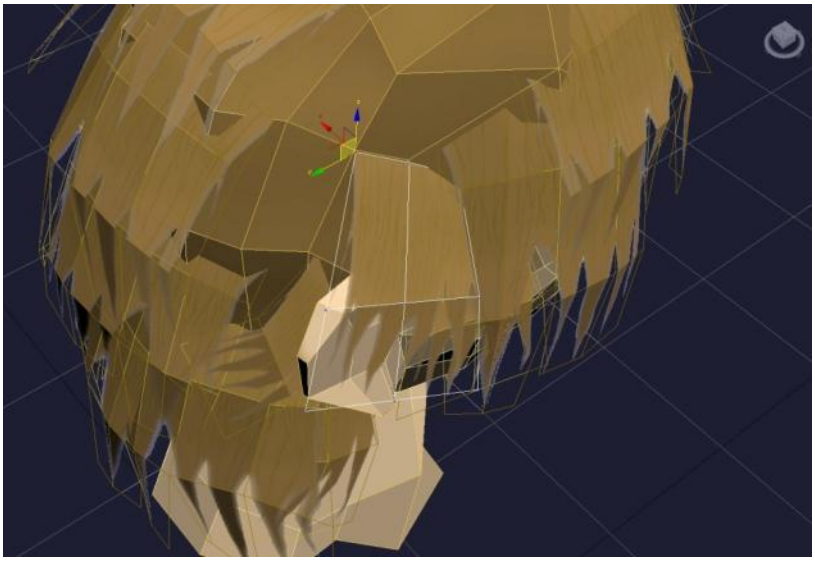


Picture 16. Hair strip texture with an alpha map working correctly in 3Ds Max.



Picture 17. The head's texture meshes well with the colors of the hair strips.

I made dozens of copies out of both hair strip types, placing each of them manually on top of the head in order to give a decent illusion of natural, flowing hair. Certain individual hair parts were rescaled and rotated in order to emulate the way the hair flows down in different parts of the head, such as behind the ears (Picture 18). The root side of the planes I placed slightly inside the scalp, following the head's shape as closely as possible. After a several dozen individual pieces were placed, the end result was already fairly impressive low poly mass of hair (Picture 19).

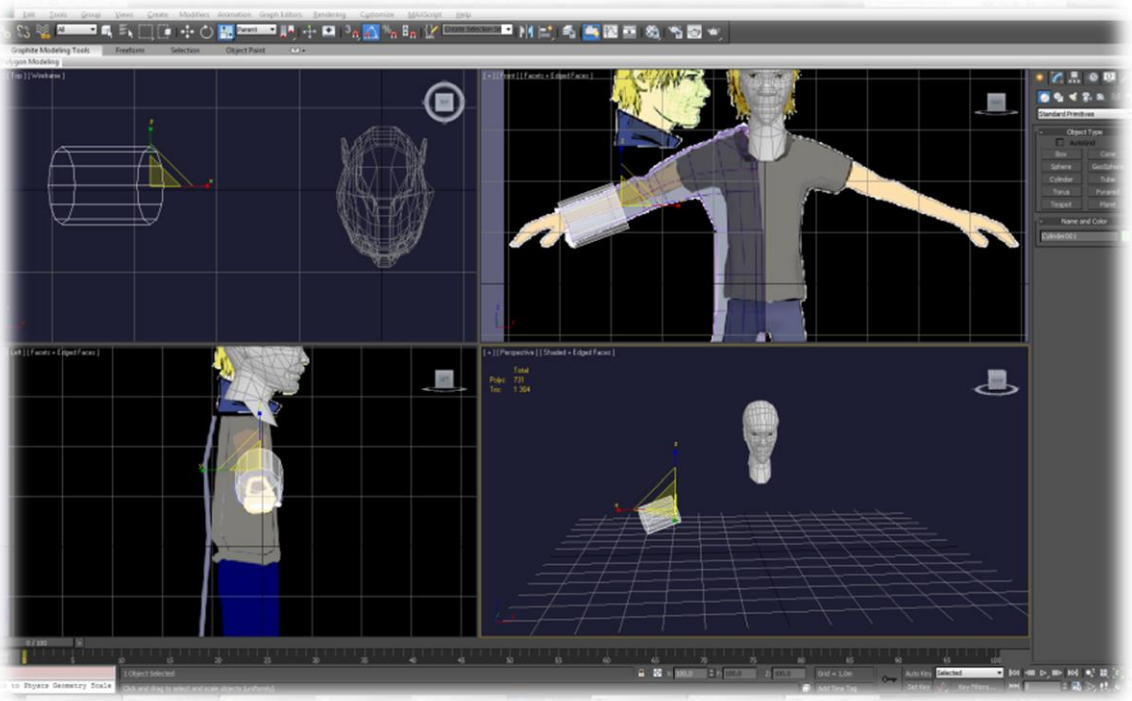


Picture 18. Manually placing hair pieces around the head in layers.

Picture 19. The final result already looks convincing even with a placeholder texture.

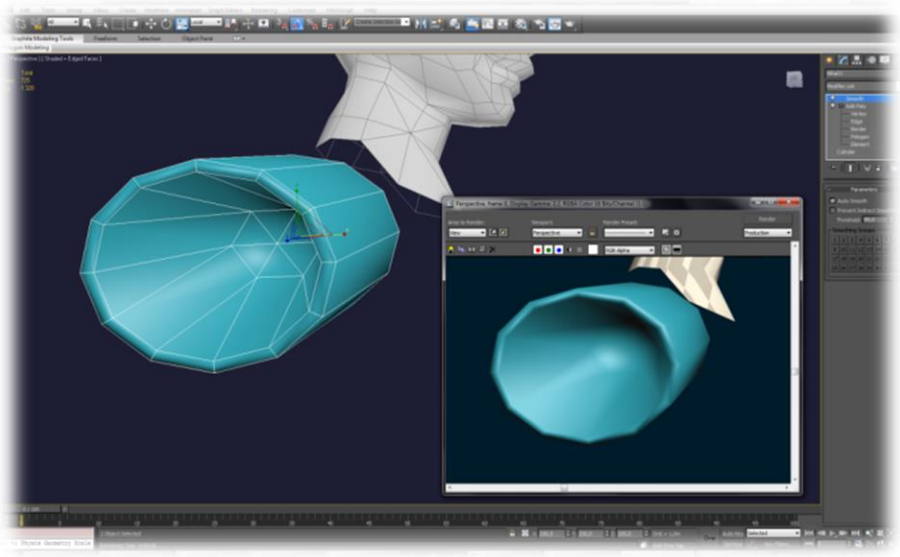
3.3 Starting the jacket

The leather jacket is a very eye catching part of Jöre's equipment, yet it is fairly simple by its overall design. I started it by creating a simple **Tube** object with only one height segment. This tube was placed at the very end of the jacket sleeve and aligned it according the reference image (Picture 20).



Picture 20. Starting the creation of the jacket's sleeve with a tube object.

I deleted the very top polygons at the higher end of the tube, grabbed the inner border and moved it downwards closer to the end of the sleeve. The **Cap** tool was used on this border to close it. I then shrank it down a bit in order to form this smooth cup-like shape, which would eventually house the character's hand (Picture 21). Next, I simply grabbed the outer border of the opposite end of tube and started extruding more parts out of it, towards the character's torso area, shaping the forming loops according the reference image.

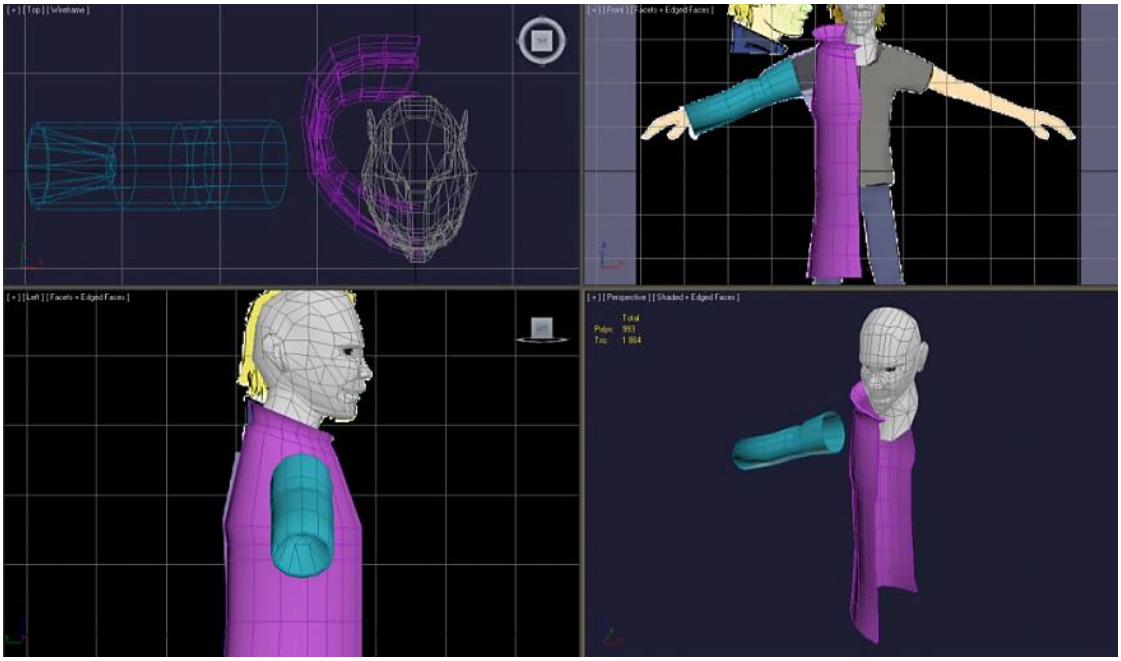


Picture 21. The sleeve's made solid from the inside.

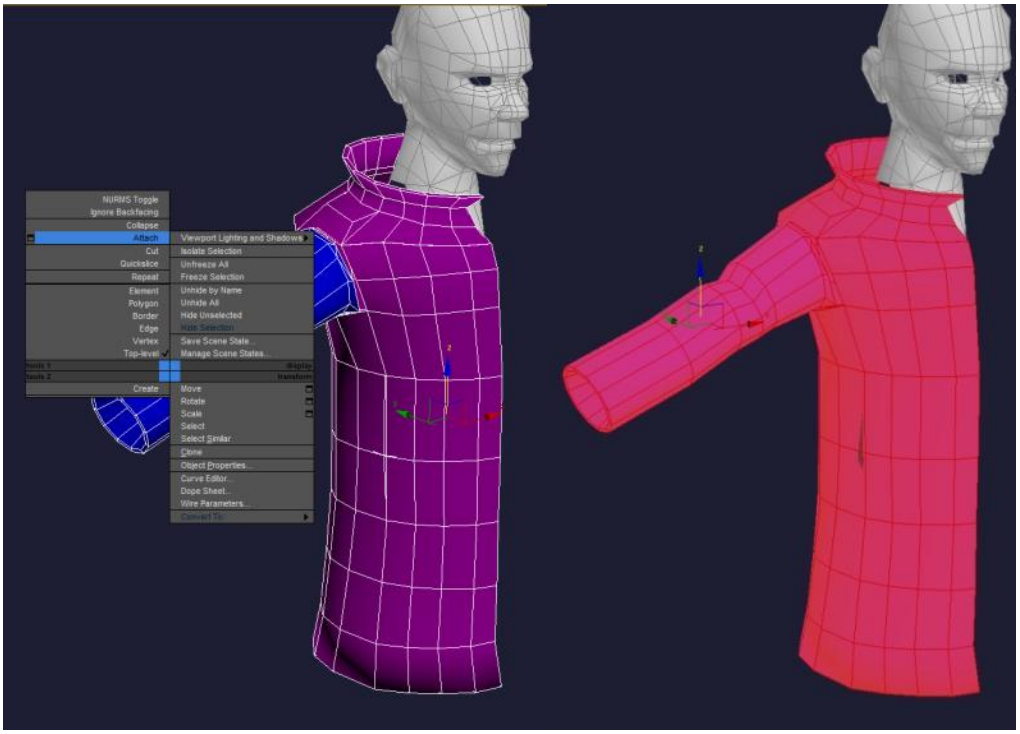
At this point I began the creation of the jacket's hem, again starting with a simple tube object that this time grows upwards. I stopped at the first marked subdivision part in my reference image and cut away half of the entire tube. The idea was that the sleeve and jacket's body would be connected into a single object later on, stitched together, and finally turned into a whole jacket with the use of the **Symmetry** modifier. The jacket is supposed to be more symmetrical and tailor made than a human face anyway.

Once the cut was done I kept extruding the top part, shaping each new top according the background images. The result was two floating pieces of tubes for now (Picture 22). In order to make the connection of these two parts easier and make the jacket flow better with the character's body shapes, some extra edges were cut around the shoulder and armpit area of the jacket's main body tube. Bunch of polygons were also deleted in a circular area from the side of the body, around where the sleeve would be connecting. The sleeve's higher end was extruded once and then moved very close to the opening in the body to allow easier welding later on.

When the two connecting ends seemed even, I selected the Sleeve object, **right clicked** on it and selected **Attach**. Once I clicked on the jacket's body part, the two individual objects were merged into a single editable poly (Picture 23). The vertices of the sleeve and the body's gaps were welded shut, making the object whole.



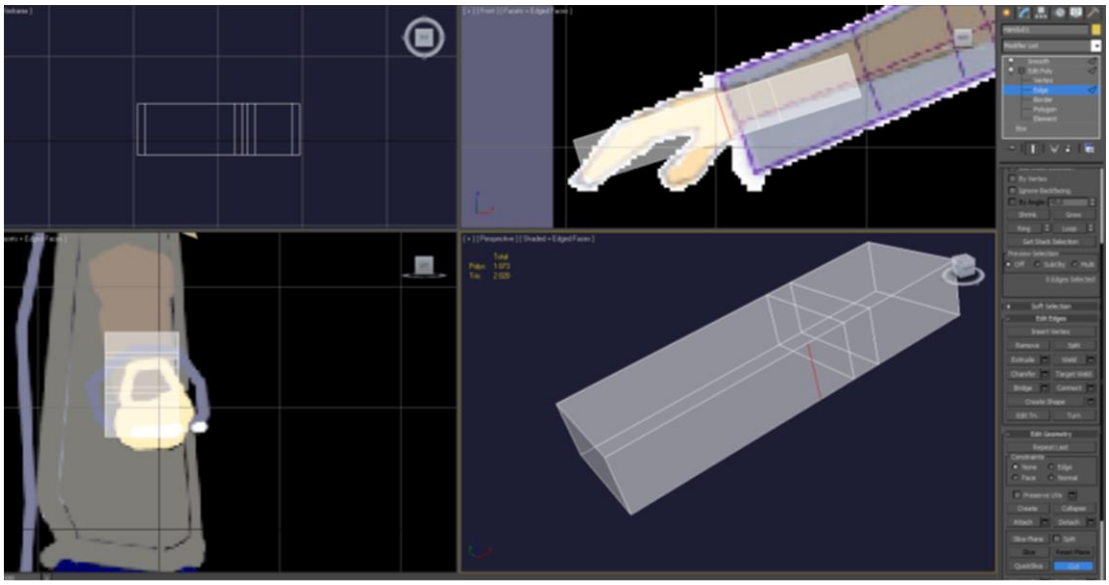
Picture 22. The sleeve and the body of the jacket, both extruded out of tubes.



Picture 23. Sleeve is merged into the jacket's body with the Attach function.

3.4 Modeling a hand

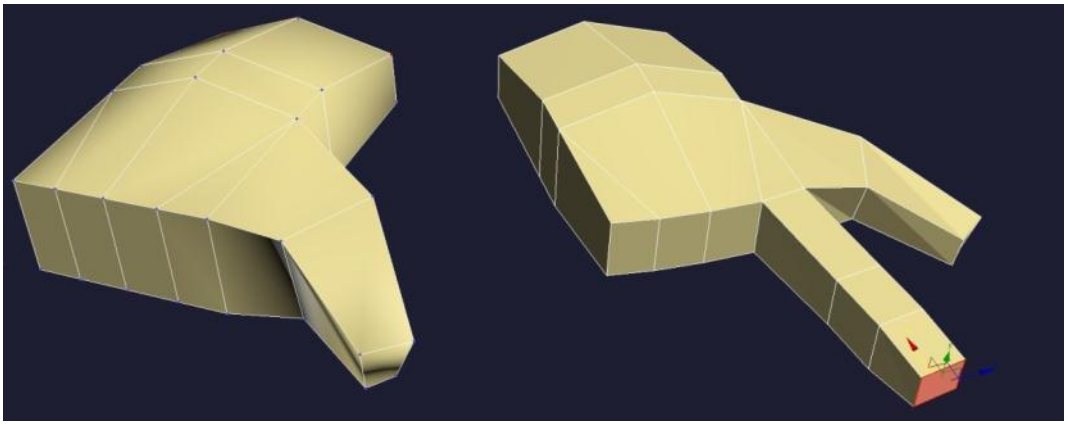
The human hand can appear very complex at first glance, but creating a low poly one is literally all about basic box modeling. I started by creating a box roughly the size of the hand in the reference images, gave it three length segments and tilted it accordingly. The jacket was **hidden** to allow us to work on this object freely. The two loops were moved inside the box, to the position where the character's wrist would be, after which the thumb was pulled out from the side of the palm (Picture 24).



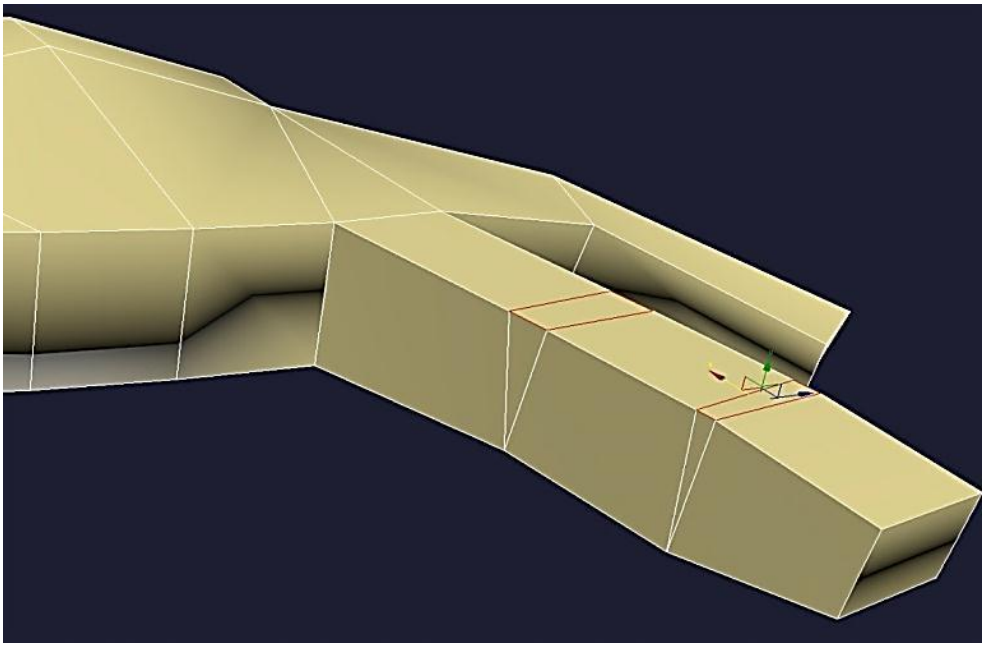
Picture 24. The hand starts as a simple box.

The thumb was made out of two extrudes; it starts from the border of the wrist and leans slightly forward. Four new cuts needed to be done in the front plane of the box, in order to start creating rest of the fingers. The index finger was extruded into three parts, each section being slightly shorter than the previous and facing more downwards. The overall shape narrowed a bit towards the tip (Picture 25).

In hindsight, I would suggest extruding the fingers in 6 parts, leaving small joint segments between the longer main sections. I always make the joints in kind of V-shape that closes down towards the direction where the limb, or some other body part, bends. This makes them look better when animating, as you're not left with a sharp corner at the character's knee or elbow for example when the limb flexes (Ben Mathis, 2005). In this case I cut extra edges in order to form these V-joints (Picture 26).

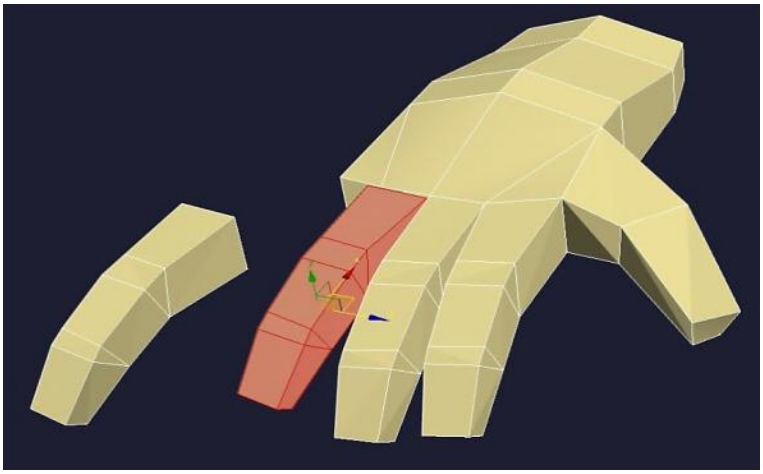


Picture 25. Thumb is extruded from the side, fingers from the front of the palm.

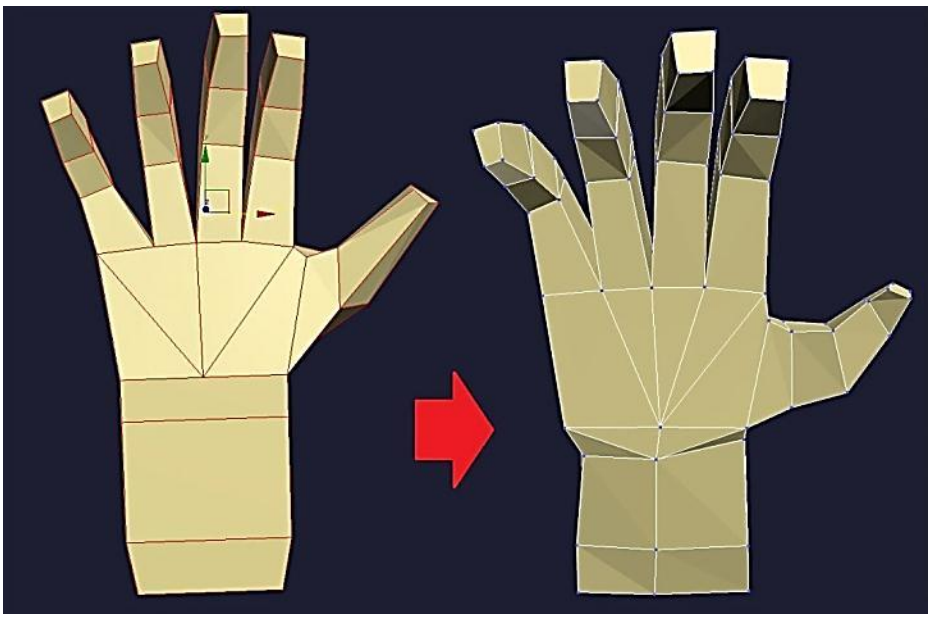


Picture 26. The segment borders are edited into working joints.

While it is possible to just extrude the rest of the fingers the same way, even all of them simultaneously, I opted to select the whole index finger and make copies out of it. I then removed the next segment right next to the previous finger and welded the new finger into its place (Picture 27). Each finger's length and thickness were slightly edited to add a hint of their natural variation.



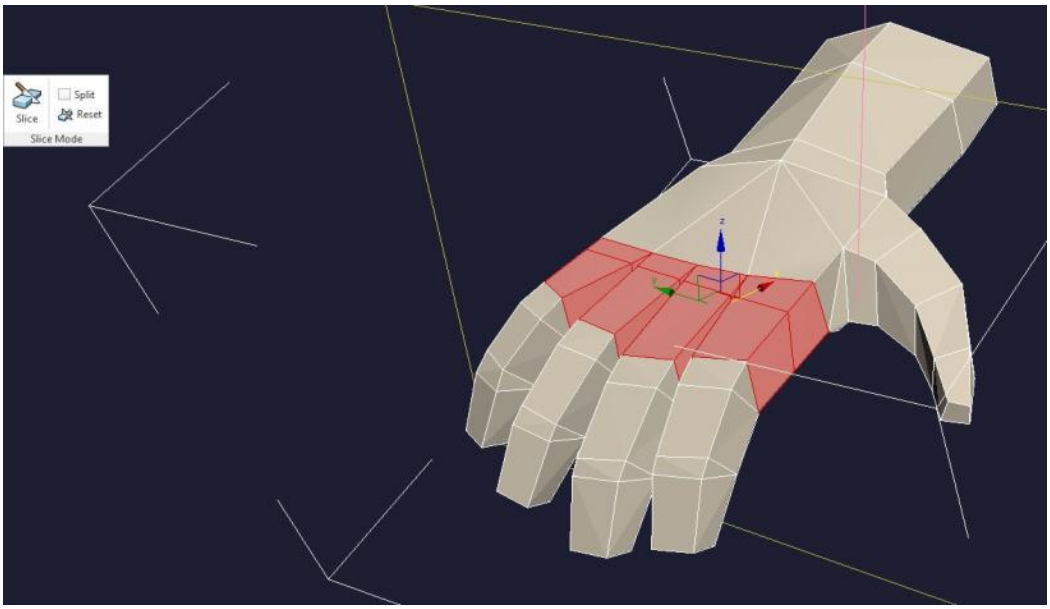
Picture 27. Moving and welding the new fingers into their position



Picture 28. More cuts were made into the palm area in order to shape the hand better and help it animate smoother.

As I examined my own hand, I soon realized that I needed to add more details into the model's palm area and on the thumb, just to help the final model to both animate and look better (Picture 28). I also noticed that I had forgotten to add the very first joints of the fingers, which were quickly added to all four digits with the **Slice Plane** tool, followed by target welding the bottom vertices to form the V-shaped joint (Picture 29).

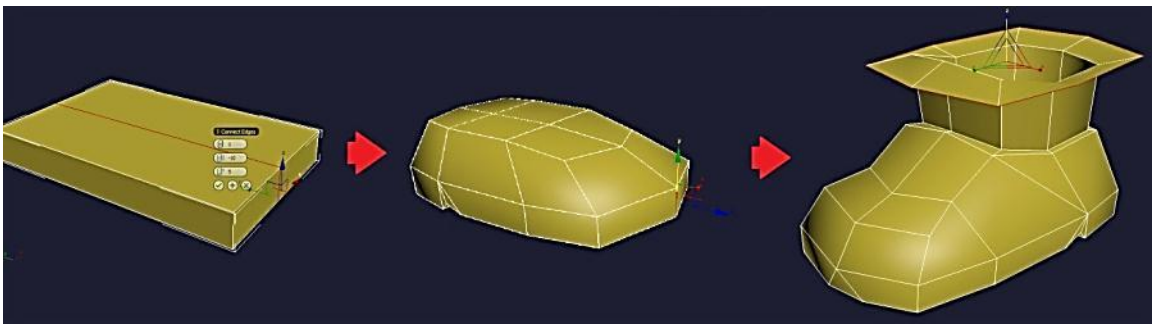
The hand was placed inside the entrance of the jacket's sleeve, penetrating its cup-shaped base. Because of this design, there was no need to waste polygons and model the rest of the arms.



Picture 29. Edit Poly's Slice Plane tool is used to create new loops to all fingers.

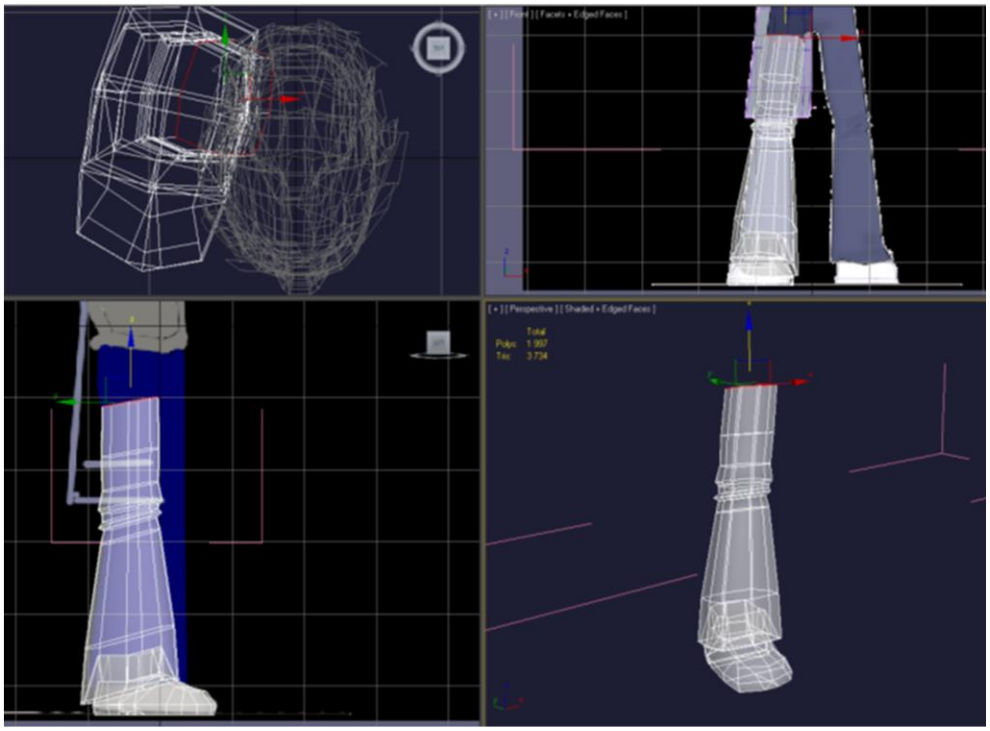
3.5 Modeling legs and torso

The rest of the character's body was modeled as a single solid object, starting from the shoes and climbing all the way up to the person's shoulders. All started once again with a basic box, which was cut into more segments and slowly shaped into the shape of a shoe (Athey Nansel-Moravetz, 2007). Short piece of a leg was extruded out of the shoe's top, then expanded outwards to start forming the jean's leg (Picture 30).



Picture 30. Evolution of the shoe.

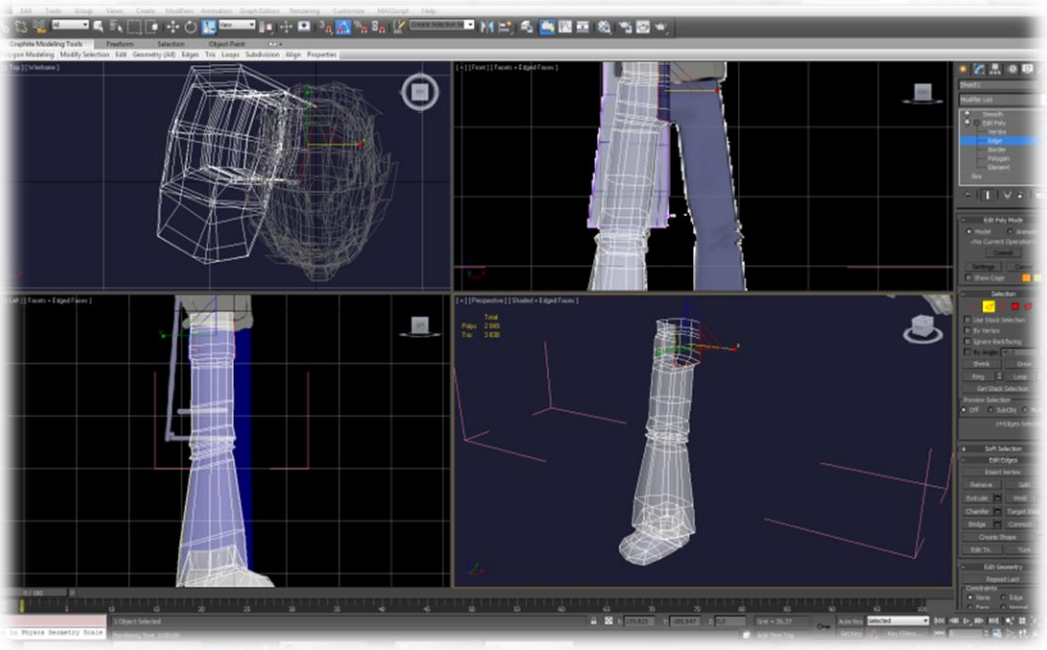
At this point I slightly rotated the leg outwards by its Z-axis, to make the character stand his legs slightly apart. I continued to extrude the jean's leg, first downwards on top of the shoe in order to form similar cup shape as with the jacket's sleeves. From here I made a U-turn and started forming the leg itself. Several short extrudes were made around the knee area, altering with shrinking and expanding the loop in order to form wrinkles (Picture 31).



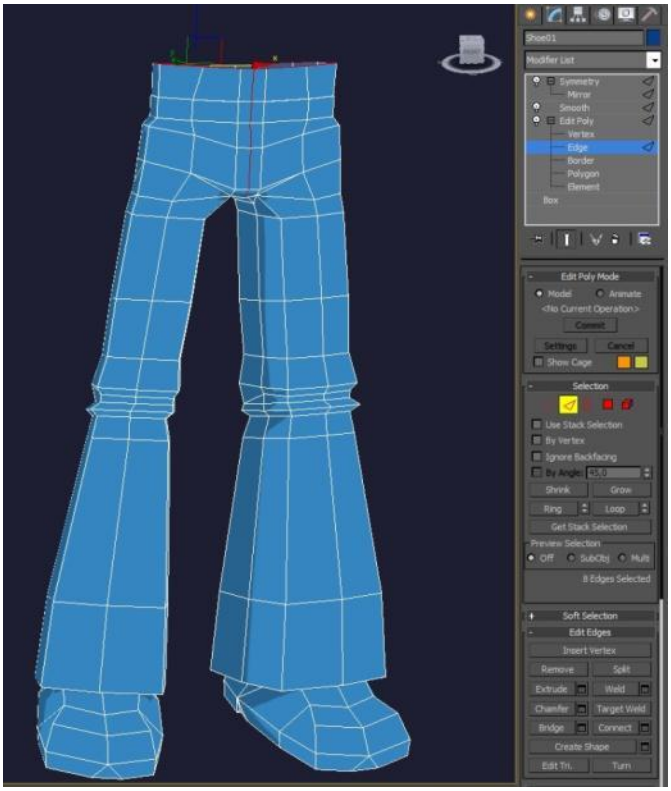
Picture 31. Legs are being extruded upwards, following the reference image.

The hip area was a bit tricky. The spot where the leg is connected to the hip has two small segments to allow smoother animation and forming the crotch curve between legs. The rest of the area is an extruded segment going upwards, all the way to the belt section. There was a small inwards-heading transition segment made before the belt itself, which was a single straight extrusion. From the belt I extruded a small part of tummy (Picture 32).

At this point it was good idea to apply the Symmetry modifier on the object. Doing this gave us a nice pair of symmetrical legs. The hip section was now retouched manually to give it a more natural shape. In men's case, this meant a slight bulge. The legs segments needed to sort of arc and suck into the crotch area, forming these V-shaped sections around it (Picture 33).



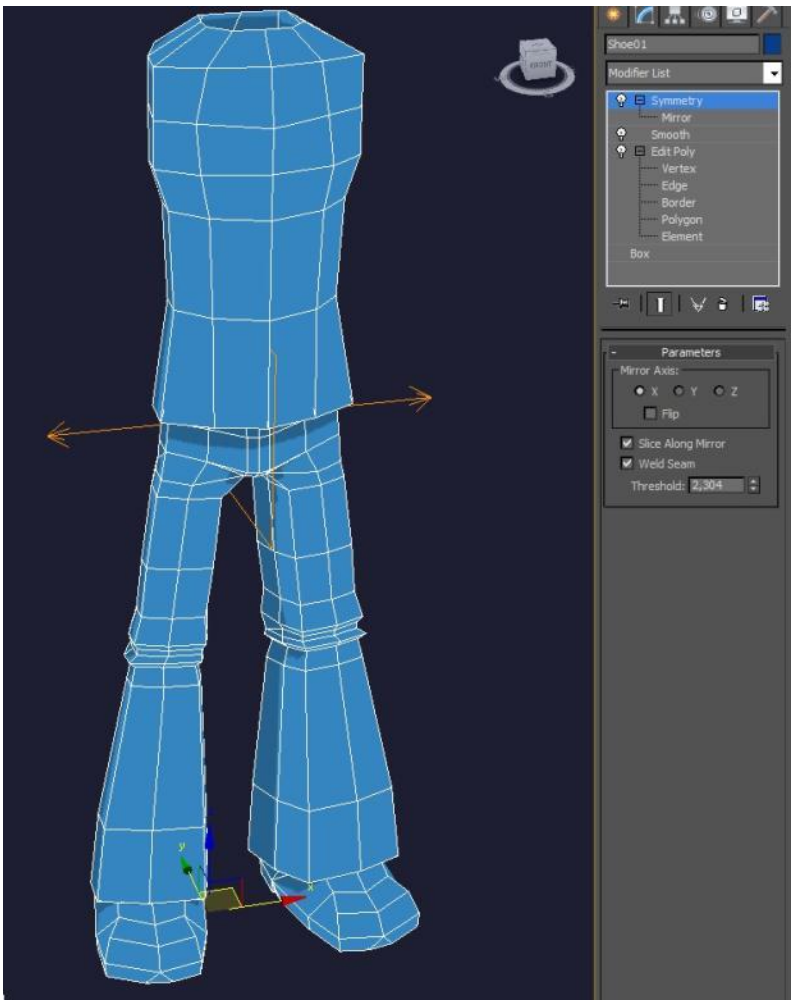
Picture 32. Shaping up the hip.



Picture 33. Symmetry modifier is applied on the object and hip section is edited.

I continued extruding from the previous stop, doing a short U-turn downwards in order to form the T-shirt's hem. The hem covered the stomach and the belt, slightly opening out-

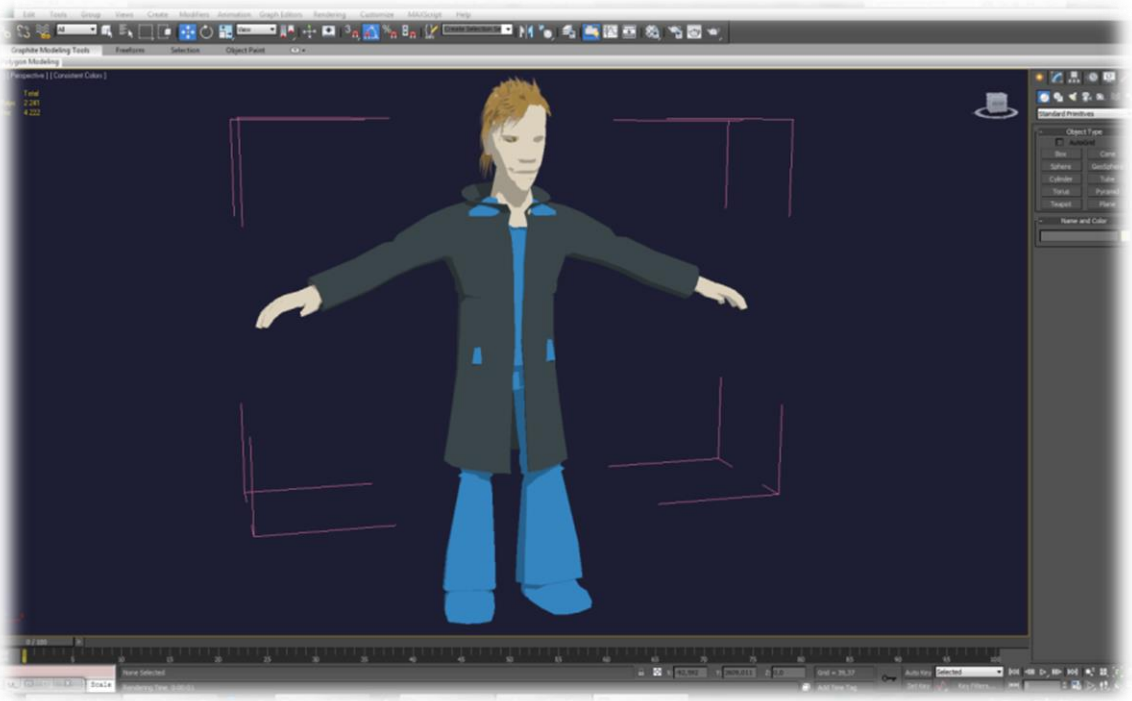
wards from the center of the body. After yet another cup-shape was done, I turned around and start shaping up rest of the T-shirt, which is also the character's torso in this case. This part of the body was fairly simple, since most of it would be covered by the leather jacket anyway. The shirt was given only some vague shapes, and it closed down towards the neck. The very top section was left open as I would be attaching and welding the head to rest of the body. There was no need for sleeves or any polygons around the part where the arms would come out of the shirt (Picture 34). The backside of the shirt, which would soon be almost completely covered by the jacket, was simplified even more in order to save valuable triangles.



Picture 34. The finished body object.

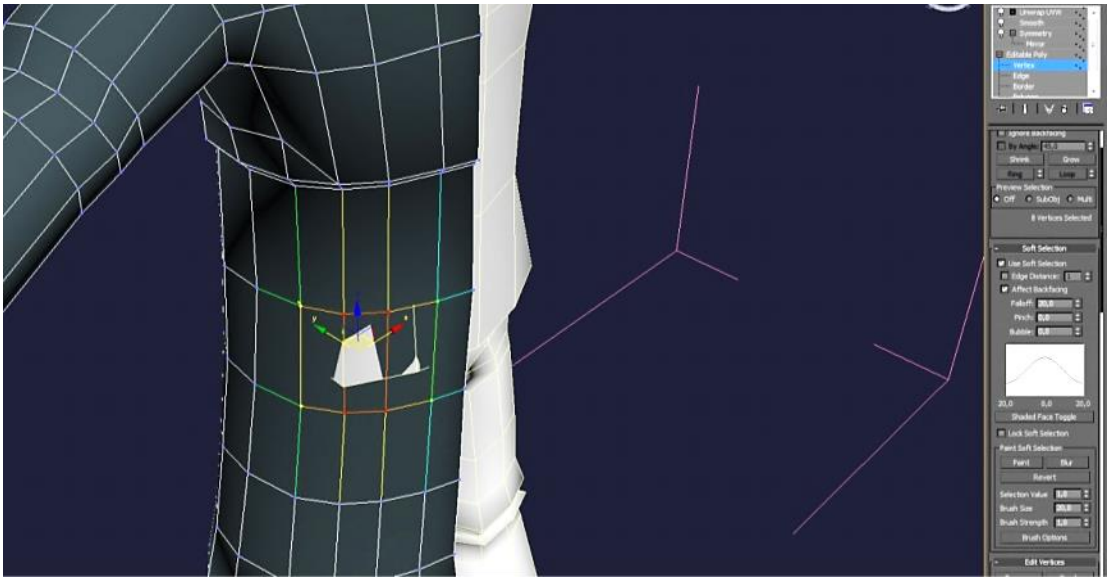
3.6 Adding details and finalizing mesh

With the rest of the body in place, we could now unhide the jacket and start adjusting things. First, I added the Symmetry modifier to the hand and jacket objects to form the full character. There was some visible clipping happening with the jacket and the body objects, causing bits of the shirt to push through (Picture 35).



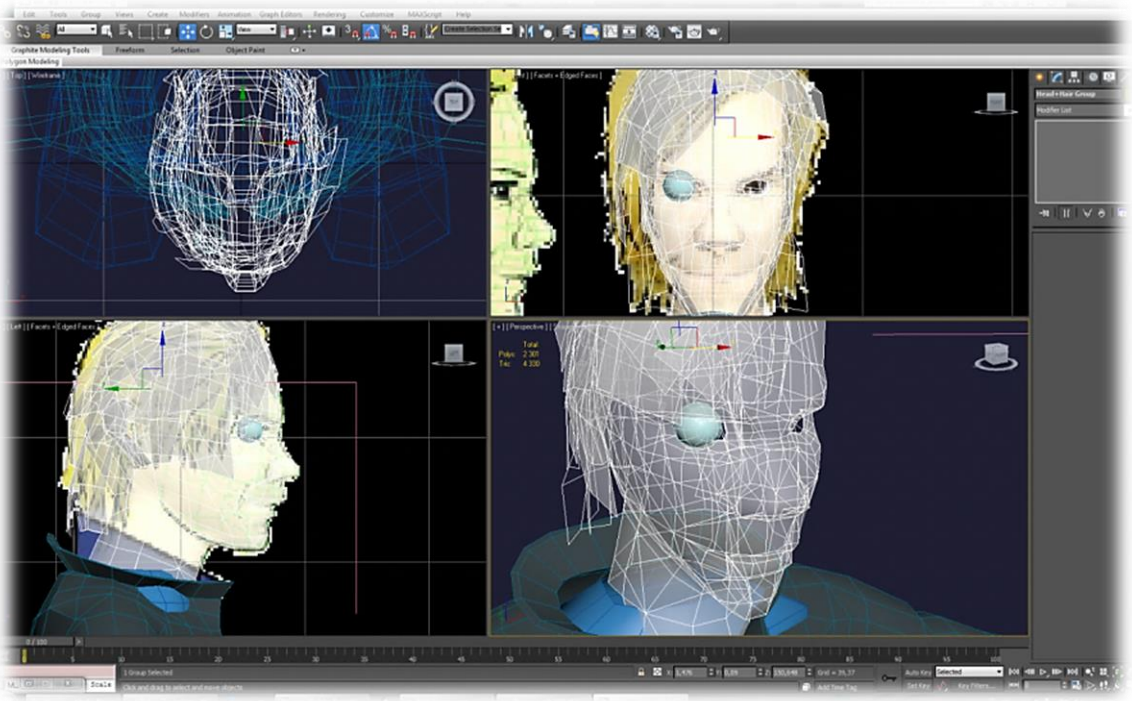
Picture 35. Jacket and hands are mirrored using Symmetry to form rest of the body.

In order to get a better view while working, I alternated between turning the jacket and the shirt objects transparent by selecting one of them and pressing ALT+X. Then, by enabling the **Use Soft Selection** option in the Edit Poly's menu, I grabbed any of the meshes vertices, edges or polygons near the clipping areas, and moved them around until the shirt was hidden underneath the jacket. The **Soft Selection** sort of radiates the effect of the changes done to the selected piece, allowing smooth, flexible adjustment of details in a wide area. The size of the affected area can be adjusted with the **Falloff** value on the Soft Selection menu (Picture 36).



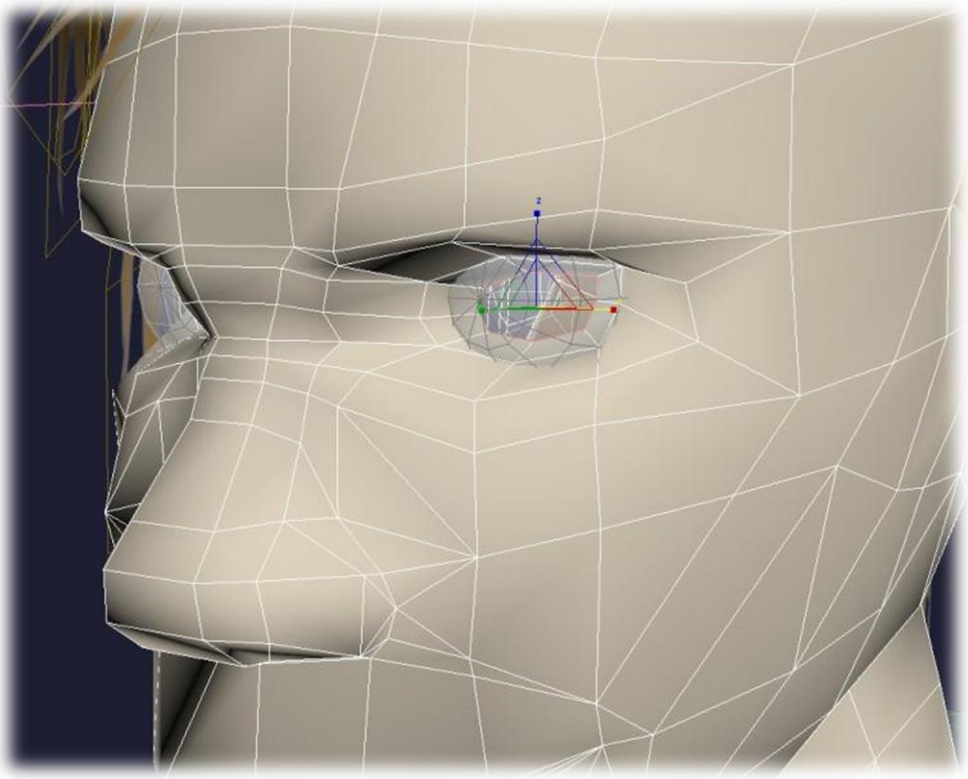
Picture 36. Using the Soft selection to fix clipping issues on a wider area.

So far the character had been blind, so I decided to finally give him the eyes. Using a simple 12 segment sphere as the base, I cut out the very rear of the ball by choosing and deleting one of the two vertices that connected the 12 triangles on both sides. The remaining opposing side would be housing the iris later on. The ball was then placed inside the eye socket according the reference images (Picture 37).



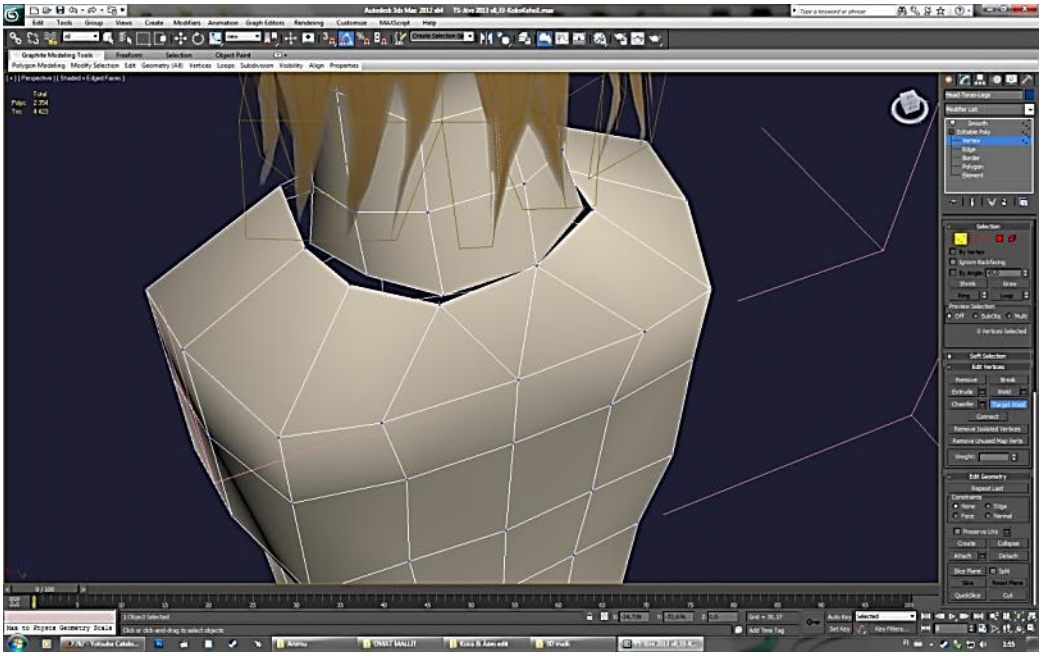
Picture 37. Placing the eyeball inside the socket.

With the good old Symmetry modifier I created a duplicate of the eye. While both of them fit their places fairly well, some polygons in the sockets appeared to clip into the eye balls. To fix this I started moving around the vertices inside the socket so that they would follow the shape of the balls more closely. It is good to have multiple circular loops in the area for this purpose. The gap at the back of the sockets was scaled down and moved backwards in order to make the eye sockets deeper, hoping it would result stronger shadows around the area in the final product, and help the eyes sit in their place better (Picture 38).



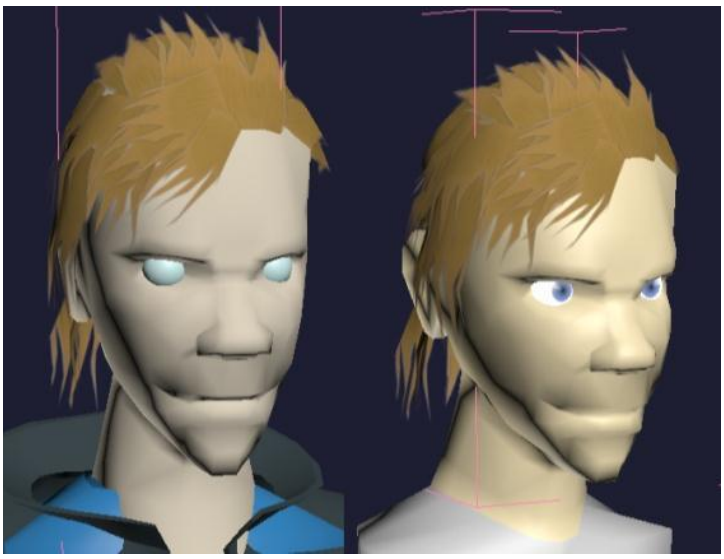
Picture 38. Adjusting the eye sockets to the ball's shape.

To ensure that our man wouldn't lose his head, it had to be welded on his body. By moving around the vertices on the gap of the shirt, I adjusted it to match the shape of the neck's bottom. In order to actually weld the two objects together, they had to be made into single object by using the Attach function. Finally, I simply used Edit Poly's Target Weld mode to drag and drop the shirt's vertices on the matching ones on the neck (Picture 39).



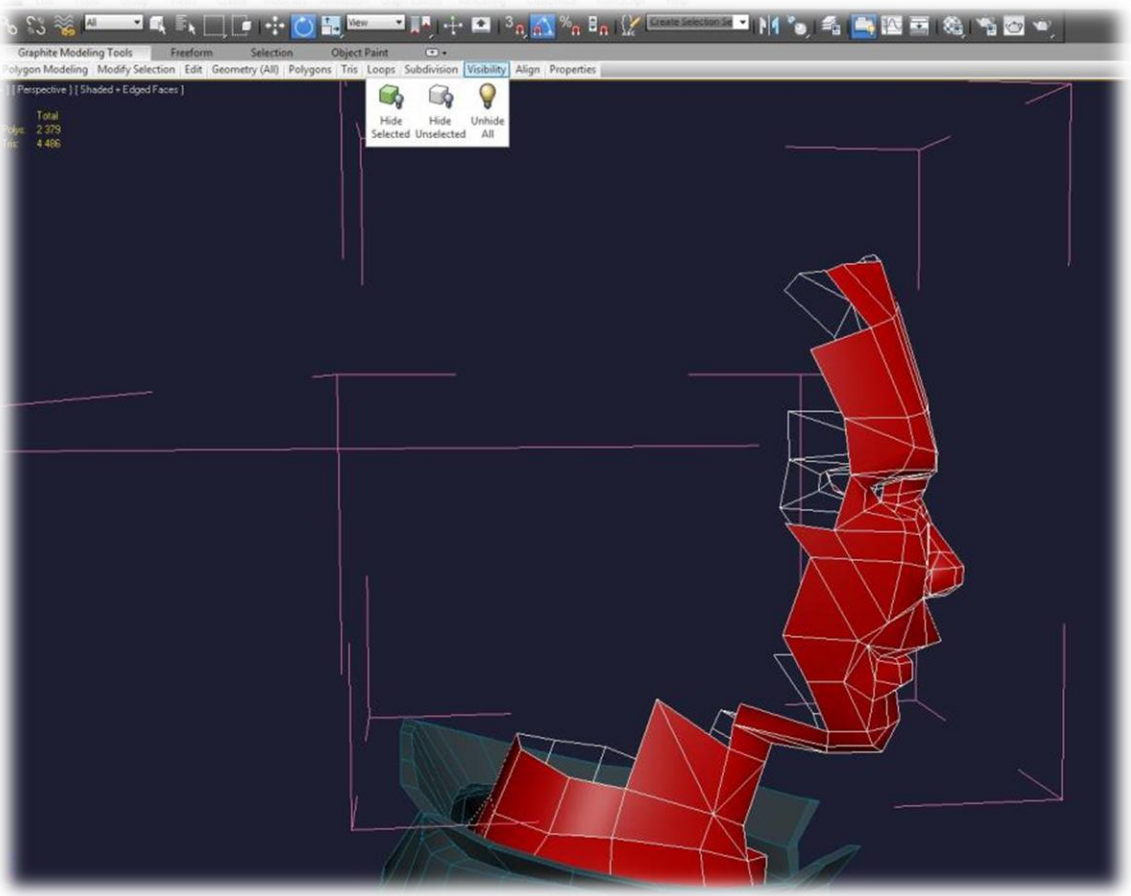
Picture 39.

I found the character to look a bit creepy with his blank white eyes, so I applied a quick coat of paint in them with the Vertex Paint modifier. This modifier's editor allows you to add color around the model's vertexes. The small ring in the front middle of the eye ball really made it easy to make an iris with the color blue, while by adding black on top of the mid-most vertex we got a decent pupil. I also added fake highlight to the upper corner of the iris. While a purely cosmetic touch, it really made the character already look more finished and nicer to look at (Picture 39). Some game engines can display these colors in the game too.



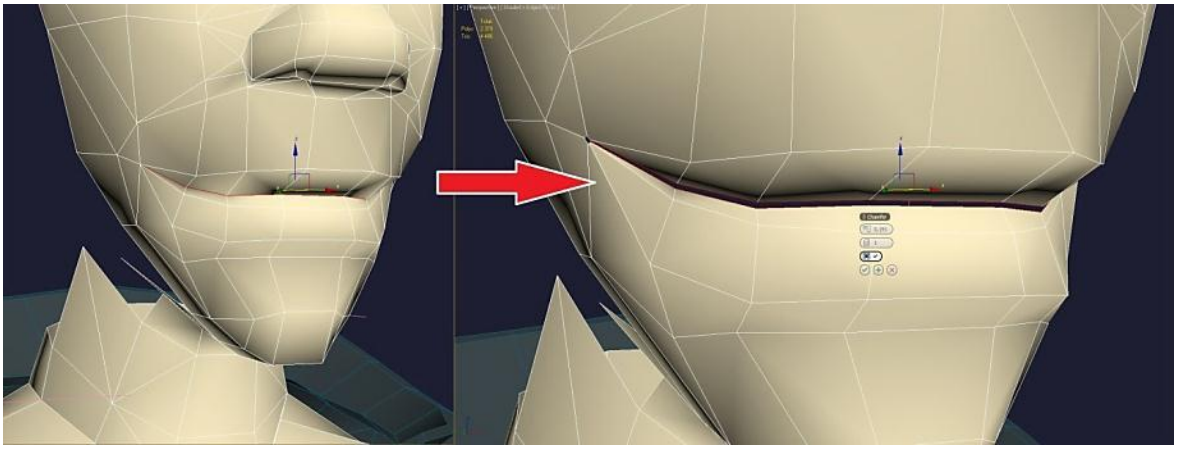
Picture 40. Eyes without any details and with vertex coloring.

While the current facial structures might have worked well enough in some parts of the game, I thought it would be a good idea to allow animating the character's mouth as well. To do this, we needed to literally open up his mouth and create the insides of it. As I would be working inside the character's head, I needed to hide the hair pieces and part of the head itself. It is easy to hide whole objects in 3Ds Max, but to hide selected polygons of an object you need to use the Hide Selected function, found in the **Graphite Modeling Tools** (Picture 41).

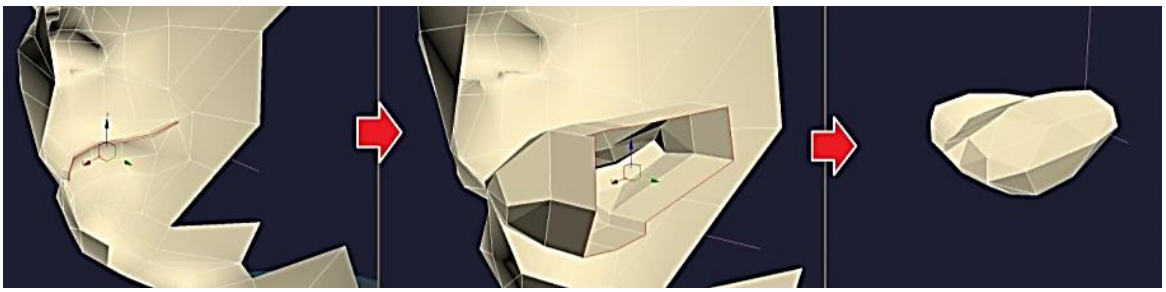


Picture 41. Most of the head is hidden to expose the insides.

I started the operation by selecting the deepest edges between his lips and separated them using the **Chamfer** tool. In order to avoid having to adjust the character's chin and other facial positions, I opened the mouth up only a little bit (Picture 42). Now it was possible to grab the edge ring of this gaping mouth using the Border selection, and start extruding the insides of the mouth, inside his head. The insides were kept simple, forming a sort of a closed ball that would house the teeth and tongue (Picture 43).

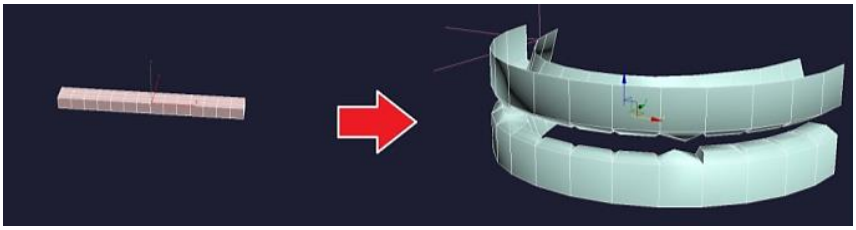


Picture 42. The mouth is slightly opened with the Chamfer tool.



Picture 43. The process of forming the closed space inside the mouth.

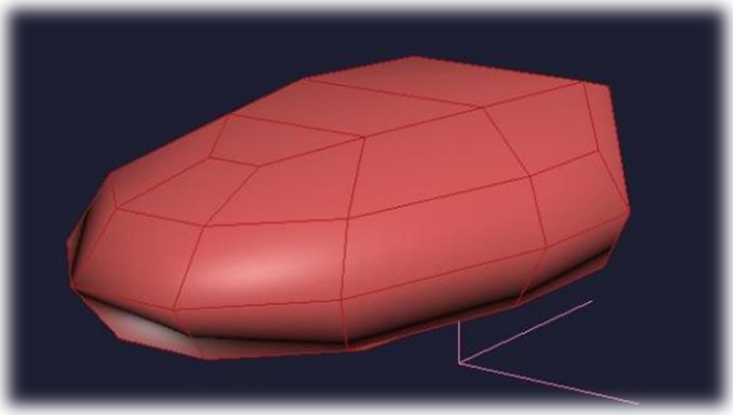
Thanks to the model's low poly design, and the fact that players seldom stare into the model's mouth, the stuff inside didn't need to be too detailed. I started with a narrow box with 14 vertical segments, one for each tooth, with two horizontal cuts on top to give them some shape. The bottom was removed and the **Bend** modifier used to create the U-shape. The four front teeth I sharpened by welding the two rows of vertices on the top into a single line. Fangs were sharpened up by merging all four top-most vertexes into one. A small gap was added in between the teeth with the **Chamfer** tool, while unnecessary polygons in the gaps were welded away. The finished shape was then mirrored upside down and collapsed into a single Edit Poly object (Picture 44).



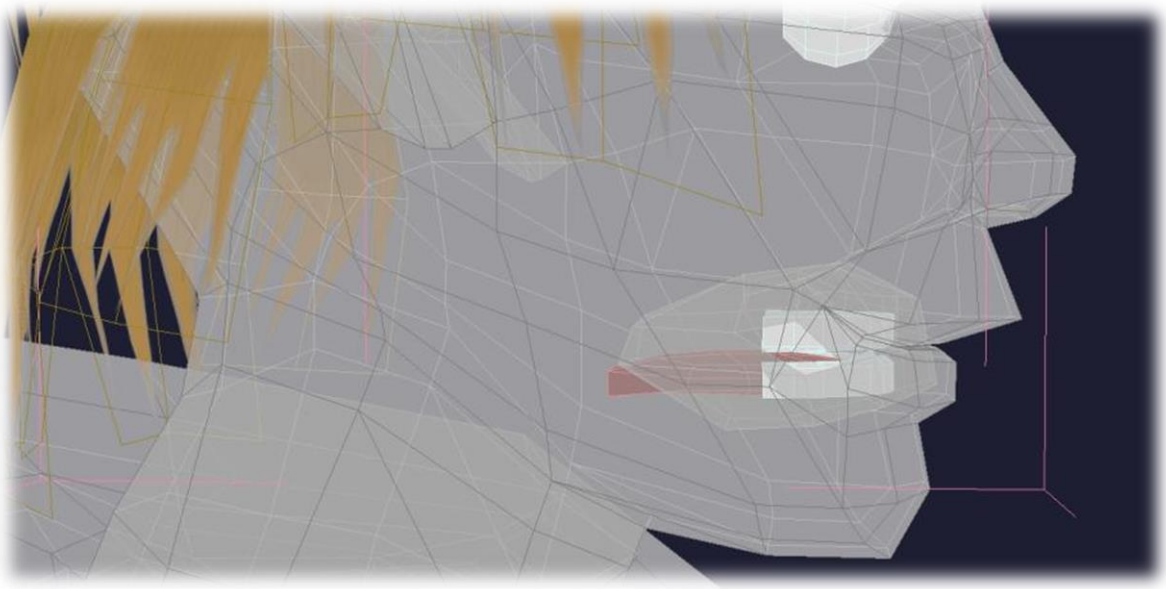
Picture 44. The beginning and the end result of the teeth object.

While the teeth and colored insides of mouth alone make the character much more life-like even up close, there can be times when he might benefit from having a tongue. I kept this object simple as well, starting with a basic sphere, flattened it a bit on its Z-axis, cut the very back of it away, and simplified it's topology just a bit (Picture 45).

The teeth and tongue are now moved inside the spherical mouth section. The tongue was edited to be slightly longer so by default it penetrates the back of the mouth and can be stuck out of the mouth if needed (Picture 46). The teeth were later made slightly longer in height so they could be exposed more without showing the obvious cuts.

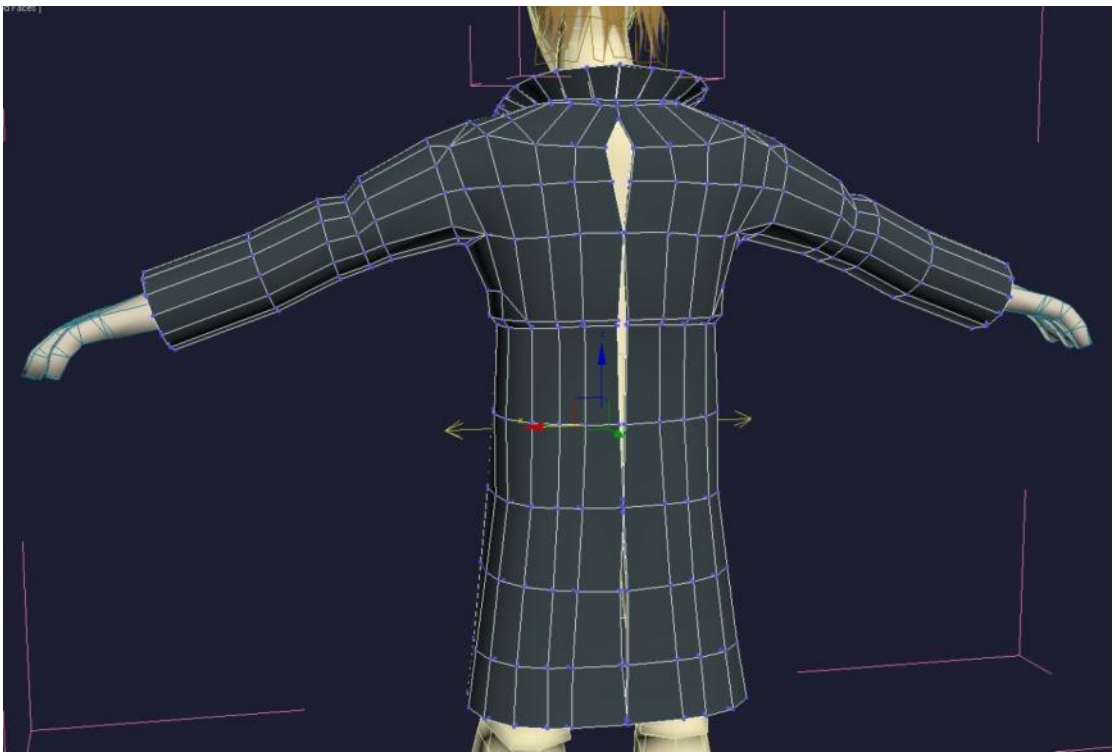


Picture 45. The simple yet effective tongue.



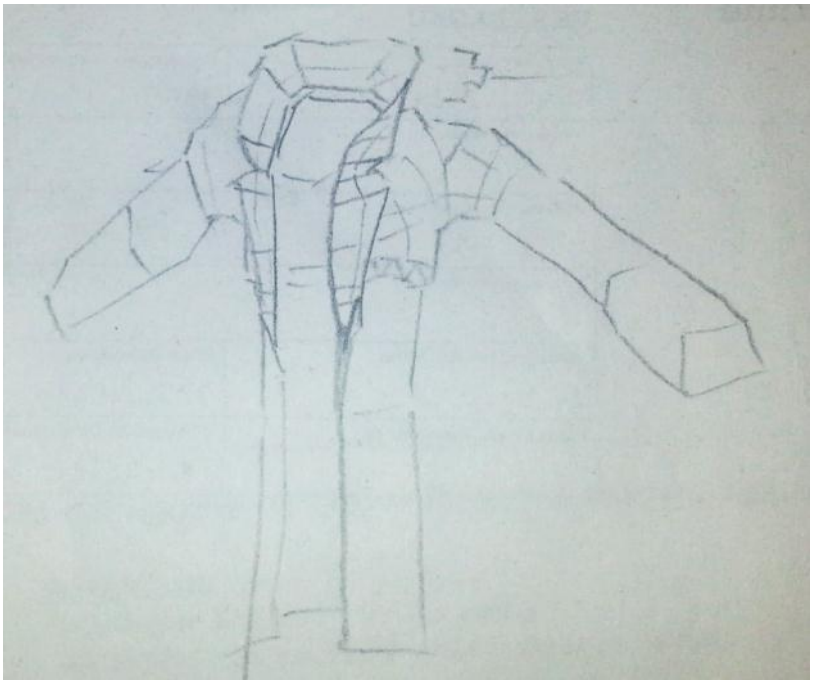
Picture 46. The teeth and tongue placed inside the character's mouth.

Circling around the character I spotted a major problem with the leather jacket. The symmetry modifier should automatically merge and weld the duplicate and original piece's geometry when you start moving the mirroring plane closer. In the jacket's case the welding process was very incomplete, while moving the mirror around was not a valid option. In the end this issue was fixed by first collapsing the object's modifiers, thus forming a new and whole Editable Poly object, and then manually welding the separated vertices together (Picture 47).



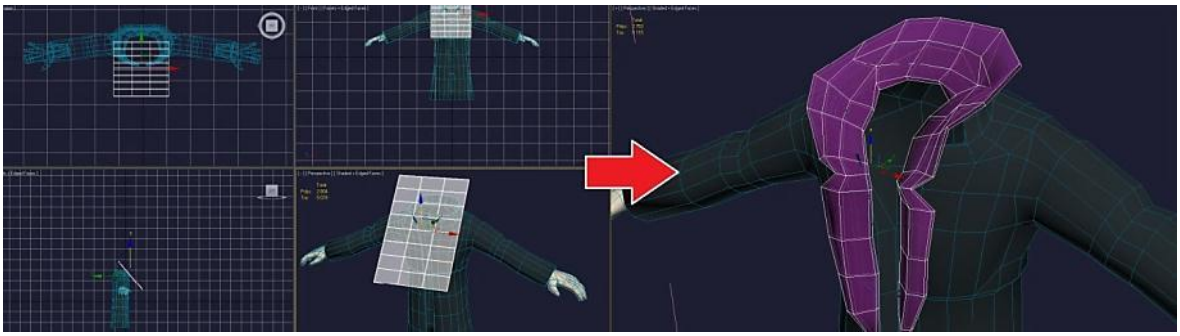
Picture 50. Issue with the Symmetry's automatic welding.

The final piece of the model I wanted to edit was the leather jacket's collar. The ugly basic stub was not quite cutting it in my eyes, and twisting around it wasn't too productive either. After some brainstorming I decided to model the collar part from scratch. I started by making a quick sketch of the part on the paper so I'd have something to use as a reference (Picture 48). I wanted the collar to stick upwards and sort of spread into all directions around the character's neck, giving him a slightly crazier vibe.



Picture 48. The quick sketch of the jacket and its collar piece.

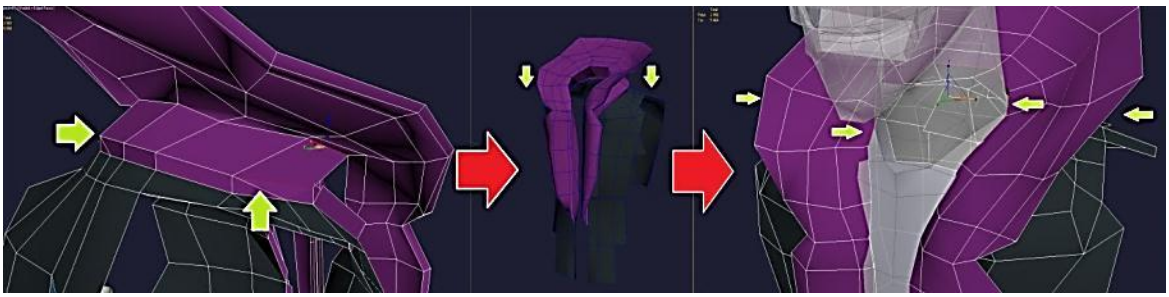
Once again I kept things simple, so I started with a box object with multiple segments. I wanted the collar to be fully three-dimensional piece, not just a flat plane. After numerous bends, rotations and rescales, I finally got something that kind of resembled the drawing of mine. (Picture 49).



Picture 49. The quick evolution of the collar piece object.

After some minor retouches I started the challenging task of connecting the collar into the jacket. I did not wish to leave the object just float on top of the main body, so the collar had to be merged with the jacket instead. Since the collar object happens to bend backwards, like a smooth L shape, I would need to do connections from two different directions and two opposite sides.

I started by removing most of the old stub collar on the jacket and making a straight up extrude around the neck area. Around the opening of the jacket, the one you can button up shut, I made extrusions inwards, each side toward each other. The collar I attached to the Jacket and kept hovering slightly above and forward from its meant position. I then used the **Bridge** tool to connect the collar's bottom edges and the matching edges of the jacket's extruded planes. When the task was done, it pretty much looked like someone would have tried to pull out this very elastic piece off the jacket. I then simply selected the collar piece and moved it down to its intended place. I now revealed the rest of the body in order to see how the collar sits on the character's head and neck. The minor clipping issues I fixed by shaping the inner edges of the collar to closely follow the neck's form (Picture 50).



Picture 50. The process of connecting and editing the collar piece into its place.

With the collar in its place, clipping issues fixed and any remaining N-gons and stray vertices eliminated, the base model was done! I was personally impressed how good the model already looked like at this point. The character rendered rather nicely when using the very basic one-color **Ink 'n' Paint** materials. Ink 'n' Paint is the 3Ds Max's stock Cel-shading material. However, I was even more pleased how the character looked like in the 3Ds Max's viewport, especially when using the Consistent Colors rendering with the viewport shadows enabled. I didn't even need to edit the default scene lights to achieve looks I would be quite pleased with even in the final game project (Picture 51).

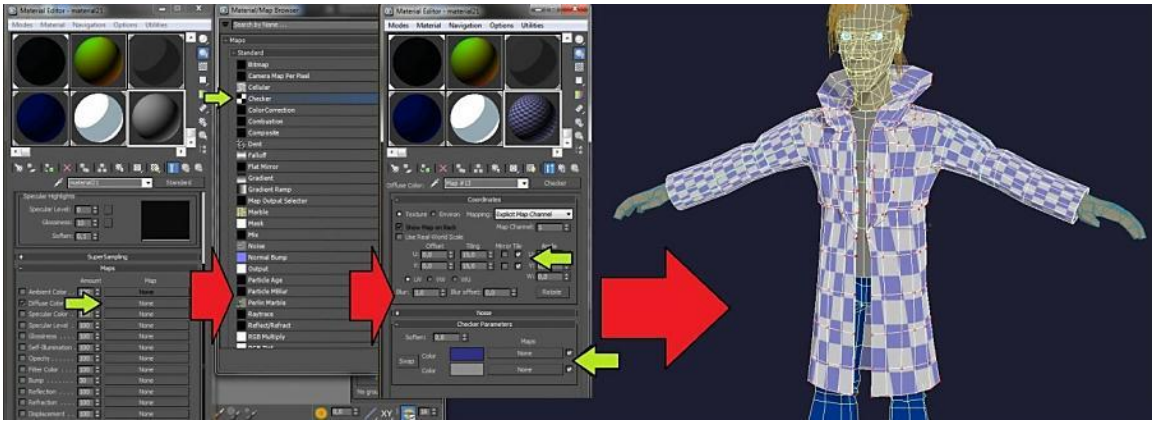
Picture 51. Finished mesh with simple Ink 'n' Paint materials, as seen in the 3Ds Max's viewport using the Consisted Colors rendering level with shadows.

4 UNWRAPPING

Three-dimensional video game graphics commonly use 2D images known as textures to add lots of extra detail on the models. The basic texture map is known with many names, such as color map, diffuse map, or just a texture. For the longest of time the basic color map textures were the only way to give 3D objects most of their details, such as make the surface of a tree look like wood, or a person to actually have a skin with wrinkles and other marks. Later on the game creators developed various new visual methods that utilize special, custom made texture images in order to further improve the illusion of various details and materials being used. One of these modern, commonly used techniques is the Normal mapping, which can give the low poly models a much more detailed looks by affecting the direction and way the light acts on the model's surface (Yanni Hajioannou, 2013, Tuts+).

However, since textures are just two-dimensional pictures, how can you transfer all that image data on top of a three-dimensional, polygonal object? The solution is the UV Unwrapping. By literally opening up and spreading the 3D model into a flat shape, like unwrapping a Christmas present or skinning an animal, the model kind of learns to place the image's material all over itself. The way the model does this can be visually seen as a two-dimensional UV map image, which can be exported out and directly edited or drawn on top in any image editor software. Any material later on assigned on top of the unwrapped model will then wrap the given texture according the UV map, with larger sections on the map naturally gaining more details than smaller pieces.

While it is possible to first create a texture image that contains all the final visual data, and then unwrap the model to match the image, it is often more efficient to do the UV maps first and work your magic on them. A good UV map ensures that the textures made for it will sit properly on top of the 3D model (Marita Paldanius, 2013). It is also a good practice to set up a simple checker texture material and assign it on the model that is being unwrapped, as it makes detecting various texture distortions and stretching much easier. (Picture 52). (Autodesk, 2013)

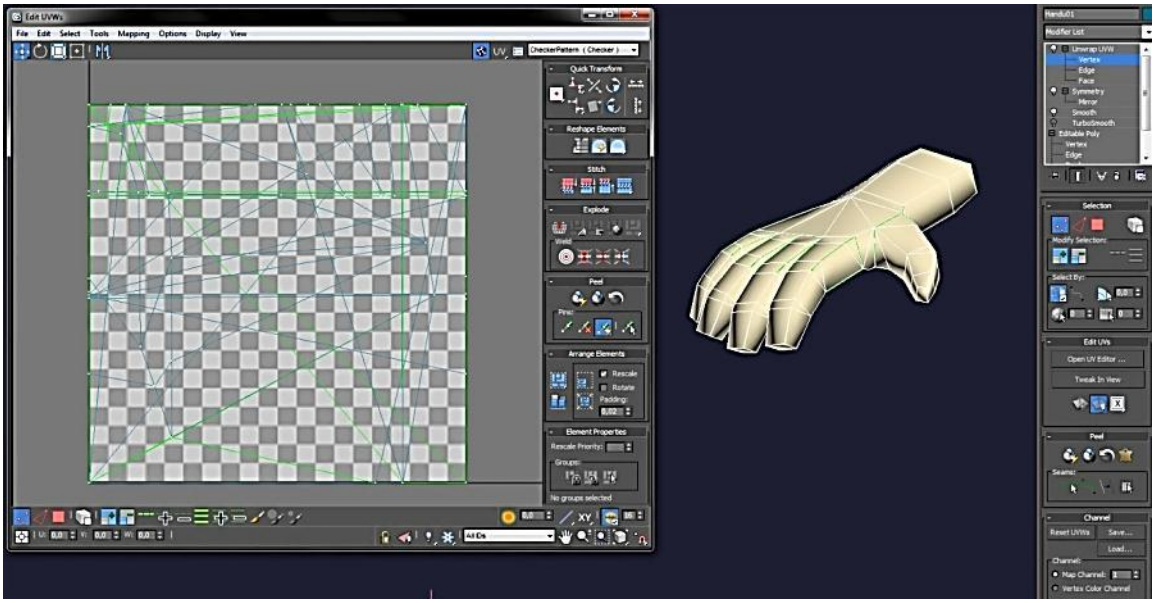


Picture 52. Making a quick tiling checker material to aid the unwrapping process.

4.1 Organic parts

Since we still had the Symmetry modifier on the hand object, all the changes made on the right hand would apply to the left one too. The hand was also fairly blocky by its shape, making it an easy unwrapping target. I used the 3Ds Max's basic Unwrap UVW modifier for the unwrapping tasks, which was applied on top of the hand. I also disabled the Symmetry modifier before adjusting the UV maps, as it could really complicate things at this stage.

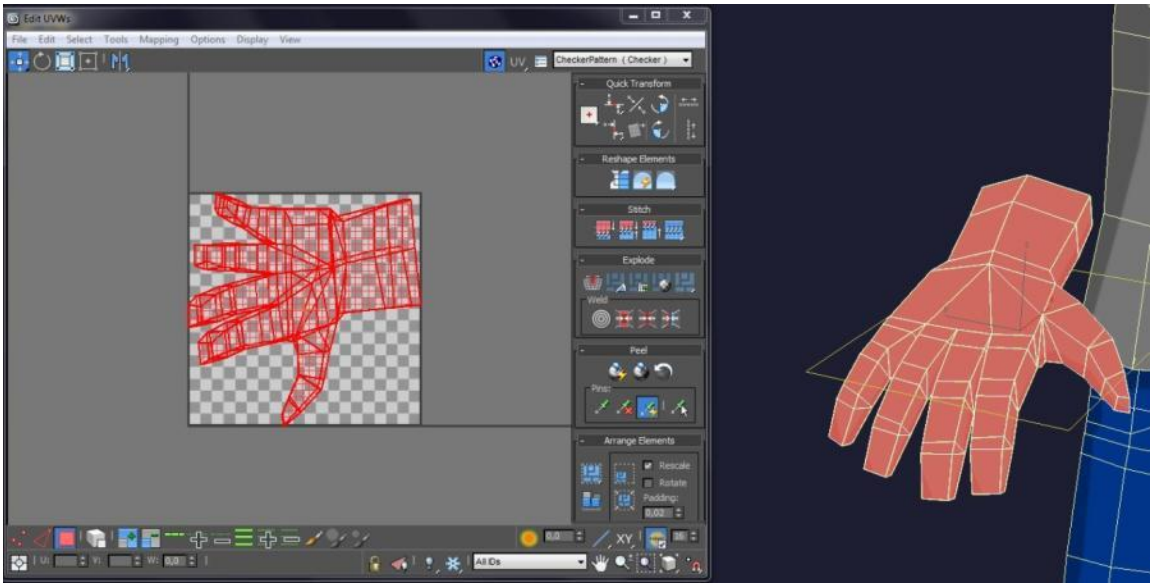
By selecting the applied modifier from the list, I got a list of new options, one of them being the Open **UV Editor…** -button, under the Edit UVs headline. This opened up a new window with a checkered square and seemingly random pile of lines in the middle (Picture 53). The messy stuff was actually our yet unwrapped object, while the checkered area would be the frame for the UV map.



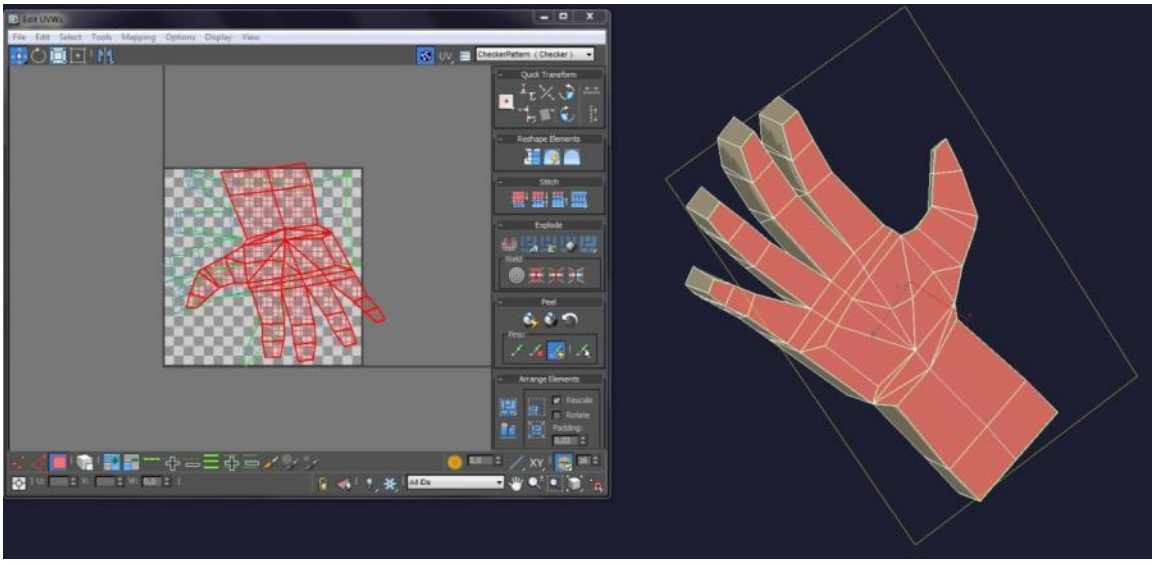
Picture 53. The Unwrap UVW modifier's UV Editor, showing untouched hand's UV map.

I started by making the object bit more recognizable on the UV Editor. I opened up the Unwrap UVW Modifier's stack on the modifiers list by clicking the small plus sign next to it and chose the **Face** option. By pressing CTRL+A, I selected all of the hand's faces at once, which also made the UV Editor's working space turn mostly red. With all the faces selected I scrolled down the modifier's options list, and from the **Projection** section with four symbols of different shapes I clicked the left-most one, **Planar Mapping**. A yellow frame of a plane appeared in the 3D viewport around the hand, while in the UV Editor the selection turned into a flat shape of the hand (Picture 54). To accept the shown mapping result, I pressed the Planar Mapping symbol again.

If I was to leave the UV map in this state, all the details drawn on the map would have been projected on both sides of the hand's model, resulting things like finger nail appearing on the top and bottom sides of the hand, and so on. Not to mention it would have also been impossible to draw the details of the palm. For this reason, I started to break the hand's UV coordinates into smaller parts. All of the faces at bottom of the hand were selected and the Planar Mapping was applied on them. The base of the hand popped up as a separated selection on top of rest of the hand's details, marked red in the editor (Picture 55).



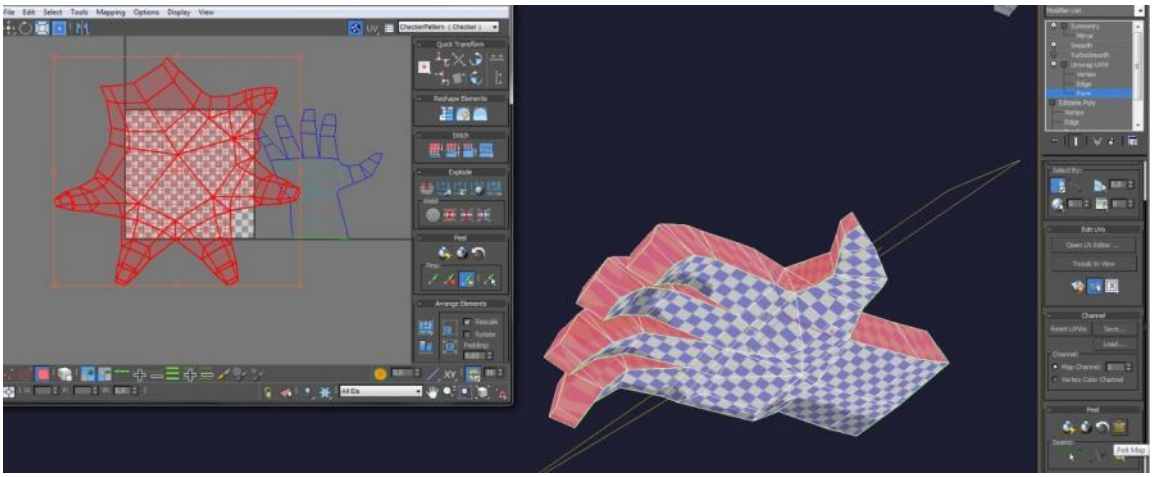
Picture 54. Hand with quick Planar Mapping applied on it.



Picture 55. The bottom side of the hand is separated into its own part in the map.

With the inner side of the hand now wide open and flat, I could grab it in the editor and move it to the side of the working area for now. With the **Ignore Back Facing** option disabled on the Unwrap UVW's list of settings, I could now quickly select all the other parts of the hand at once in the editor. Since the remaining piece contained some complex three-dimensional parts, such as the fingers being placed right next to each other, I used a bit more advanced automated mapping system known as **Peeling** to spread open the remaining shapes. From the Peel category on the list I chose the Pelt Map, which opened up a new

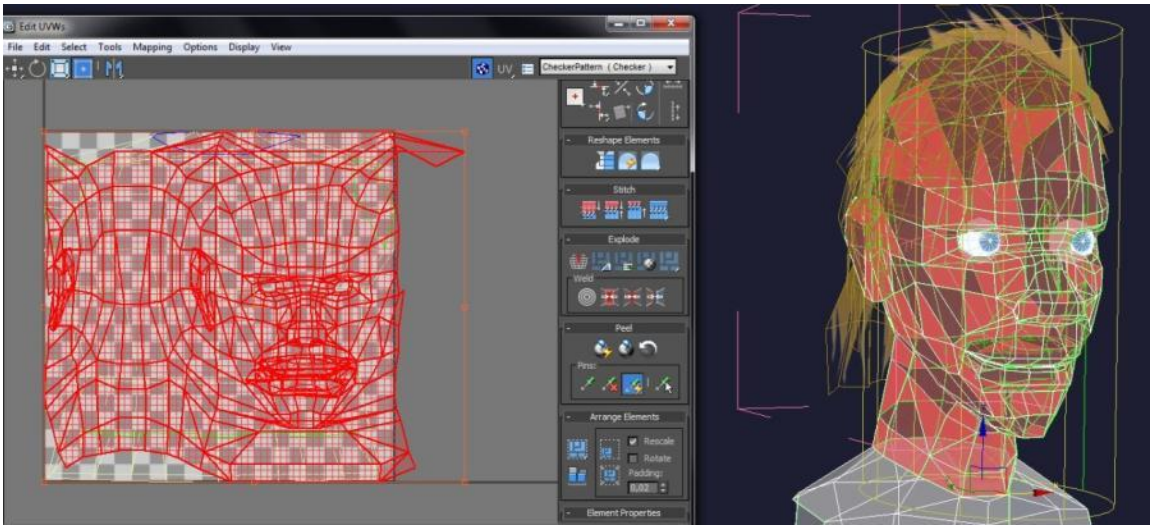
window. By clicking the Start Pelt button on it, the selected area was instantly flattened like an animal pelt on the editor (Picture 56).



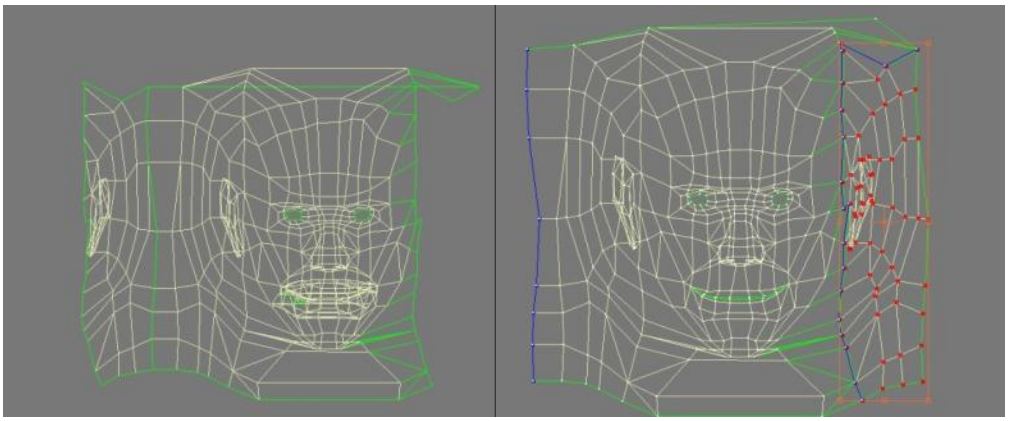
Picture 56 Pelt Mapping is used to flatten most of the hand at once.

This result was now sufficient, but I could still reset the mapping to its original stage, or try to make the shape even more open with the **Relax** option. I could move, rotate and scale the selection freely by choosing the **Free Transform** tool on the UV Editor's toolbar, placing the made pieces so that they didn't overlap each other and did not take too much space on the map. The pelt-mapped part was slightly edited so that the fingers pointed upwards in the image and had more space between each other, allowing more details on them in the texturing phase. The Symmetry modifier would make the corresponding parts of both hands perfectly overlap on top of each other in the UV map, saving some space on the image.

Next, I assaulted the head. The whole head and neck area was selected, and this time the Cylindrical Map was used, effectively skinning the character's head open (Picture 57). The result was still far from perfect, as the whole right side of the head was thrown to the left corner of the mapping, with visible green seams showing connections between the current and intended positions of the area. To fix this, I had to cut a necessary part of the side off from the current map by selecting the wanted faces, right clicking on the selection and choosing Break. The selection was now detached from the rest of the mapped area and I could move it to its proper location. I set up the selection was set right at the edge of the opposing side and switched to Vertex mode. By selecting any of the vertexes, the corresponding match of it would light up blue, marking the dots that had to weld in order to close the gap in the face (Picture 58).

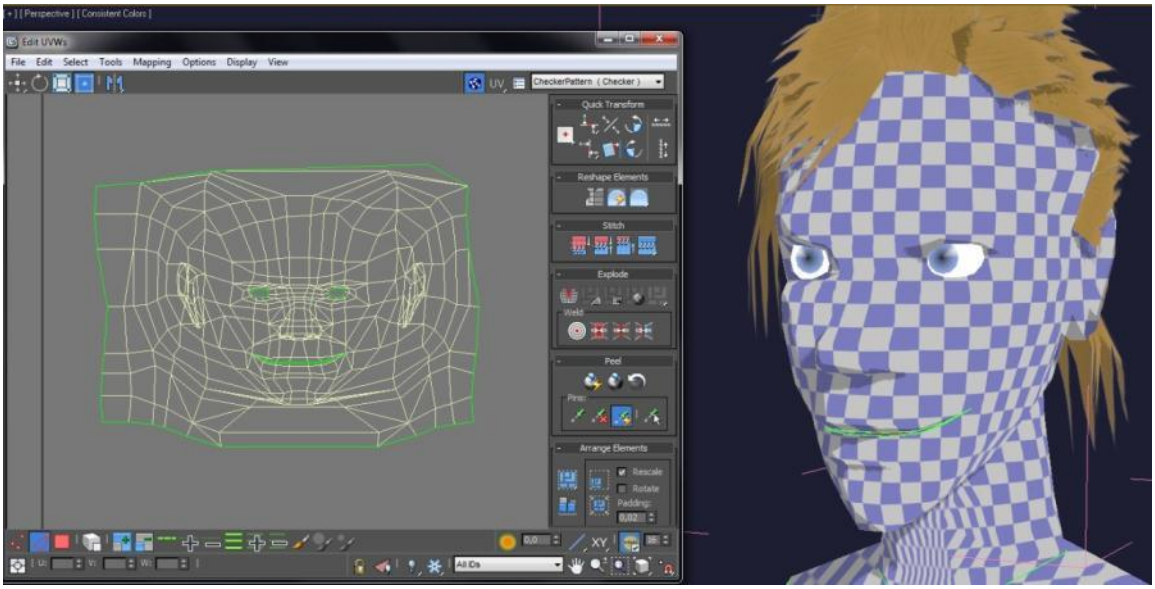


Picture 57. The face is spread open with cylindrical mapping.



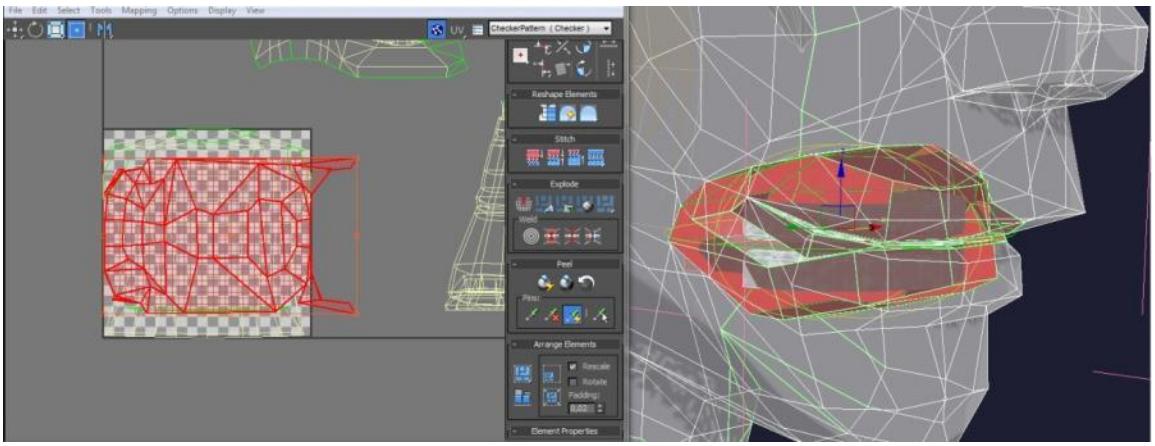
Picture 58. The right side of the face is cut and restored back to it's proper position.

The 3D view showed that the checker texture was now consistent and straight throughout the whole face (Picture 59). However, the very center area of the neck had obvious squeezing, caused by the too wide planes on the UV map. I fixed these issues by breaking the middle plane's vertices off the face's from it's sides, and scaled it down on its X-axis, still leaving the connection to the chin intact.



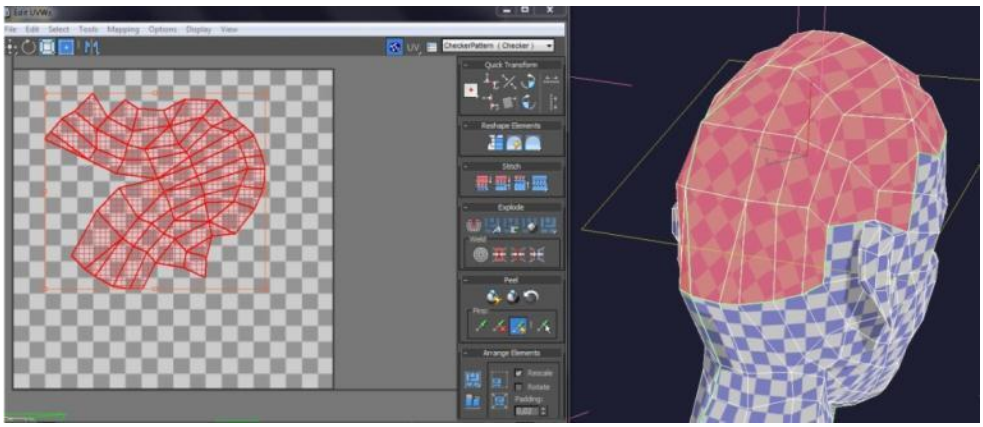
Picture 59. Face shows good checker pattern thanks to spread UV map, neck has issues.

The closed area inside the character's mouth can cause a mess around the face's UV map. I used the X-ray view and the Hide Selected functions to get a proper view inside the person's head and selected the mouth lump, ending the selection to the inner sides of the lips. Simple Planar Mapping was thrown on it, switching between the X-Y-Z choices until I got satisfactory mapping results (Picture 60). Then, I separated the selection from the rest of the head's map. While unwrapping, I spotted a single five-sided N-gon in the mouth. The problem was that adding or removing any details from the mesh would have resetted the whole UV map back to its original messy pile. However this is not the case if the modifier list is collapsed, which allowed me to add a single extra edge to divide the N-gon into a quad and a triangle. When the Unwrap UVW modifier was re-added, all the prior mapping process remained.



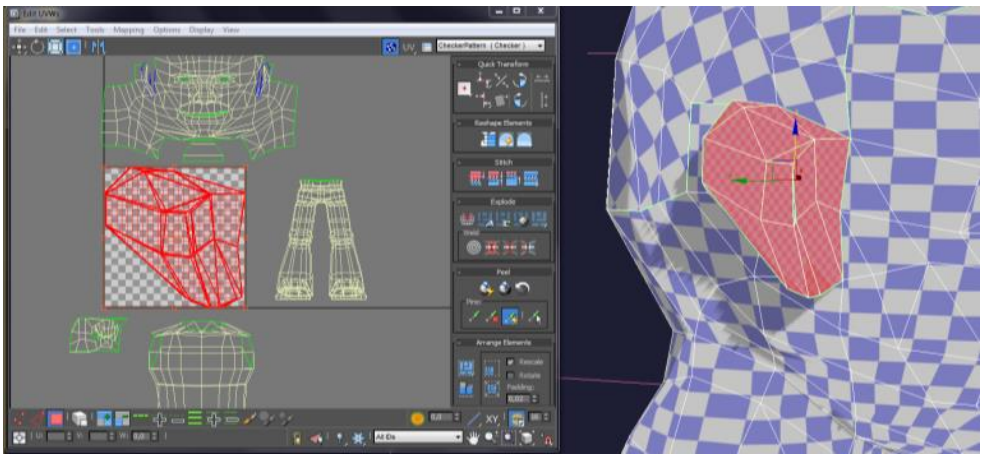
Picture 60. Separating and quickly mapping the mouth's insides.

While most of the character's hair would be formed by the individual hair planes, the head would look very odd if we could see a bright bald skin underneath these strips. To improve the illusion of thick hair mass, I separated a bare minimum area on the skull that would be covered in a hair texture. The shape I got with basic maps was not very consistent, so I select three midmost vertical edges from the back of the scalp and then used Break on them, splitting the area open. With the Pelt Mapping the shape now spread up better, resulting into a smoother texture (Picture 61).



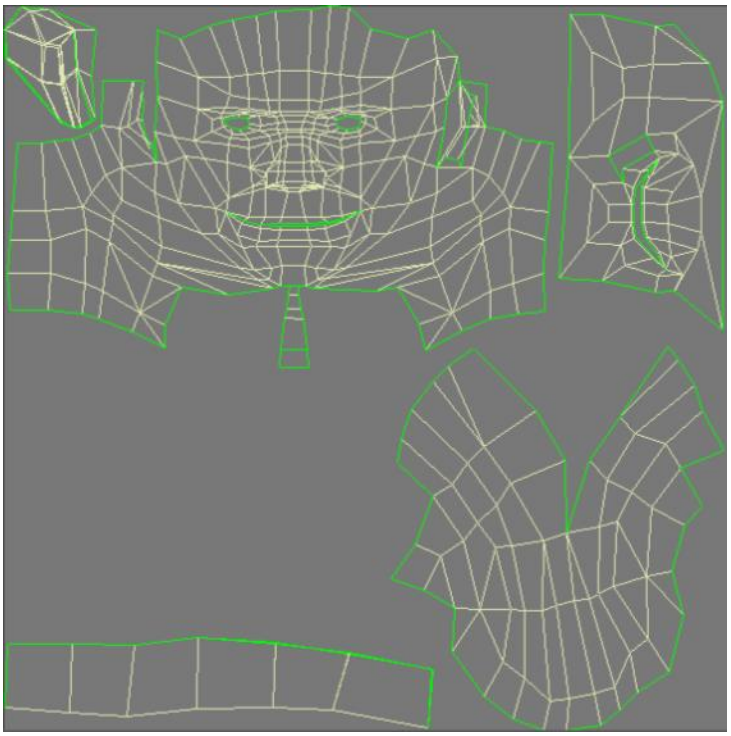
Picture 61. The scalp area's separated into its own section to add hair details.

To allow more details on the ears, a fairly complex area on the human body, I kept them separated from the rest of the head's map. I only needed to select the outmost area of the ears and apply a basic Planar Mapping on them to get satisfying results (Picture 62). The maps were originally stacked on top of each other in the UV map.



Picture 62. The ears are given identical quick Planar map treatment.

The head section of the body was now finished. I placed the different parts inside the work frame area in the UV editor, scaling and changing their orientation to ensure that the most important pieces cover the most of the final UV map. A small area was left open to fit in the hand's UV maps, in order to get all the organic parts to get their details from a single texture (Picture 63).



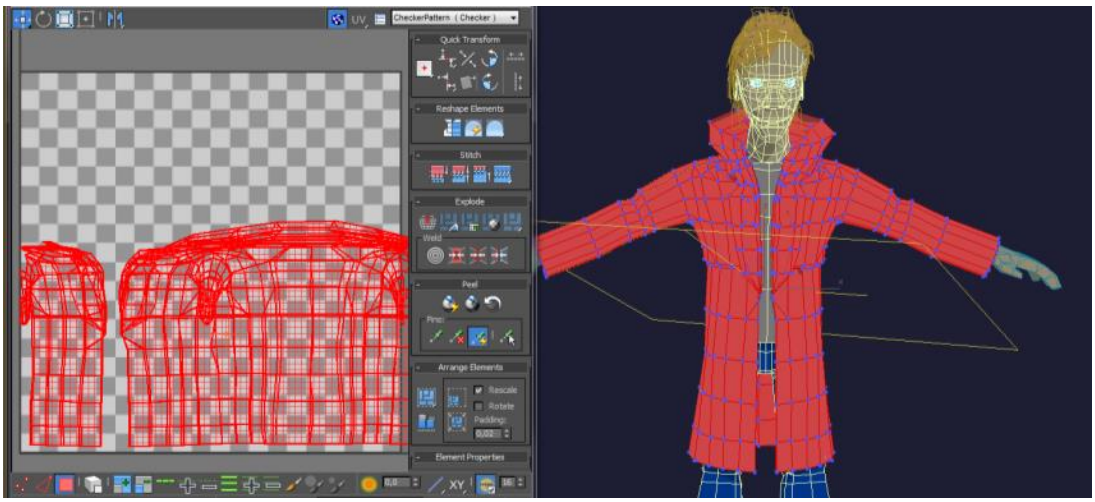
Picture 63. The initial version of the head's UV map.

4.2 Clothes

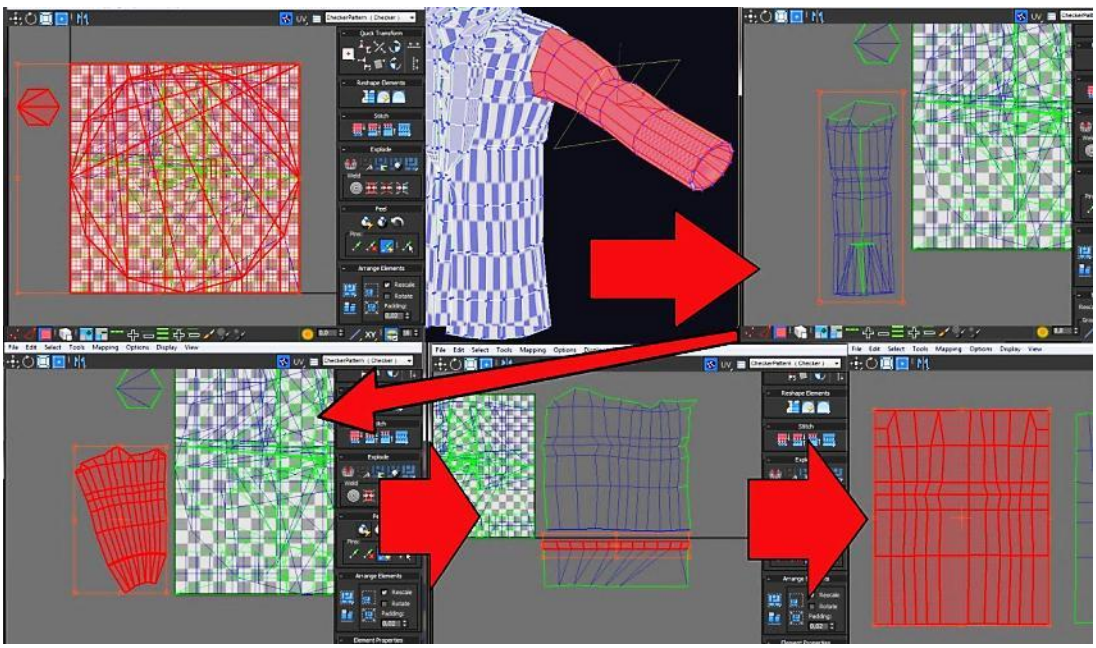
I started unwrapping the clothing with the leather jacket, as it covers most of the character's body and was mostly formed out of simple shapes. In the Unwrap UVW menu I chose the Cylindrical Mapping for the whole object, as the jacket was pretty much a vertical tube. This once again made the UV map a lot clearer in the UV editor (Picture 64).

I started improving the map by separating the sleeves off the main body first. The very center bottoms of the cup-shaped exits of the sleeve were selected, and planar maps were applied on them in order to turn rest of the sleeve into a simple, cylindrical form. In theory the Cylindrical map option should have unwrapped the remaining sleeve perfectly, but for un-

known reasons the program had problems positioning the unwrapping gizmo properly around the wanted part. Because of this, I opted to use basic planar map to get a decent view of the sleeve in the editor. Then, I cut a new seam through its whole length to the lower side and used the Pelt Mapping to open up the tube into a flat shape. Using the **Free Transform** tool, I then straightened all the edge loops and seams so that the entire sleeve was turned into a square (Picture 65). Same procedure was done on the other sleeve and then stacked on top of the first one's maps.

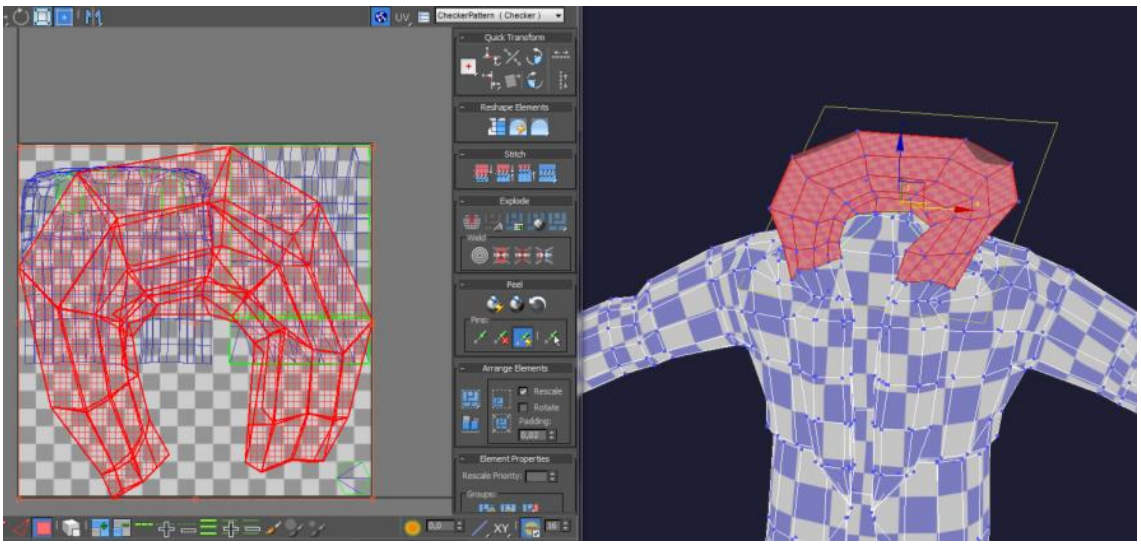


Picture 64. Jacket is quickly spread open with Cylindrical Map mode.



Picture 65. The process of opening and flattening the sleeves.

The collar was again one of the more challenging parts to work with. Since it bends into so many directions it was difficult to unwrap. It also had polygons hiding between its own form and the jacket's body. I started chopping the structure into smaller pieces, applying separated Planar maps to the very topside of the collar (Picture 66), and then to the lower sections in the front. With the outer faces out of the way, I now had an access to the inner parts of the shape. These would not need too fancy UV maps or texturing, being mostly hidden from the viewer's eyes.



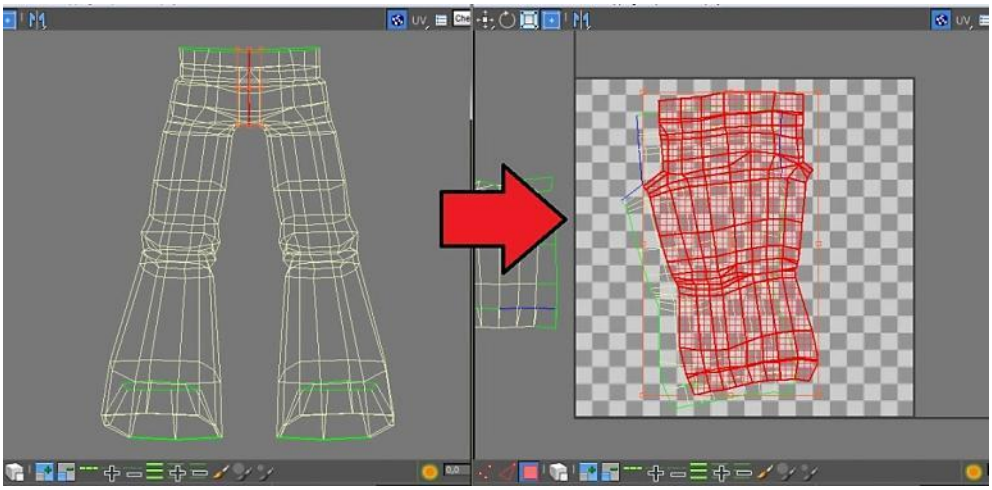
Picture 66. Planar mapping the top of the collar area.

In order to improve the textures on the shoulders of the jacket, I separated small areas of them into their own parts. The jacket was also divided into multiple pieces to aid texturing (Picture 67). In the hindsight I realized that I could have made most of the jacket's body into one, seamless segment by using cylindrical mapping, changing the mapping gizmos orientation to Z-axis, and then turning the gizmo 90 degrees, so that the cutting side is placed towards the jacket's natural opening. In this version the fronts, sides and backside of the jacket are four different pieces, all set close to each other in the UV Map. Originally some of them were even stacked on top of each other for mirroring effect.

Picture 67. The seams shown in green mark the cuts in the jacket

With the jacket done, I moved on to the body object's clothing. Starting by isolating the jeans with a basic Planar mapping, I cut the shape into two separate sides with the Break function, and ran the Cylindrical mapping on both legs. The results were stacked on top of each other to use the very same texture area on both legs at once (Picture 68).

The shirt was quickly done with basic Cylindrical mapping, while shoes got two Planar maps, one for the soles and the other for all the topside's details, including the short piece of leg.

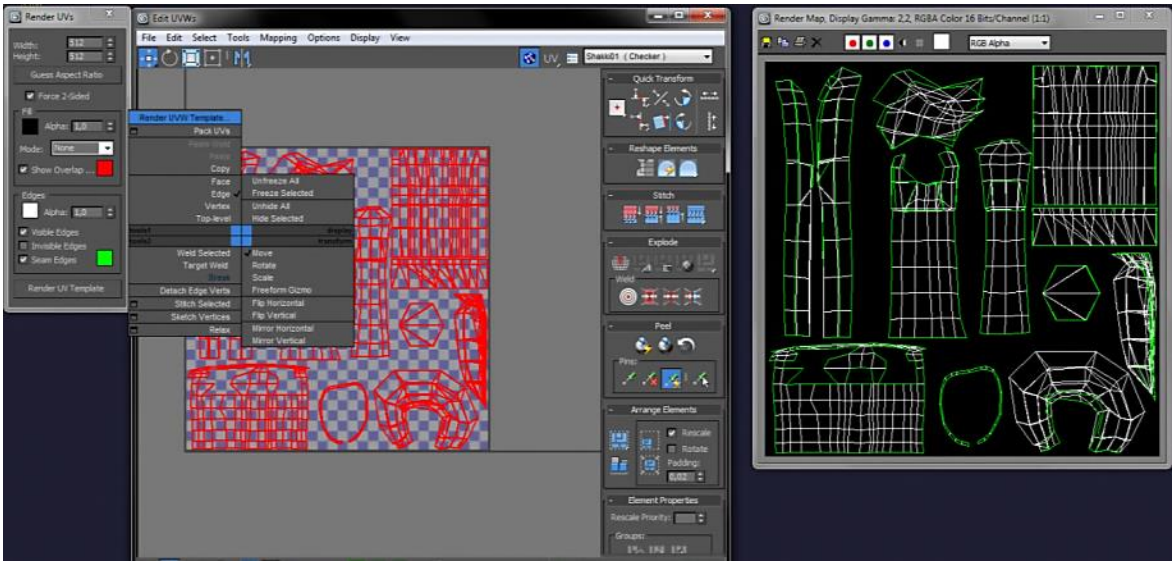


Picture 68. Jeans are divided into two cylinders, opened up with Cylindrical mapping, and then stacked.

4.3 Rendering UV Maps

In order to maximize the details in the model's textures I decided to export three UV Maps: one for the clothes on the body, one for the organic parts, and one whole image dedicated to the leather jacket. The rendering process is easy, as all I needed to do is open up the UV Editor, right click on the work space and select **Render UVW Template**. From the window that opens up I could adjust the visual settings of the created UV map image, such as the X and Y resolutions and coloring. It is a good practice to have the rendered map be at least twice as big than the final texture, just so that you have more space to work with and add details in (Athey Nansel-Moravetz, 2007).

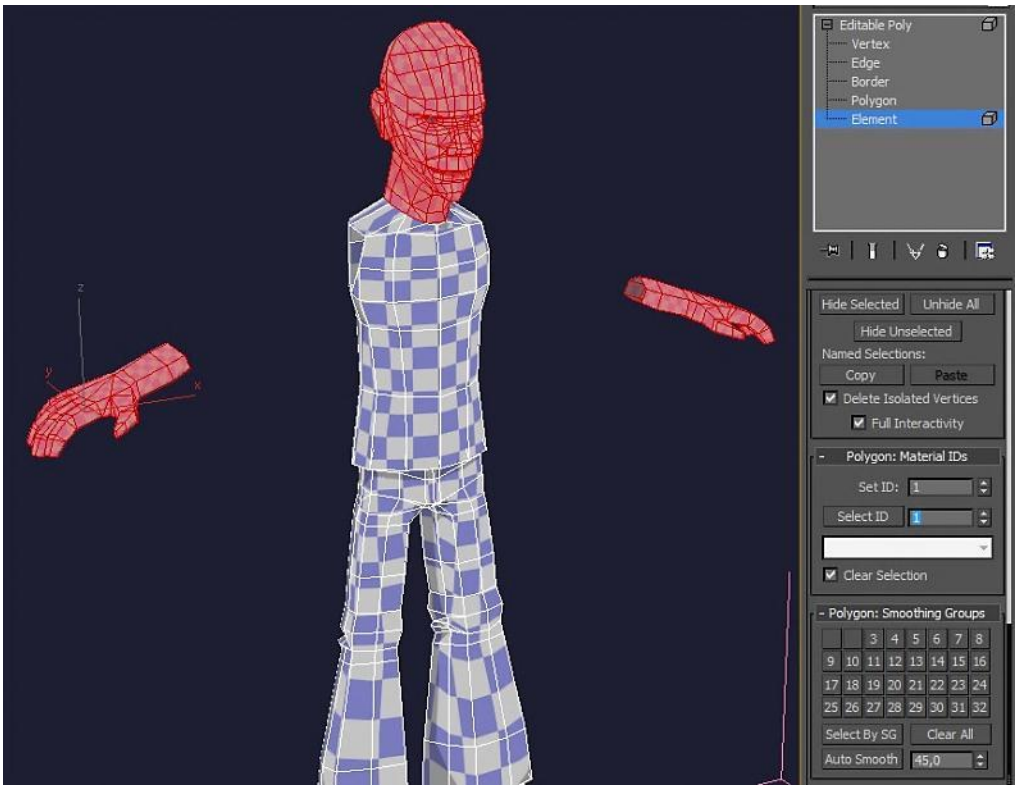
I chose to have my UV maps in the modern, massive 4k resolution, meaning images of 4096 by 4096 pixels. Hitting the **Render UV Template** button drew a preview of the UV map, by default with a black background with white edges and green seams (Picture 69). Clicking the small floppydisk button on the higher left corner of the window allowed me to save the shown UV map image, with choices to select the destination and format of the final image. The .PNG format was chosen for the sharpest picture quality.



Picture 69. Rendering the UV map image for texturizing use.

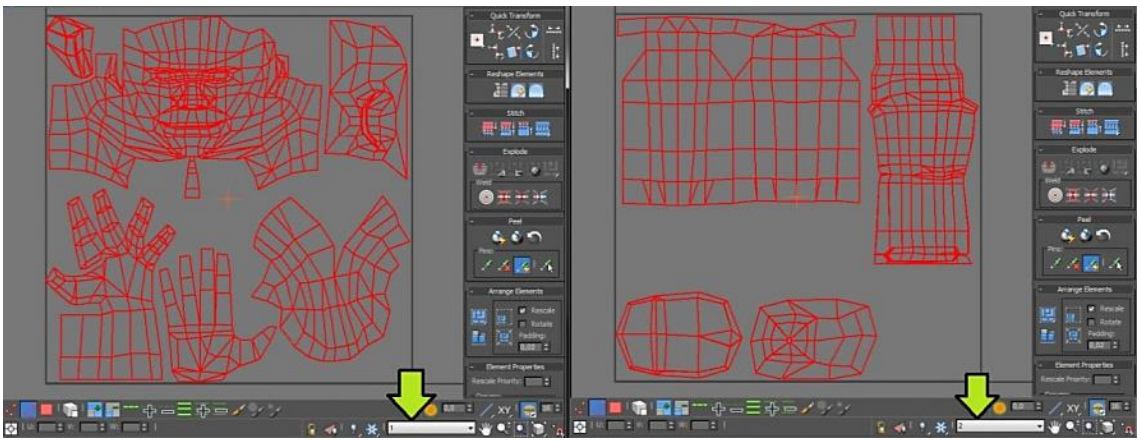
However, since the hand and rest of the body were currently separated objects, they could not be viewed in the same editor, thus making the creation of a single UV map for all the parts difficult. I choose the easy solution and attach the hands into the body as well. Within the Edit Poly menu I selected these organic parts and assigned them their very own

Material ID by setting number one in to the empty space next to Set ID, under Polygon: Material IDs headline (Picture 70). Rest of the body I give the ID of number two.



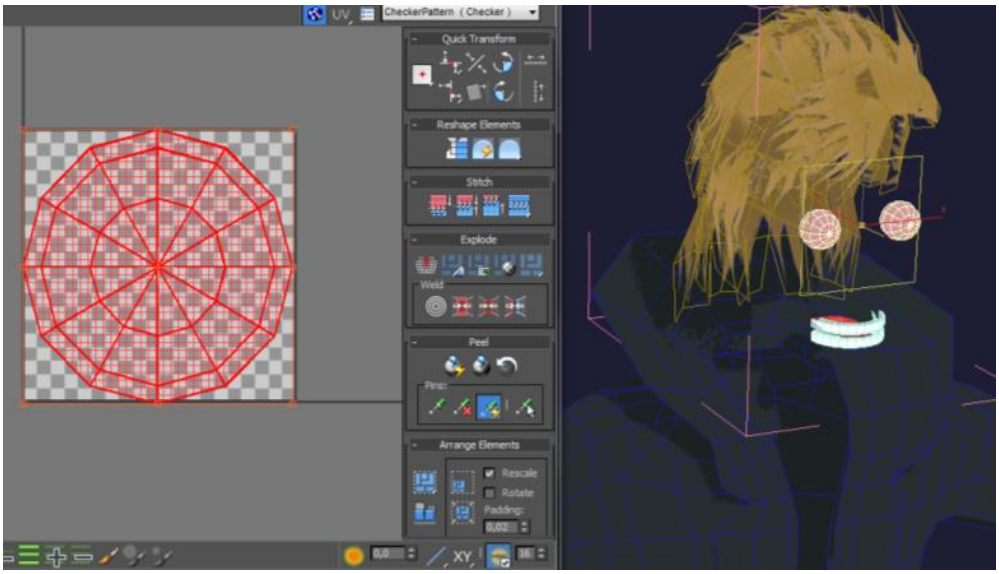
Picture 70. Head and hands are given the Material ID value 1.

With the different parts of the single object now given their own ID codes, I could choose to show either one of the available Material IDs in the UV editor, allowing me to export individual UV maps for both IDs without the other obscuring the view (Picture 71).



Picture 71. UV Editor can be made to show only the organic parts or just the clothes by changing the Material ID.

The eyes, teeth and tongue were given a very quick Planar mapping treatment (Picture 72). I decided that aside the eyes maybe, it would be possible to leave these parts to be single color only, or alternatively use basic 3Ds Max material effects to shade them. However thanks to the unwrapping there was now always the choice of texturizing them.



Picture 72. Planar mapped and stacked eyes.

5 TEXTURES

As already mentioned in the previous chapter, textures have a major impact on the graphical quality of 3D models. Having texture mapped polygon graphics were even proudly marketed as a feature during 1990s, as seen on many game promotional materials of the era (Sega Retro, 2014). The textures help to define the object's materials and can even give an illusion of extra geometry that's not really there. They can also have huge effects on the game's atmosphere, as clean and brightly colored interiors of a building are certainly going to feel more welcoming than a worn and rusty variant of the same place.

In the recent history the various big AAA game studios have significantly reduced the amount and depth of details on regular Color maps in order to avoid visual conflicts when using real-time lighting and shading effects together with their models with higher poly-count. Meanwhile smaller scale developers planning to produce low poly content may produce impressive results with just basic handmade textures. Use of high quality Color maps in a game utilizing cartoon-like looks can result a very recognizable and fresh looks, without having to use too many system taxing special effects. I find the Telltale Games' The Walking Dead –series to be one of the best examples of recent games successfully using a distinct style over mimicking the reality (Picture 73). Not to mention in a game with a rather serious atmosphere and sad story.

Games aiming for cartoony looks can easily get away with using just solid colors together with Cel-Shading, as seen with The Legend Of Zelda: Wind Waker (Picture 74), which actually caused some serious controversy during its time thanks to its different visual style (Steve W, 2003). Yet no matter how pleased I was with the way my model looks in the 3D editor, I see the TS project to be the kind of game to benefit from actual texture mapped details. One of my biggest inspirations for my game's style has been the Sega's Valkyria Chronicles, which uses various pencil-lines-on-paper effects and watercolor-like palette (Picture 75); Yet another great example of unique visual style in gaming history in my opinion.

I used Adobe Photoshop to create all my textures. While it is possible to create impressive images with the mouse, I really recommend using a drawing tablet if possible. I had the luxury of using a Cintiq 12WX tablet device that has a built-in monitor, allowing me to directly see the result of my hand's work. It almost felt like drawing with a pen and paper!

Picture 73. Telltale's The Walking Dead games use a cartoony graphical style, achieved with use of low poly models and hand-drawn textures.

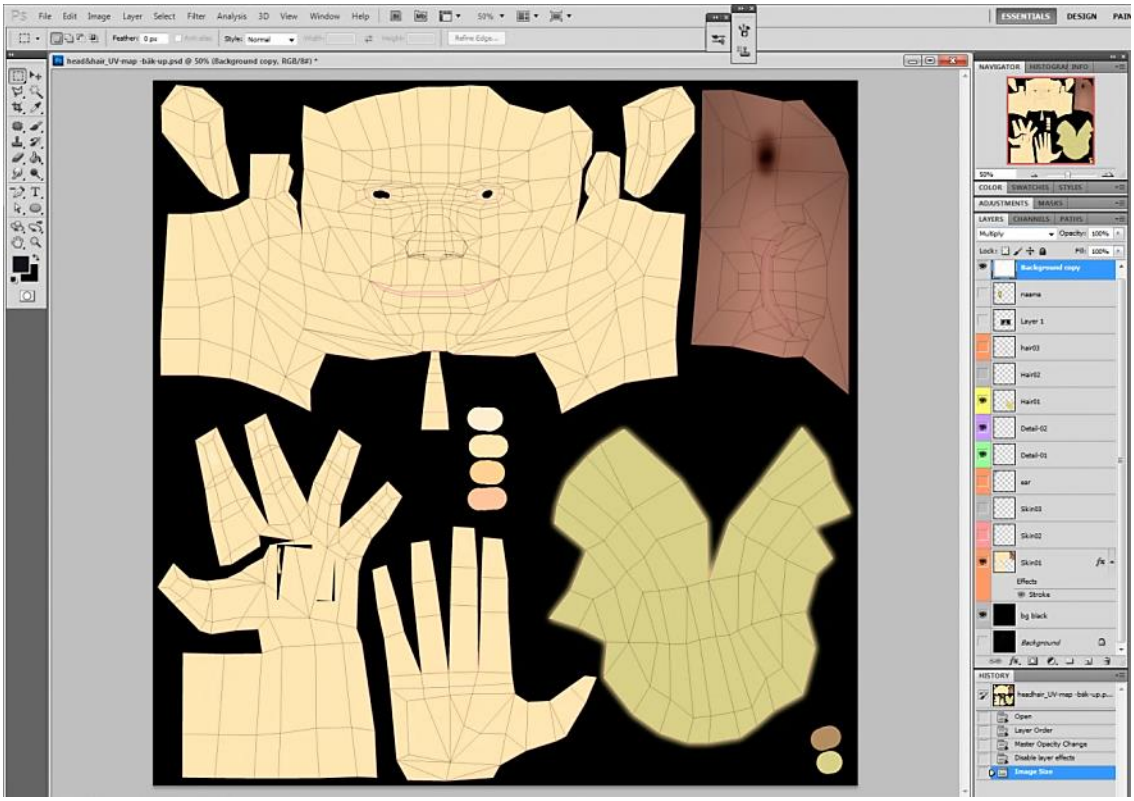
Picture 74. Nintendo's The Legend Of Zelda: Wind Waker uses traditional Cel-shading to create a colorful, cartoony world that's instantly recognizable.

Picture 75. Sega's Valkyria Chronicles creates a "sketchbook" visual style by combining the CANVAS graphics engine's custom Cel-shading effects with stylized textures and models.

5.1 Organic parts

As described in the planning the style section, the character itself is supposed to have minimalistic details in order to maintain the comic book look. Because of this all his organic areas were hand drawn, or rather colored.

I opened up the exported UV map of the head, hands and hair in Photoshop. Using multiple layers to build up the various details on the different parts of the image was a much recommended practice here, as I could later adjust any individual layer's properties, or even start from scratch if needed. A copy of the base layer was created, while three layers for the skin and three layers for the hair were added, all color-coded to make them easier to recognize on the layers list. I created the basic colors for the skin and the hair, and painted small circles with them into the empty space on map to store up clean samples of the colors. Next, I used the **Magic Wand** tool to select all the empty blackness around the map pieces, and then chose the **Select Inverse** to select the body parts themselves. Big brush was used to coat the selected areas with the two colors, keeping both materials on their own bottom layers. At this point I moved the copied layer of the base UV map image to the top of the layer list and changed its blending mode so that I got just black lines over everything else (Picture 76).

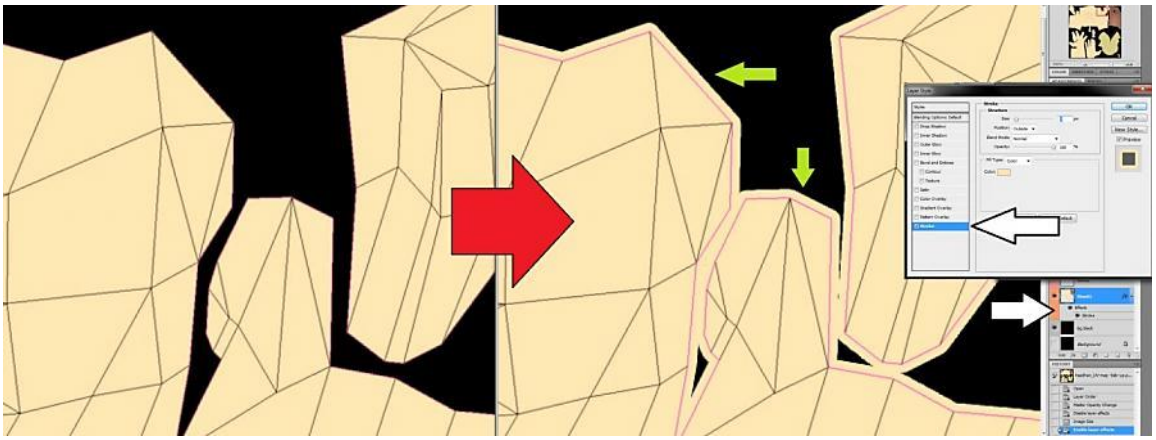


Picture 76. The basic layout of the UV map in Photoshop, coated with some basic colors.

I saved the file as the basic Photoshop's **.PSD** file and imported it as the diffuse map into one of the Ink 'n' Paint materials created in 3Ds Max. I then assigned it on the objects using the **Material ID** 1. By doing this, the model's textures were updated in real time every time I saved the changes in Photoshop. This allowed me to quickly see how I was doing with the texture, without having to first use the Save As -function to export other formats. I just needed to remember to disable the top-most layer casting the wireframe over everything else, as otherwise it would have shown in the 3Ds Max's viewport (Picture 77).

Picture 77. The last saved version of the object's assigned texture will show up instantly on the model in the 3Ds Max when using .PSD files as the texture.

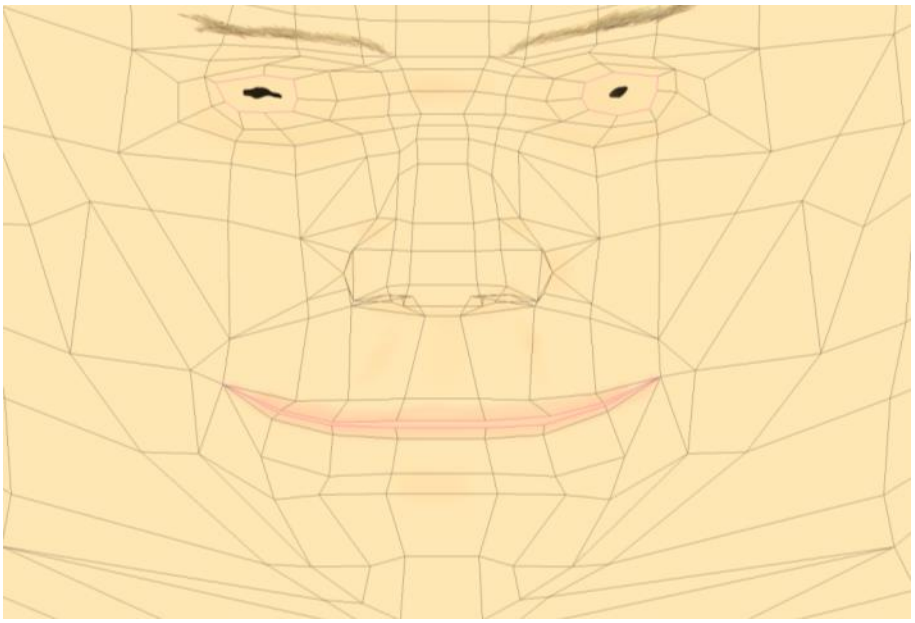
The textures with the visible wireframe lines shining through actually helped me to notice a common issue with hastily done textures: color bleeding. Some small bits of pink and black could be seen around the character's skin, originating from the texture's wireframe layer. Too carelessly painted textures of another area can also fall on top of other areas. All this could be fixed by changing the background color into something that fits the overall colors of the texture. In the skin's case I applied the **Stroke** effect on the layer, using the same skin-color to make it indistinguishable from the rest of the mass (Picture 78). Hiding the wireframe overlay now hid the color errors, allowing me to start painting the texture.



Picture 78. Using the Stroke Layer Style on the base colors helps to cover the intended areas completely and eliminates unwanted bleeding.

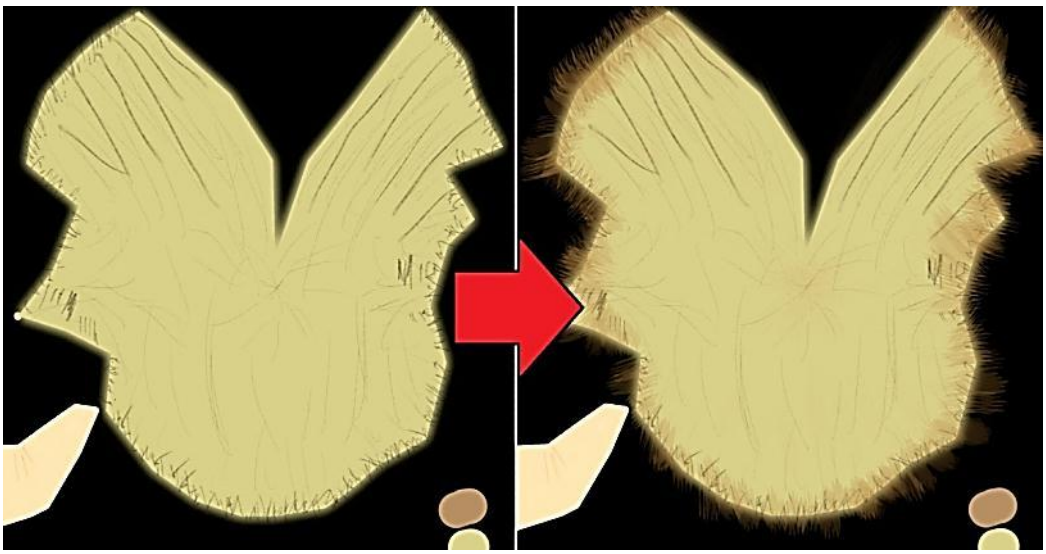
While I wanted to avoid making the character look too real and detailed, some basic shading on the Color map itself can greatly enhance the shapes and depth of the model. Since I was not using Normal maps on this character, I didn't need to leave the details too flat. I started by picking the slightly reddish tinted variant of the skin color, chose the **Brush** tool with a very soft and round brush setting, and adjusted down its **opacity** to very low levels. With this setup, a faint layer of color was added on the Skin 02 layer, around the person's lips. By reducing the opacity even more and increasing the brushes size, some faint blush was added around the cheeks and ears as well.

While I could continue like this, using different colors and brush settings to add details, I decided to start shaping the bottom skin layer directly with the **Dodge** and **Burn** tools. These tools are used to highlight and darken the colors they're used on. The **Exposure** setting very low on both, around 5% at best, since it is very easy to go overboard with these two tools. Now, using the Burn tool, again with a soft brush, I started adding faint shadows all around the face, such as around the ear sockets, under the nose and on the gap between the lower lip and chin (Picture 79). Weak **Blur** tool was used to soften up all the added details just a little bit in order to avoid too steep variations in the skin's tone. Similarly I used the Dodge tool to add very faint highlights to parts of the face that should stick out more than rest of the section, such as the tip of the nose, chin and on top of the eyebrows. The finished additions were blurred once again.



Picture 79. Faint details are added on the face with faint, soft brushes.

When I started the hairy area on top of the character's head, I tried to keep things as sketchy as possible. On Hair 02 layer I started drawing thin and faint lines, represetanting the directions the hair would flow down on the person's head when combed back. Lots of fine dark lines were added to the edges, to represent the transition between skin and hair around the hair line. The mullet was given a few stronger lines, as this was the area most covered in the hair strips. On Hair 03 I started giving faint brownish tint to the different sections of the hair, trying to find a fine balance with the colors in order to simulate a very bright brown hair (Picture 80). I saved and checked the result in 3Ds Max, rotating the camera around the head to see how the texture fits the overall style (Picture 81). For now I left it like this.



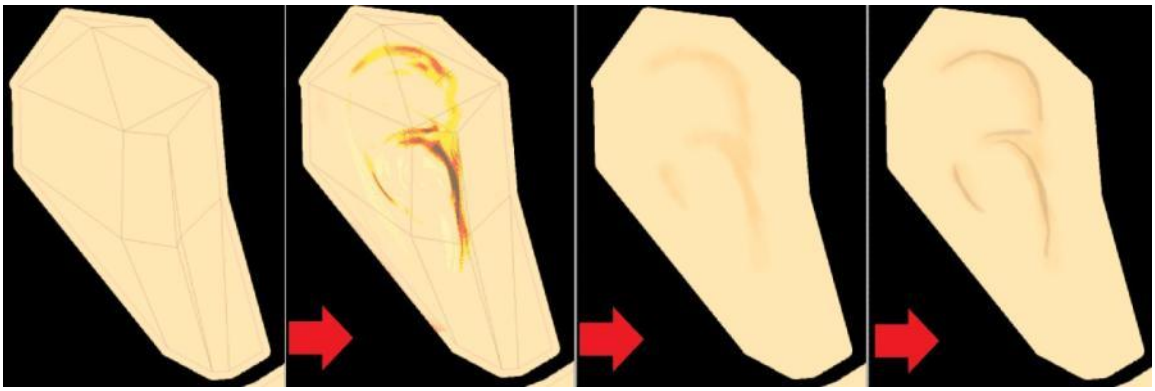
Picture 80. The scalp's hair is created with three layers, adding finer details with each level.

Picture 81. The work in progress hair painted on the model's head.

While still on the hair layers, I decided to give my boy his eyebrows. Zooming very close on and using thin, slightly opaque brush, I kept adding individual hairs at rapid rate. The brows were done with both of the hair colors, on top of each other, and later both **desaturated** and darkened them to make them appear less blonde (Picture 82).

Picture 82. Eyebrows as seen up and close on the model.

When working on the ears, I used a **posterized** piece of a photograph as a guide, tracing the varying shadows and highlights to the skin layers below. A faint, cartoon-like outlines were added into the inner loops of the ear in order to make the shapes stick out more clearly.

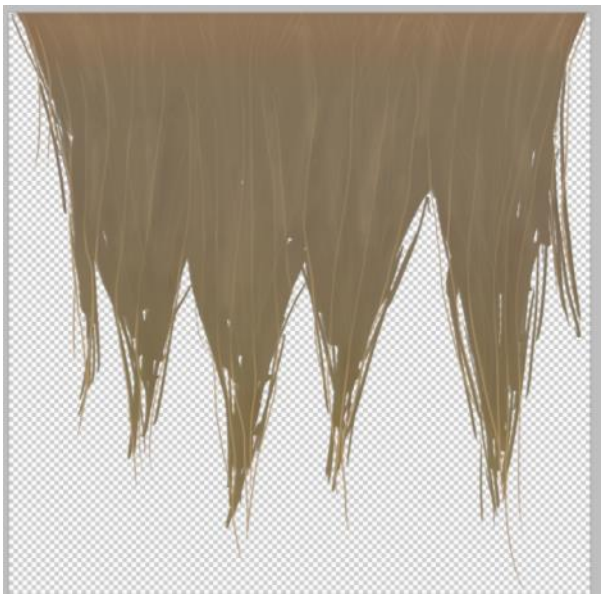


Picture 83. The evolution of the ear.

The hands got fairly similar treatment as the head. Various wrinkles and shadows were added to the joint areas, while highlights were used on the more elevated and smoother areas (Picture 84). Nails were polished into existence with the Dodge tool, with a small U-shaped shadow marking their root.

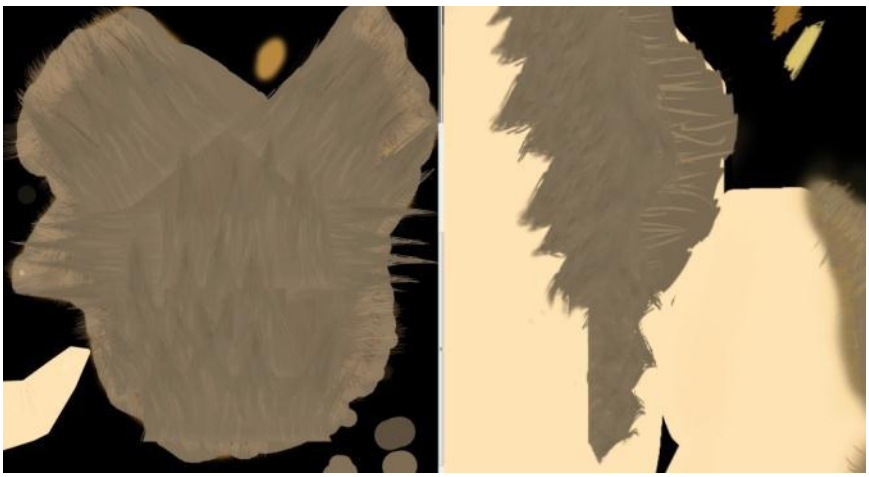
Picture 84. The faint detailing on the palm

Since the hair worked so well already with the place holder textures, I did not change the overall style too much. The texture was done in much higher resolution and the color was edited to be more muted. Individual hairs of various tints and sizes created the overall form now (Picture 85).The alpha layer was blurred slightly to reduce the rough appearance. I saved the image this time as a **.TIF** file.



Picture 85. The new high resolution hair strip with alpha.

With the new hair strips in place, I used their texture in order to improve the head's hair piece. Several copies of hair strip were layered directly on top of the re-colored scalp, which would make it harder to distinguish the actual head's surface from the individual hair pieces. I also gave some similar details to the back of the neck and on the sides, behind the ears (Picture 85). Now the character even got sideburns. Overall the transition between skin and hair was greatly blurred thanks to implementation of the textures. The organic parts were now done (Picture 86).



Picture 85. Reworked scalp and hairlines made utilizing the final hair strip texture.

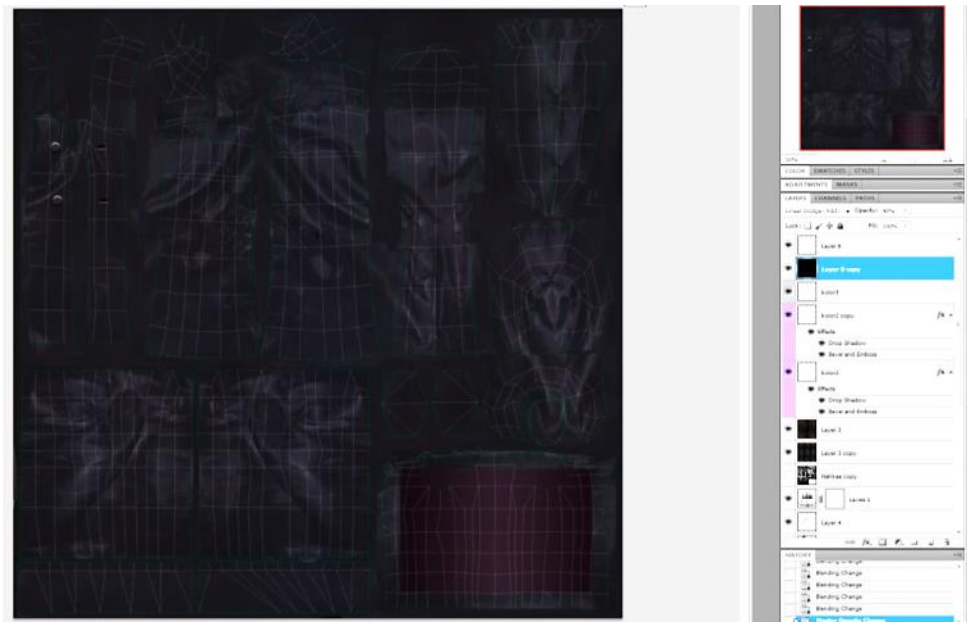
Picture 86. Finished head texturization

5.2 Clothing

Since clothes from another dimension were kind of part of the intended style of the game, I was able to take lots of shortcuts when texturizing them. Meaning I dug out plenty of clothes out of my own wardrobe and took photographs. The leather jacket was almost completely built from two photos (Picture 87).

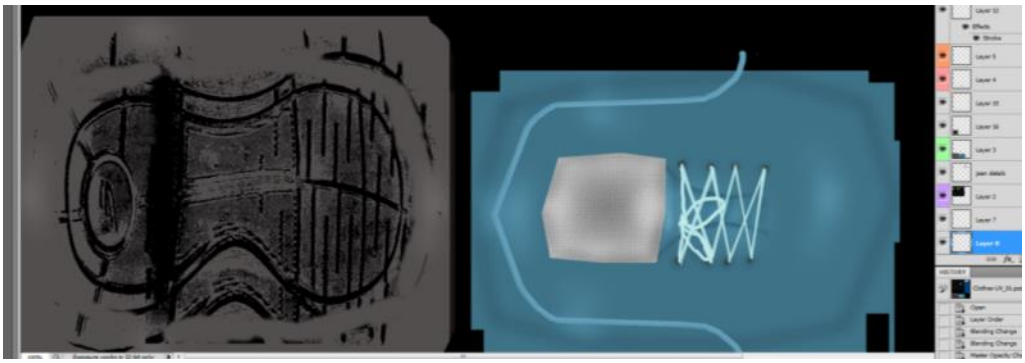
Picture 87. Two photographs used to create the leather jacket's texture.

Obviously I could not just copy and paste these images on top of the model and call it a day. It took numerous tweaks and lots of cutting things around in Photoshop in order to make the final thing look good. The few truly handmade parts in the jacket were the jacket's red inner lining and the buttons on the hem.



Picture 88. The layout of the leather jacket's texture

Rest of the clothing was a mixture of photos and handmade details. The shoe soles were taken from a photo as well, but edited to be this wider black and white shape. The top of the shoes were hand drawn, using similar methods as on the skin earlier. The shoelaces and the bright line arching behind the shoe were hand drawn on top of the base color (Picture 89).



Picture 89. The shoe texture up close.

The T-shirt I gave this very dark grey color, and added some **gradient** effects to simulate lighting as the shirt disappears underneath the jacket. The skull and thorns image was first quickly sketched in photoshop, then vectorized the shape using the **Pen Tool** (Picture 90).

Picture 90. The skull print on the T-Shirt.

The last remaining piece was the jeans. I first planned to use yet another photograph to quickly flesh out the pants, but it didn't look quite right here. Instead, I ended up painting the jeans with a slightly muted dark blue color, and using the photograph of the jeans as an **Overlay** texture, adding various small details on top of them. Certain parts of the photo,

such as the pockets, were cut and edited around, and finally placed in as details on the pants. Wrinkless and worn surfaces were manually added on the base color layer using Dodge and Burn Tools. The belt was made by first painting in a simple, dark grey rectangle. I added the jean's loops on top by copying small sections of them over the belt. When the position of said loops looked good on the model, I used weak Dodge touch to add minor highlights vertically across the belt sections, giving them this faint light-reflecting looks.

The buckle was manual work as well, done on another layer, and last given some shape and glossiness with Burn, Dodge and Gradient tools. The holes on belt were just dark dots that I rescaled and then shaded by using Burn and Dodge directly underneath them on the belt layer. Finally, I painted a small part of exposed skin and gave the character a belly button (Picture 91).

Picture 91. The pants up close with the wireframe overlay.

6 SUMMARY AND DELIBERATION

The goal of the thesis was to let me practice the use of 3Ds Max and other useful graphical tools used in the modern game industry. A secondary objective was to create a usable 3D asset for a personal game project, following the original designs and style as closely as possible. The character model was to be kept under 6000 triangles and contain a working texture mapping. Modeling the character so that it could be easily animated was preferred as well.

The work was personally recorded with still images. Together with the written part of the thesis, they were to form not only a report describing the work's stages, but also a potential tutorial for beginner level 3D modelers, who would preferably already have the basic knowledge of navigating the programs mentioned in the text.

Working sketches and references were produced during the early days of the thesis work, and out of these designs a visually acceptable 3D character model with textures were created (Picture 92). In this regard the project was a success.

The modeling provided many challenges and many details certainly could have been done better. It is not yet certain if the model is as optimized as it could be, and the character has not been rigged for animation either. Attempts to provide the character proper Normal Maps were tried, and some time was actually spent in Autodesk Mudbox software, sculpting a high poly version of the model (Picture 93). However the exported Normal maps did not work properly at all, indicating that the low poly model might not have been properly set up. Also a very unfortunate crash during one rendering attempt of the Normal Maps corrupted many details on the high poly model. Because of this misfortune, various time constrains, and the satisfactory result gained with Cel-shading type lighting and traditional Color Maps, the plans for Normal maps were discarded. However, the absolutely perfect outcome was never a necessity in the case of this project.

The schedule created for the thesis did not hold too well. Every stage was finished several months later than they were planned, most of the reasons lying in the personal life and sudden requirements to do other works. Since the work process was already so familiar and the project itself was all personal, it was at times hard to find material which could be used as references for some of the statements.

Picture 92. The finished model as seen in the 3Ds Max's viewport.

Picture 93. High poly version of the character sculpted in the Mudbox.

The project gave me a great chance to get familiar with the newer generations of the Autodesk 3Ds Max, my last experiences having been with the 2009 version. I was pleased to find many new functions and tools that made the modeling and unwrapping easier and faster. The box modeling method I was already familiar with, but this time I managed to use it in various new ways.

I was surprised how easy to approach, and ultimately even use the Mudbox was. After just few hours of trying things around and watching some tutorial videos, I was already sculpting impressive new details on my own model. Certain innovations, like the **Steady Stroke**, actually made it easy to work with the model even with the mouse. However, the stability of the program was less than good, as I experienced numerous random crashes, losing plenty of done work.

While modeling, texturing and sculpting, I learned the importance of backup copies and storing different version numbers. While I ended up gathering several dozen versions of the model's 3Ds Max file, I somehow failed to do the same with the Mudbox file. The file's corruption was nothing short of a catastrophe.

The model will certainly go through some edits before it is used in a game project. Rigging and animating the character is an obvious necessity. Some of the textures will be revised for better quality, which may require altering the model's UV maps as well. Normal mapping is going to be attempted once more to improve the character's details. Its final shape the character will ultimately get when the game's engine is chosen, and the necessary graphical effects are implemented.

Even with its shortcomings and issues, I still consider the project to be a success. The personal goals were reached and a lot of the necessary work was finished, providing a great base for future adjustments and usages in other projects (Picture 94). Overall the thesis project was a great learning experience.

Picture 94. The finished 3D model with textures and custom 3-point lighting.

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APENDICES

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