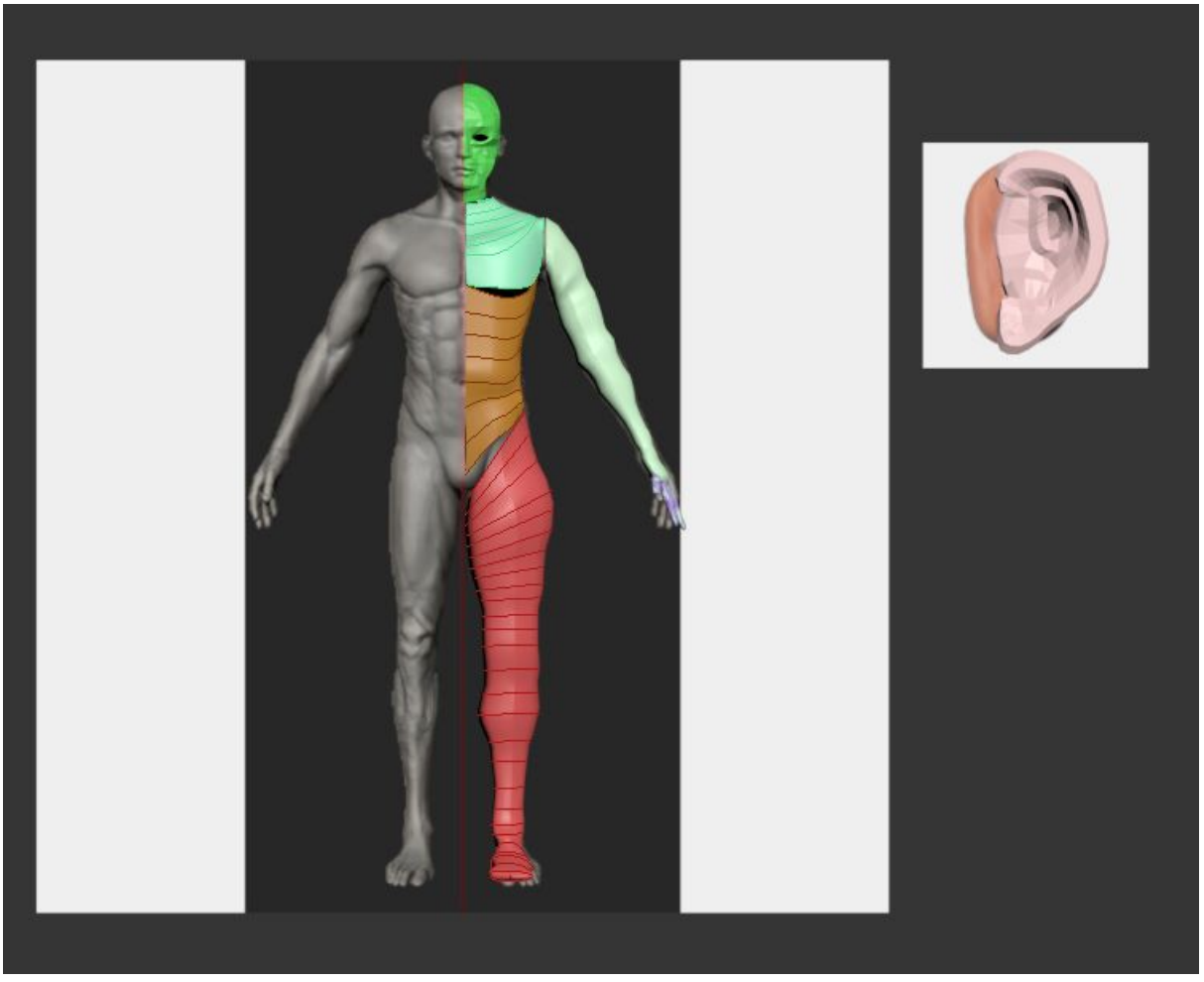
Task 1: 3D Modelling and Rendering

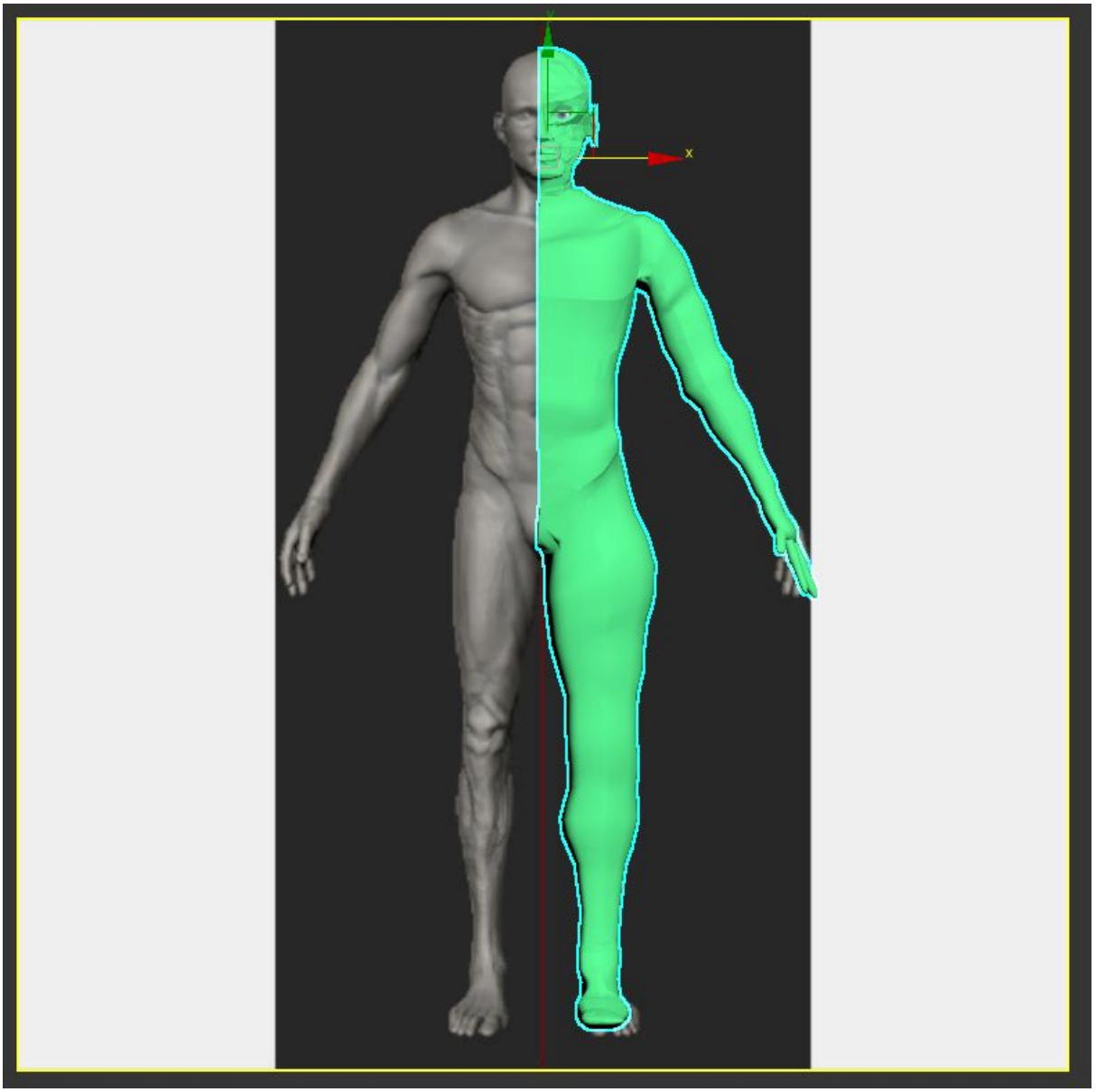
Intermediate Representations

During the modelling of the character, at certain points the model modifiers is required to collapse and be incorporated into one mesh so that additional modifiers can be applied to multiple components to accurately develop a model. The following representations are indicative of the state of the model before collapse and each have separate .max files that can be inspected.

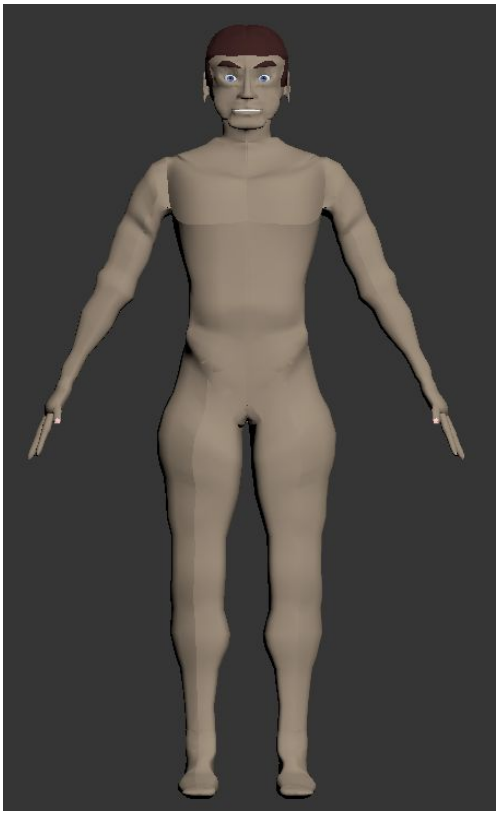
Character's Left Body Parts Modelled



Character’s Left Side of Body Modelled as One Mesh



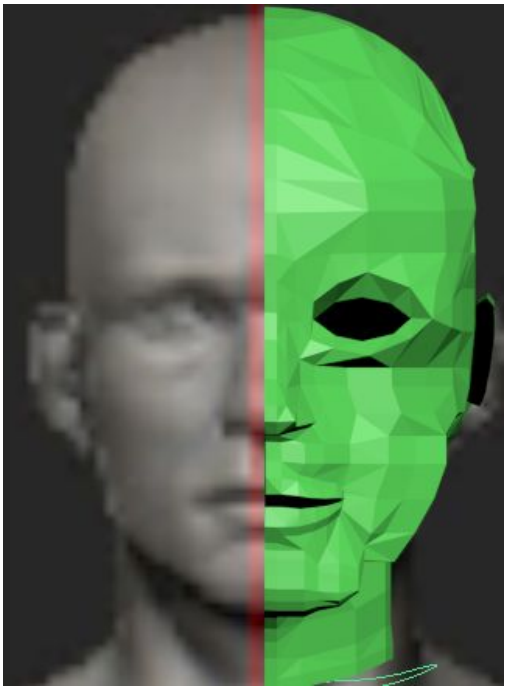
Final Representation Using Mirror and Smooth Modifiers and Materials

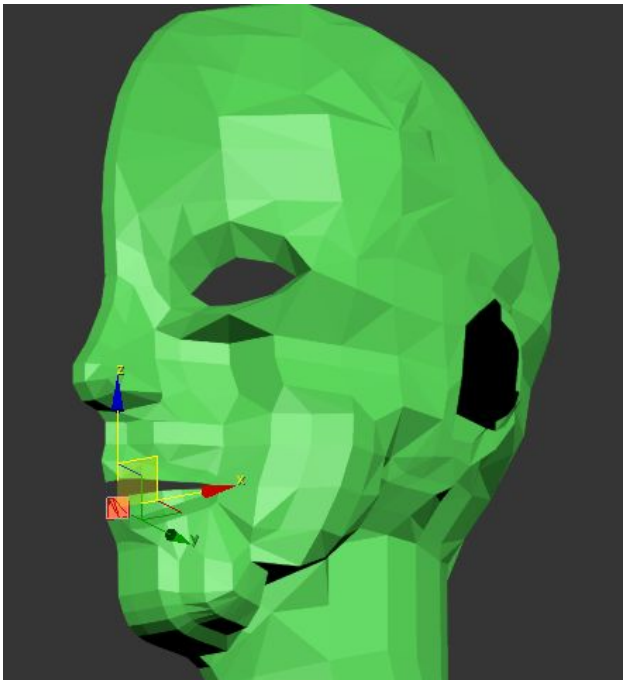


As Main Modelling Methods

Using Polygon Mesh (editable mesh and/or editable poly)

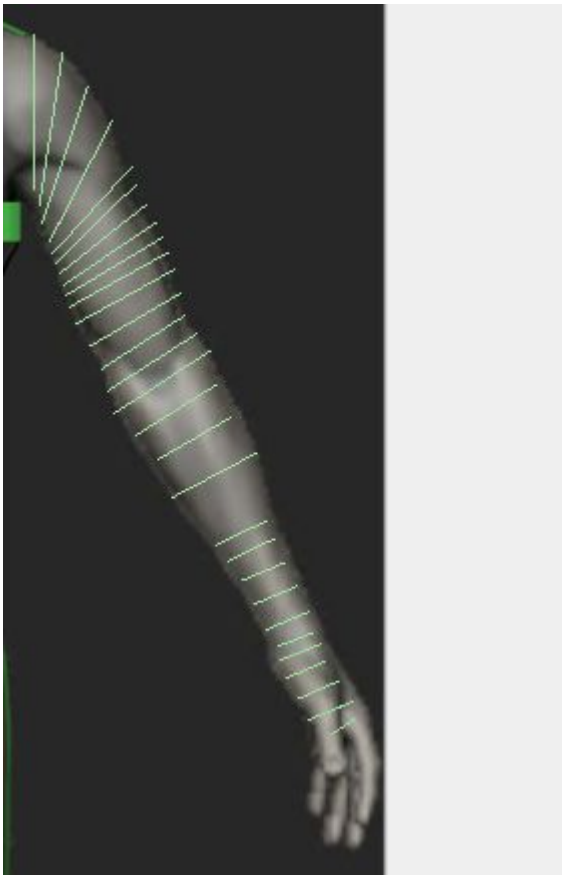
By creating edges from an initial polygon, converted into an editable mesh, the mesh can have more edges created to form the model based around the reference images.

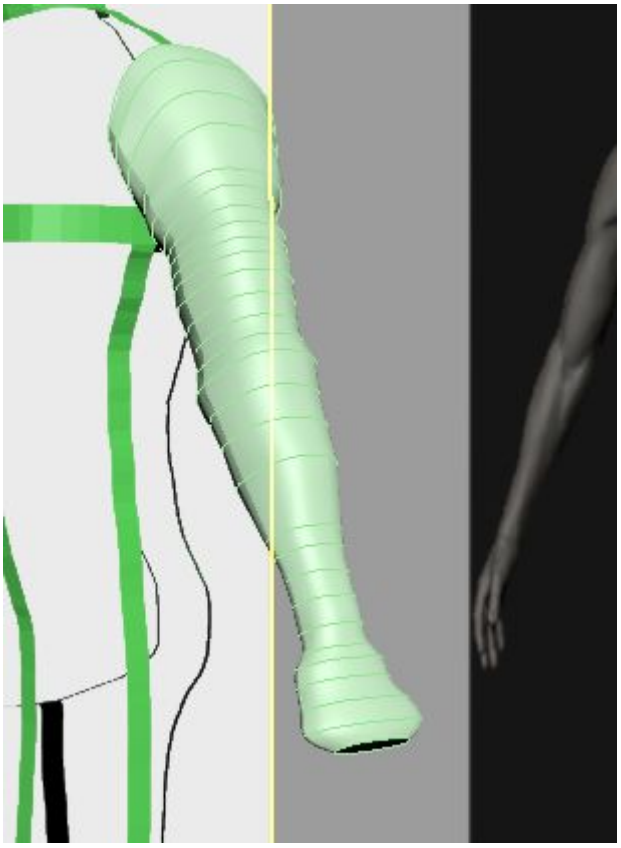




Using Spline Surfaces (Bezier patch and/or NURBS)

More cylindrical body parts such as arms, fingers and legs can be effectively modelled by using a CV NURBS curve to draw cross sections of the body part and form surfaces across these body parts by using a u-loft technique.

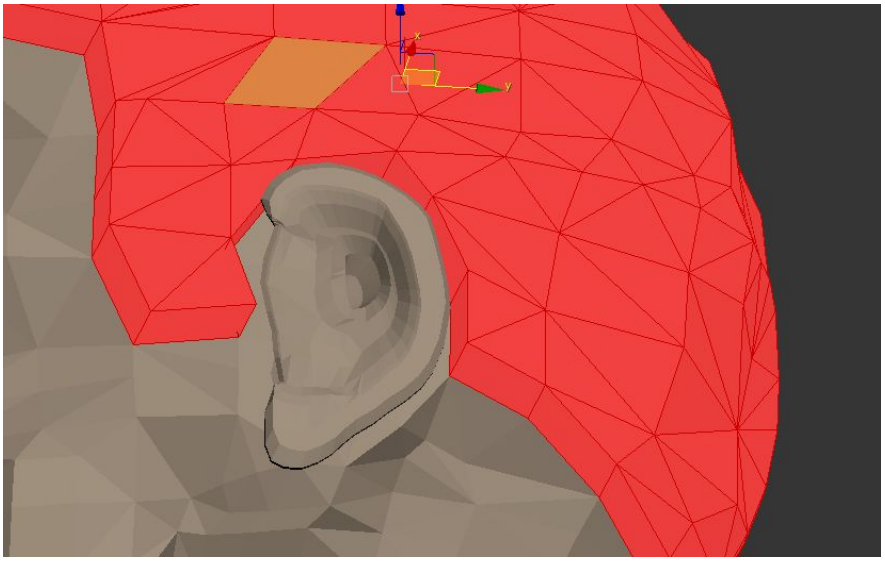




Additional Modelling Methods

Extrusion

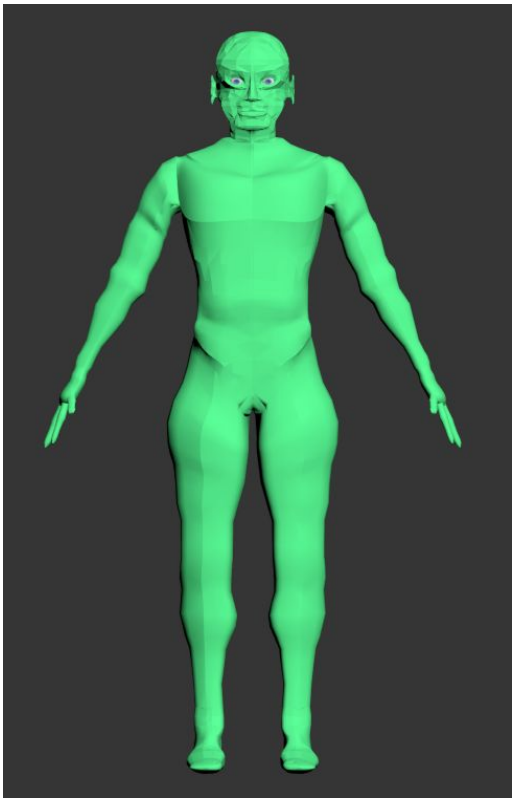
The sections of the head which are to have the hair material applied are selected and extruded from the skin. This helps to achieve the look of hair for the character as it is offset from the rest of the skin.



Using Modifiers

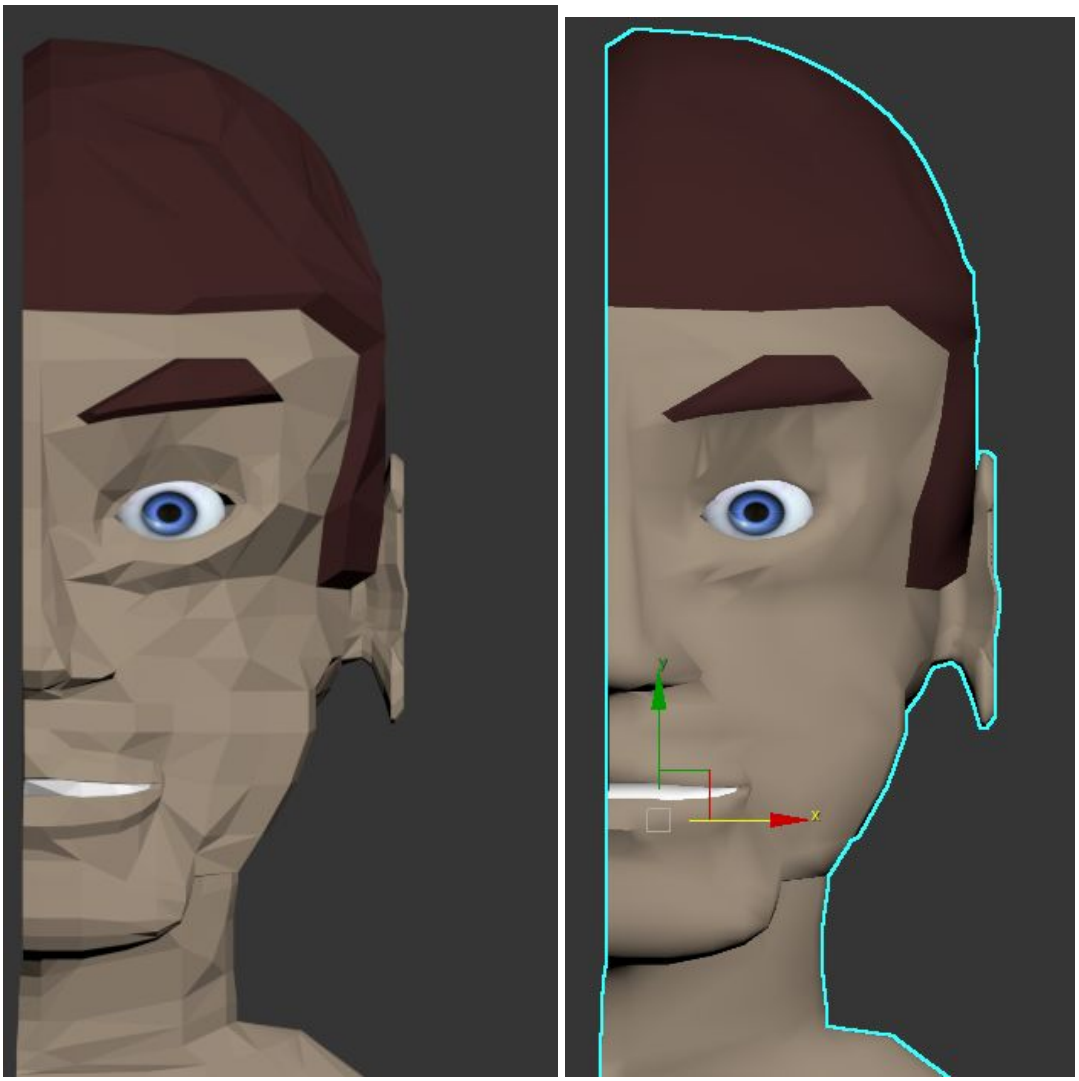
Mirror

The Editable Poly of the left side of the body has the mirror modifier applied along the x axis, with the copy option selected and the Offset set to -47.816cm. This provides better control over how the right half of the body is reflected compared to just using the Symmetry modifier and provides a full skin.



Smooth Modifier

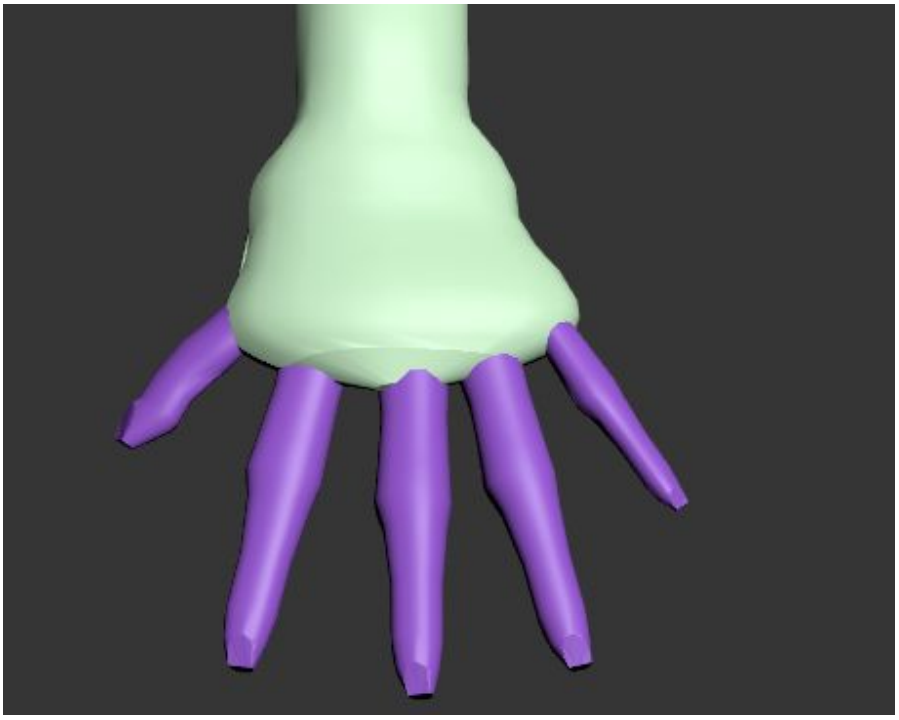
The smooth modifier helps to smooth some of the sharper edges in the model. It is applied using the Auto Smooth option with the Threshold value set to 60 and with the Prevent Indirect Smoothing option unchecked.

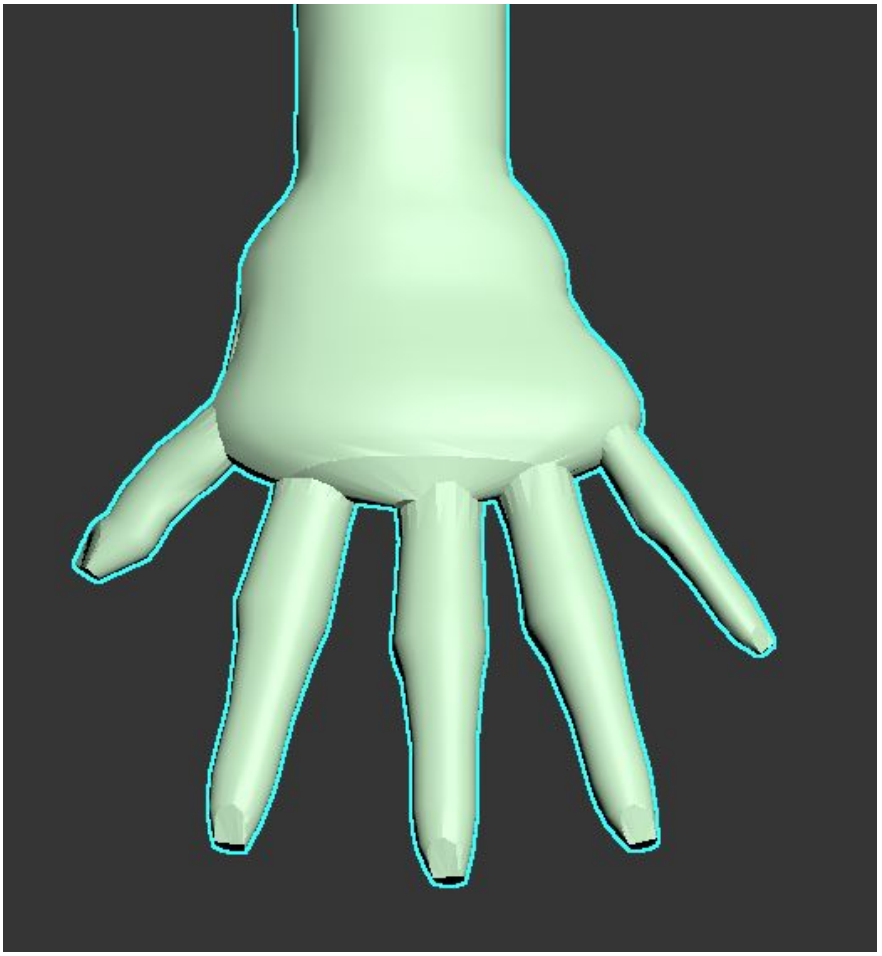


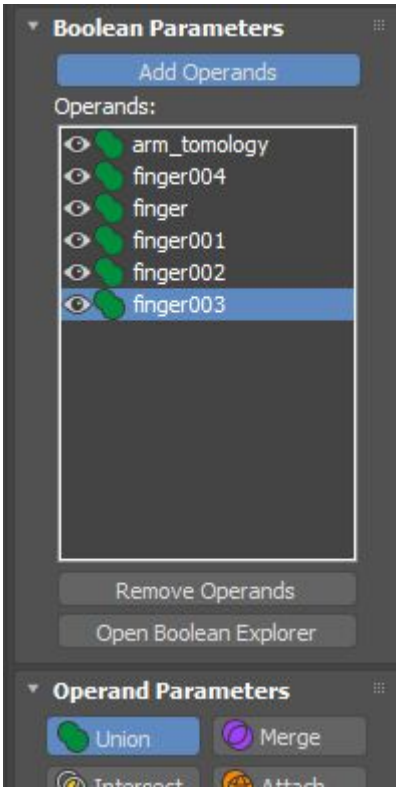
Constructive Solid Geometry

This technique uses boolean operations on different objects to create compound objects.

Joining Fingers with Hands



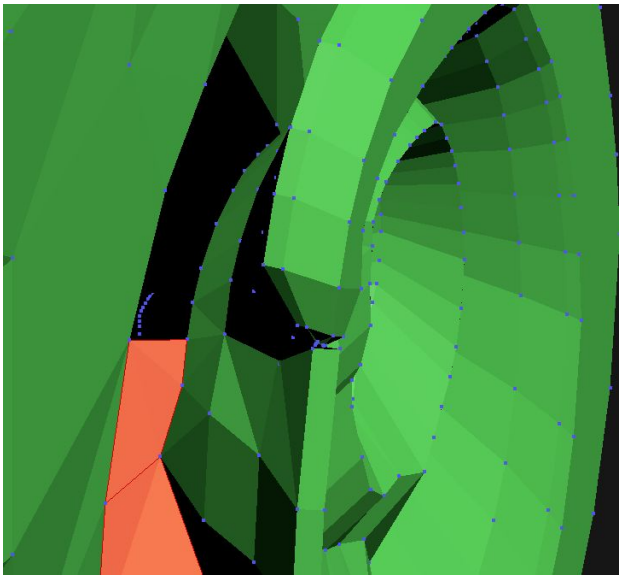




Combining Body Parts

As different body parts where created as separate objects, once each object is created, they can be joined into one object using a boolean union on all of the body parts. The gaps can then be patched up by creating polygons. This then allows for converting the objects into a single editable mesh and then refine how the body parts fit together to create the desired left-side-of-the-body skin.

Combining Ear With Head

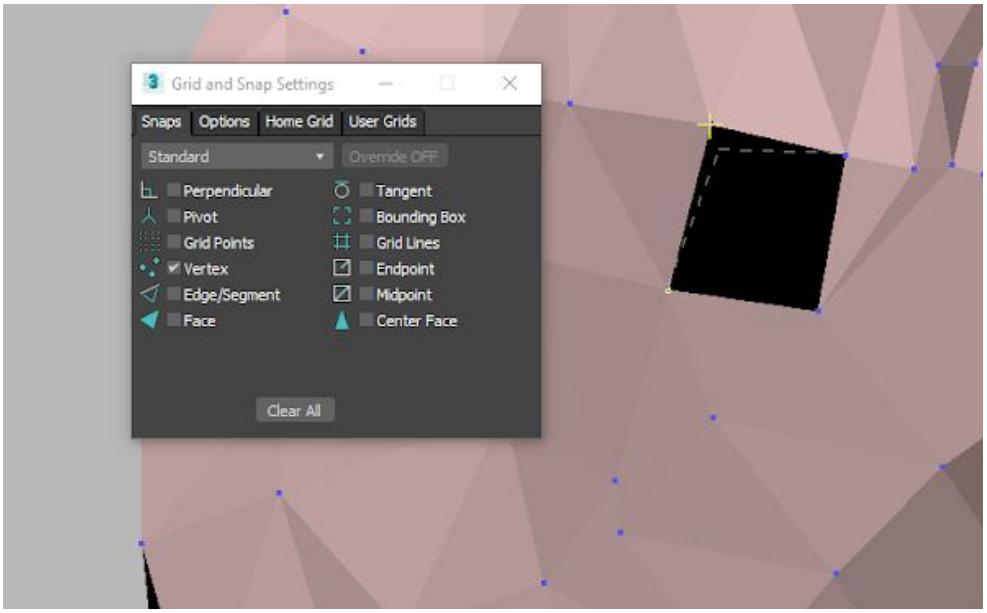


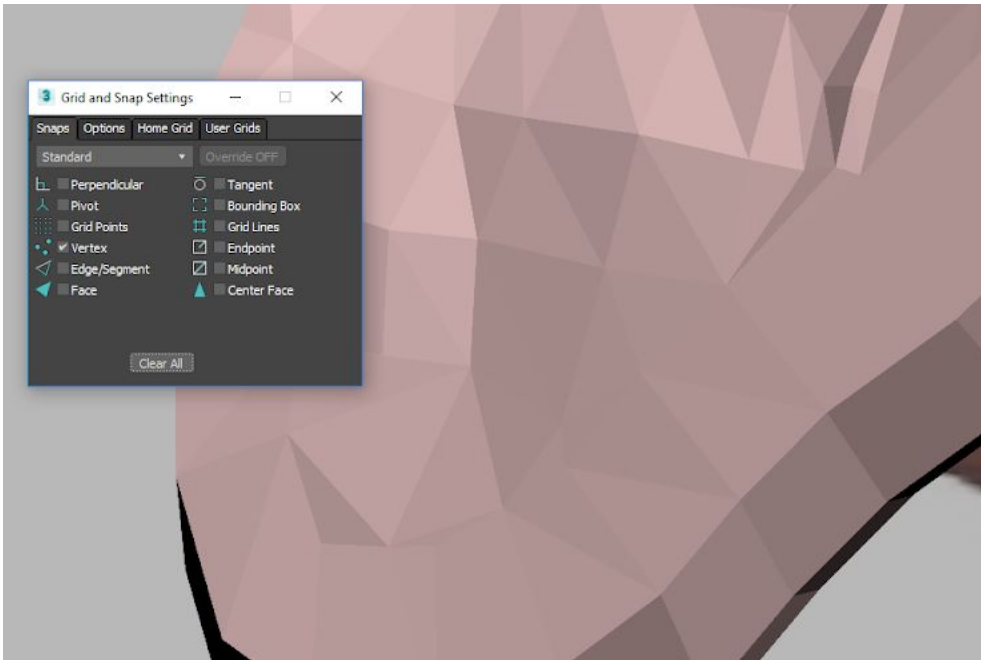
Creating Vertices Along Edges

By using an Editable Poly,body parts can be joined along edges even when there is a difference in the number of vertices along the edges of the body parts that are being joined. This is done by creating vertices across an edge so that body parts can be more easily joined.

Inter Vertex Polygon Creation

When working with polygon meshes, a common technique used was to create polygons between vertices to create faces that would help generate the desired shape of whichever body part is being made. This is made easier with the vertex snap tool. To create the polygon with the surface normal facing the camera, vertices must be selected in an anti-clockwise order, as per the right hand rule.

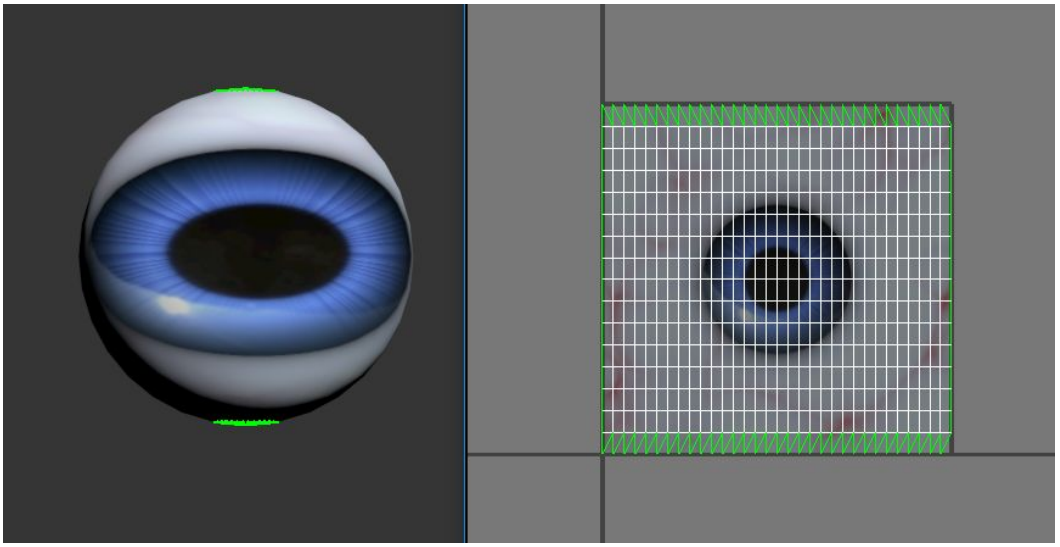


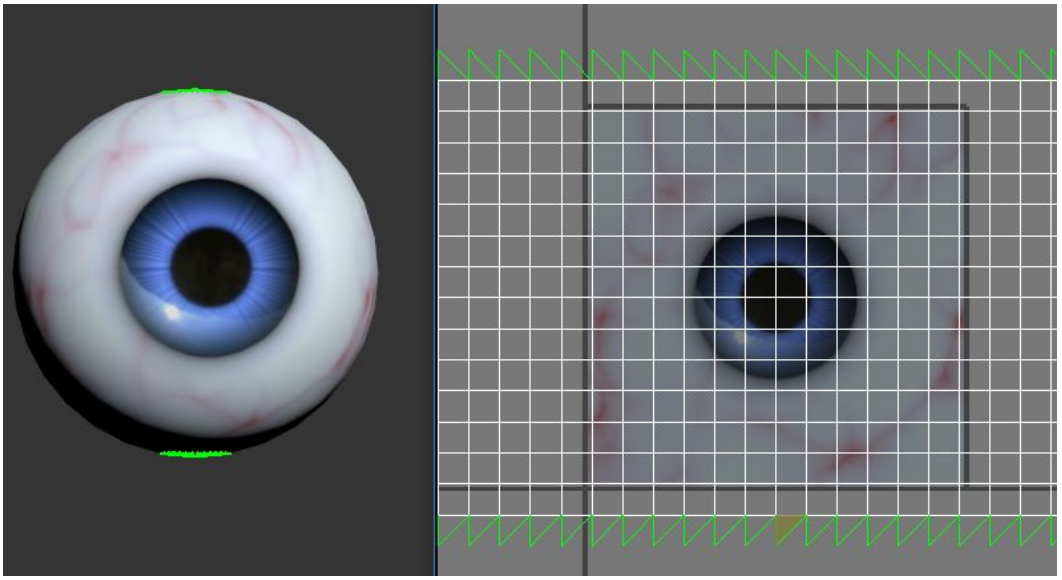


Design and Use of Materials and Textures

Texture For Eye

An image (eye-texture.jpg) is chosen for the eye material and then the UVWs Editor is used to shape the material to an appropriate shape for the eye once the Unwrap UVWs modifier has been applied to the sphere object. The Glossiness value was set to 100 to give a shiny look to the eyes.





Texture For Hair, Skin, Teeth and Fingernails

By using the SubObj Preview Selection mode and a selection groups for the: hair and eyebrows, skin, and fingernails, materials can be applied to groups of polygons which would share the same material. As the hair, skin, teeth and fingernails are multi-polygon selections it is difficult to achieve a realistic representation with a texture image. Instead, a diffuse colour is chosen for each selection, with appropriate settings for the surface properties (hair and skin non-glossy and soft, teeth and fingernails glossy and non-soft).

Hair Surface Properties

Diffuse Colour:

Glossiness: 5
Soften: 0.5

Skin Surface Properties

Diffuse Colour:

Glossiness: 10
Softness: 1

Teeth Surface Properties

Diffuse Colour:

Glossiness: 100
Softness: 0.1

Fingernails Surface Properties

Diffuse Colour:

Glossiness: 75
Softness: 0.1

Scene Design and Rendering

Scene

To demonstrate the capabilities of the ray tracing renderer a basic shed, a plastic box, and a lamp are added to the scene. The shed is set to have a material of an image which is non-glossy and non-specular to cast shadows onto. The box is set to be translucent and shows how light passes through. The lamp uses a Target Spot light to cast a shadow of the character onto the shed.

Lighting

An Omni light is used to create ambient light. Its colour is set to white and its intensity multiplier is set to 0.5 to mimic moonlight. A Target spot is used and has its colour set to yellow and intensity multiplier set to 1.5 to act as the street lamp. Both lights select the Shadows On option.

Renders

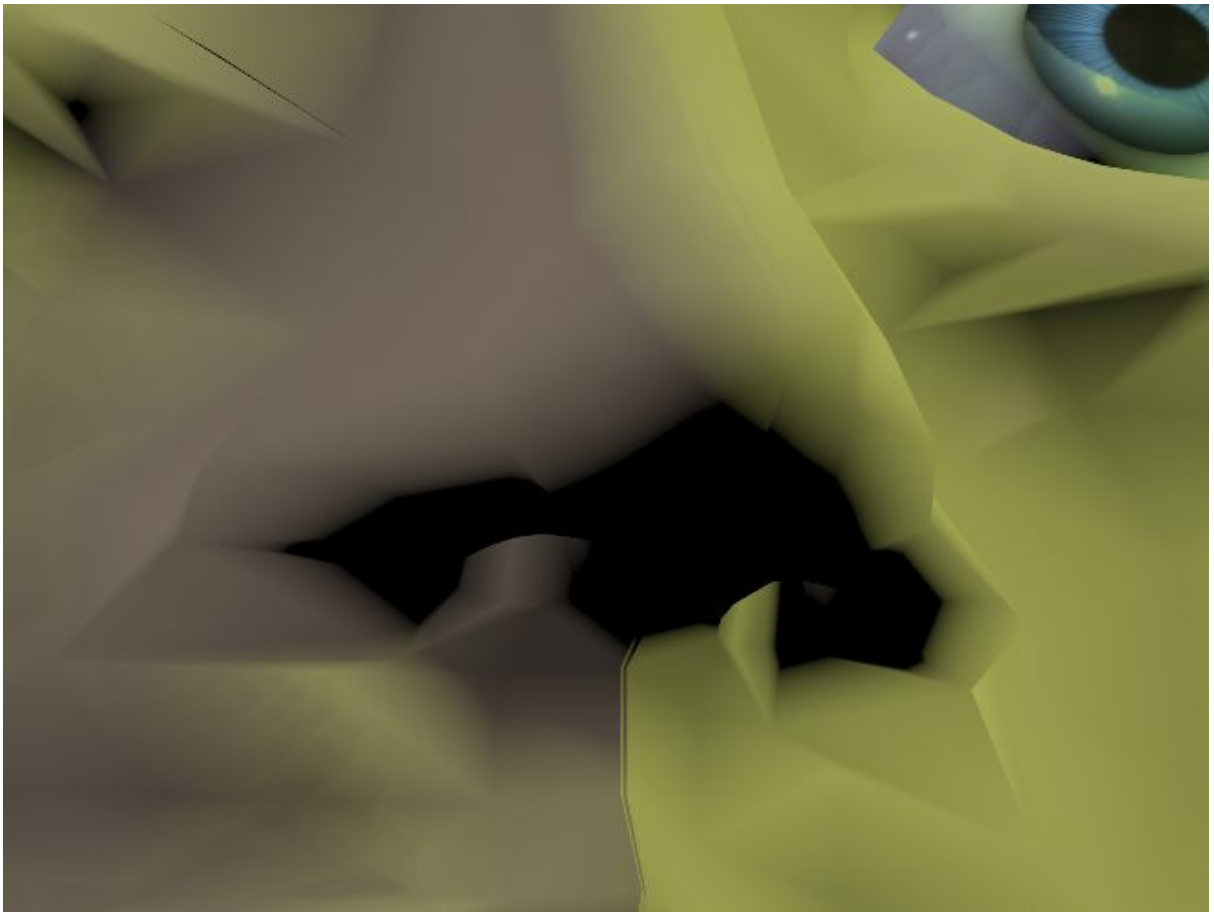
Render Method and Justification

From the available renders offered by 3Ds Max the Scanline Renderer was selected as the production renderer. One consideration that went into this decision is that some (ART Renderer and Arnold Renderer) renderers do not support the lighting objects. Also, as the scene is fairly simple with few objects, the Quicksilver Hardware Renderer offered no benefits over using the Scanline Renderer.

As the scene does not heavily feature multiple reflective surfaces the Raytracer Global Parameters where kept at the default values of a Max. Depth of 9 and The Cutoff Threshold of 0.05. The colour specified to use at Max. Depth is set to black.

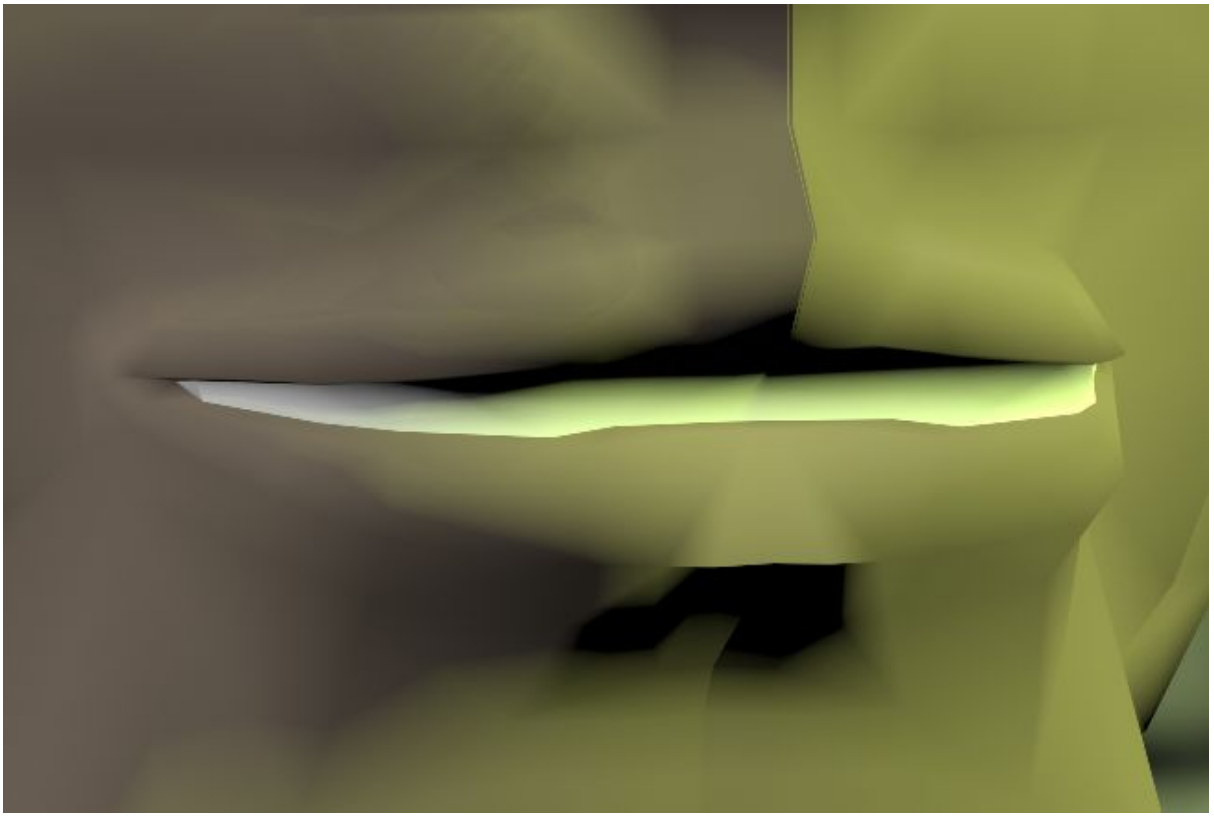
Eyes Close-up

Nose Close-up



Ears Close-up

Mouth Close-up



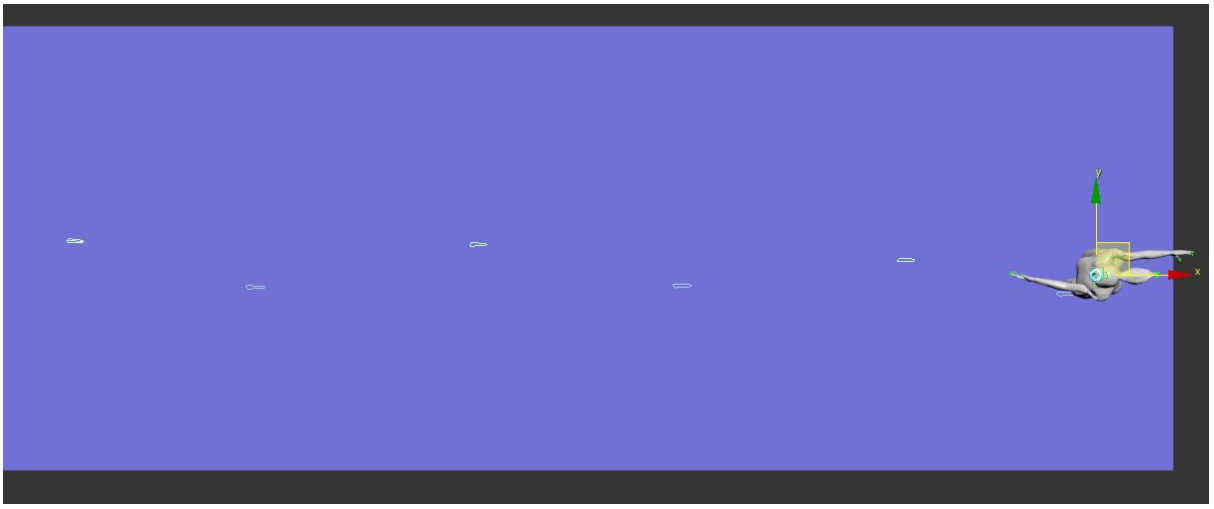
Final Scene

Task 2: Figure Animation

Motion Selection and Design

The animation aims to characterise a gymnastic vaulting routine. This movement provides a series of well defined, dynamic actions which is effective in demonstrating the wide range motions a biped can complete in a short amount of time. Additionally this specific routine will only require a few other scene objects to act as an accurate portrayal of a gymnastic vaulting routine.

The footstep mode is useful in defining the animation for the run up to the vault, but once more complex motions are needed (cartwheel, vault, landing) the biped is converted to a freeform animation. As the footstep mode does not accurately portray the body movements during running, the keyframes generated by Footstep mode need to be modified to consider the movements of the arms, shoulders, torso and head to more accurately portray the character running.

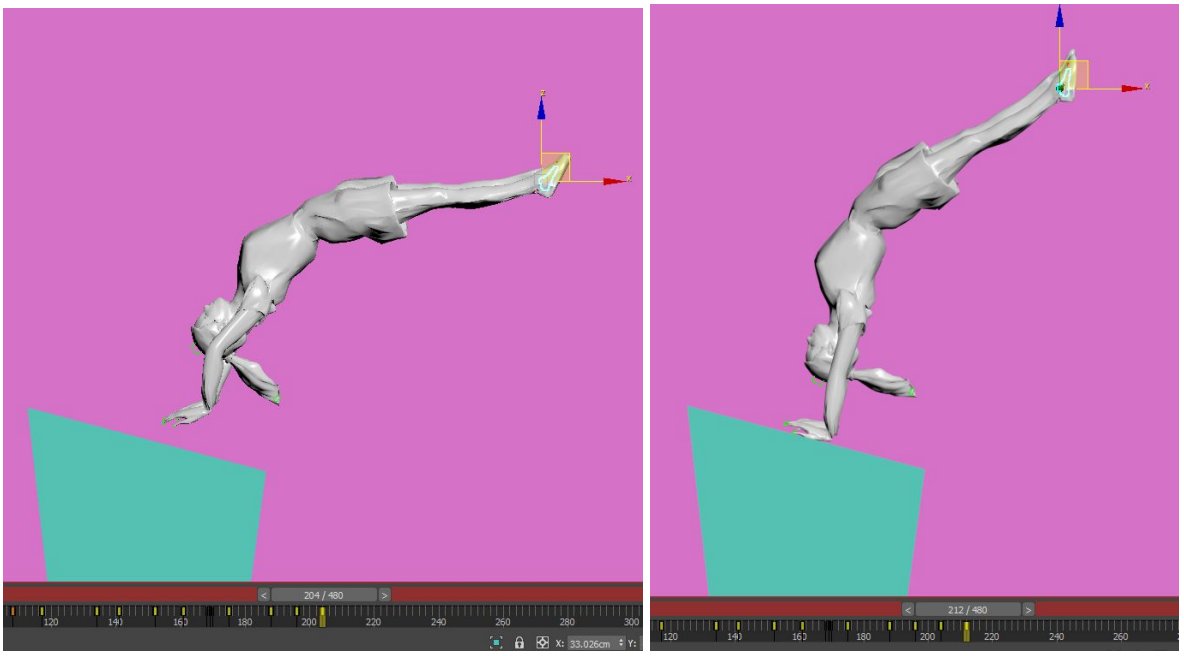


Storyboarding and Keyframing

To effectively demonstrate the desired action, certain keyframes must be achieved to generate accurate interpolations of the motion. By observing a typical gymnastic vaulting routine, it can be seen that the key frames that need to be captured are:

- the frames for the leading run up,
- the frames for the cartwheel onto the springboard,
- the frames for jumping onto the springboard,
- the frames for vaulting onto and from the vaulting table,
- the frames for the in-air rotations of the gymnast,
- the frames for the gymnast landing the vault.

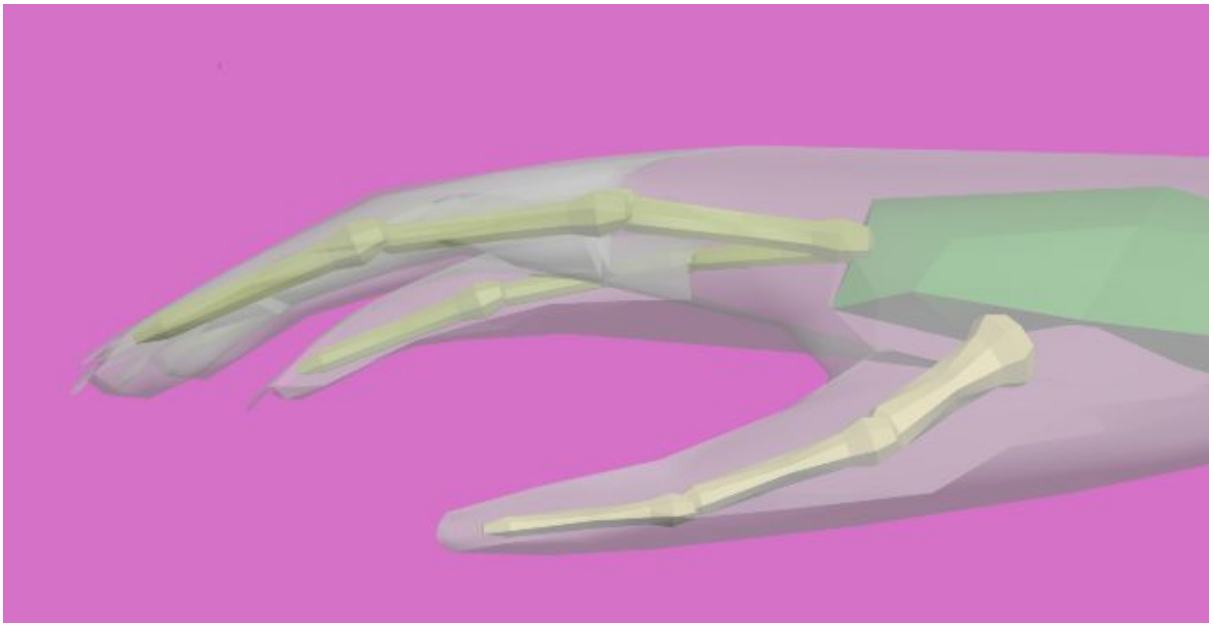
The animation primarily uses the Auto Key method to generate it key frames. This is a useful method of setting keyframes as it allows for the manual manipulation of the biped to realistically describe motion of the character as the time slider is progressed. The Set Key option can then be used to set or modify keyframes as the position of the biped it moved to improve the animation throughout its development.

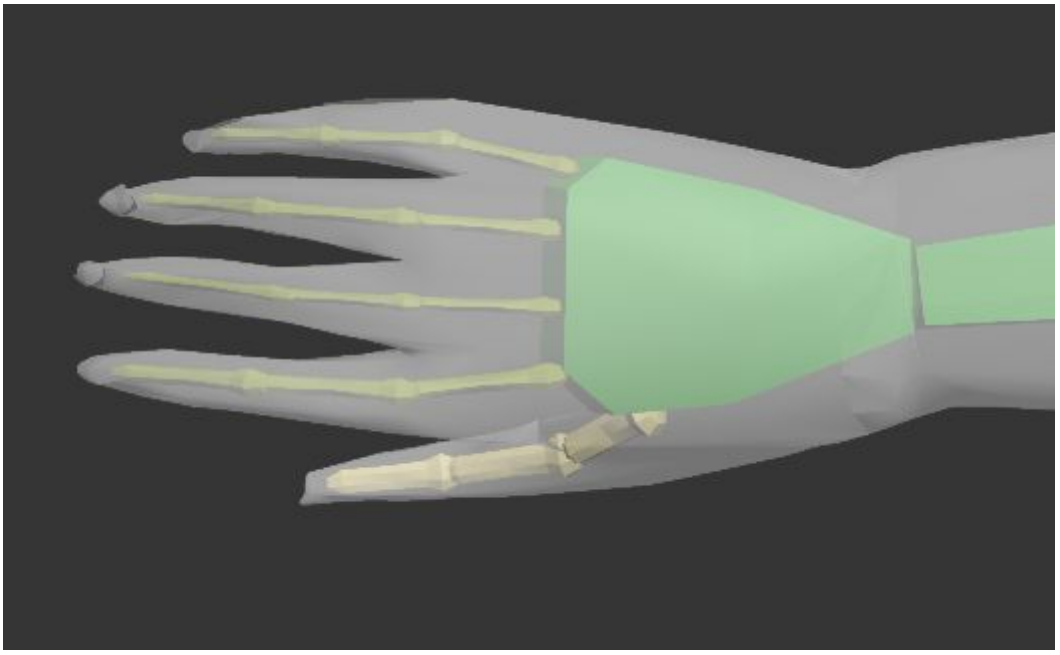


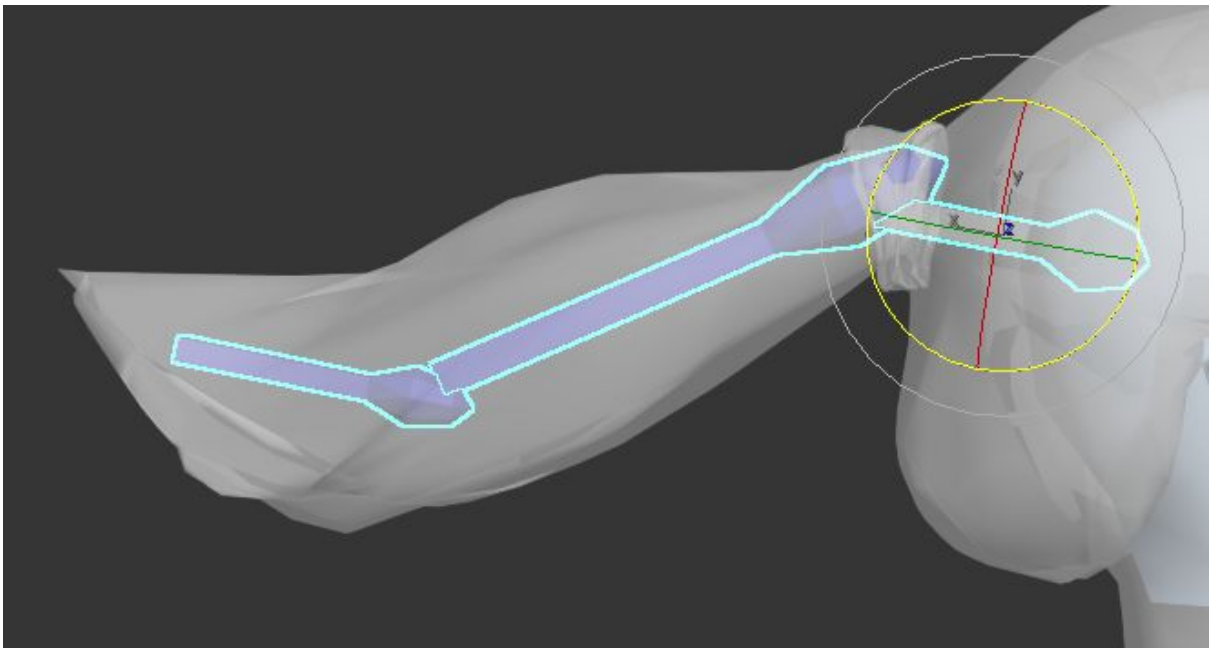
Skeleton Design & Skin Binding

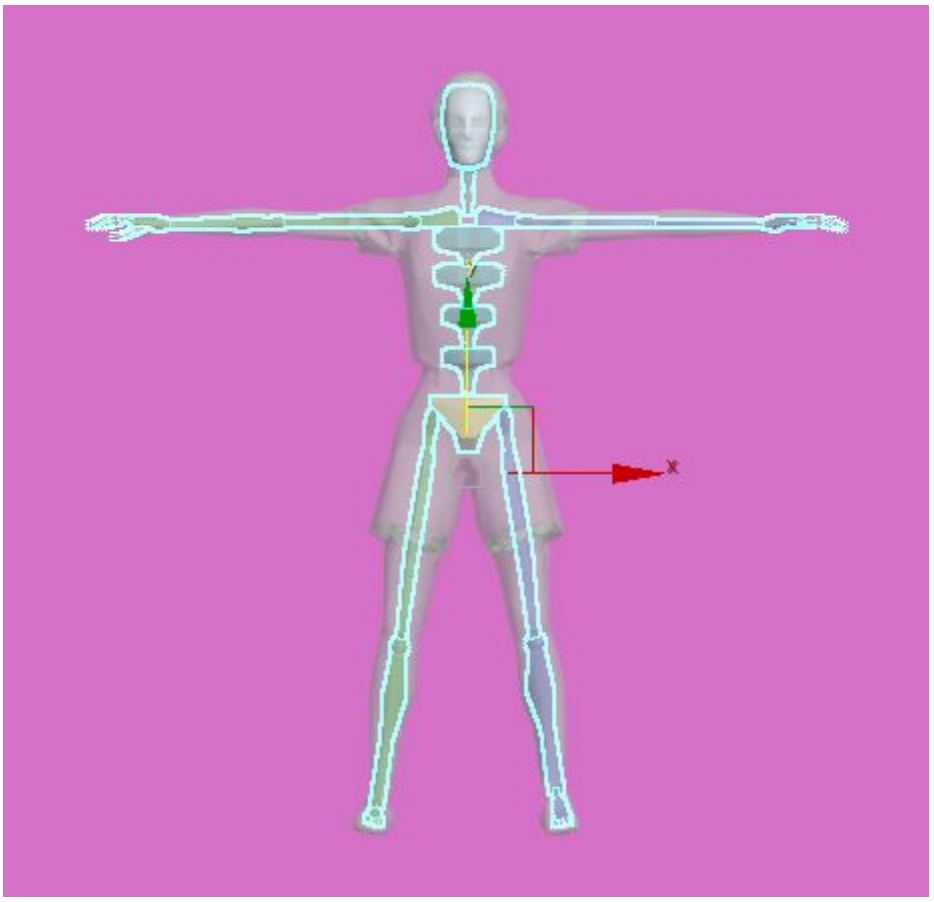
Biped Customisation

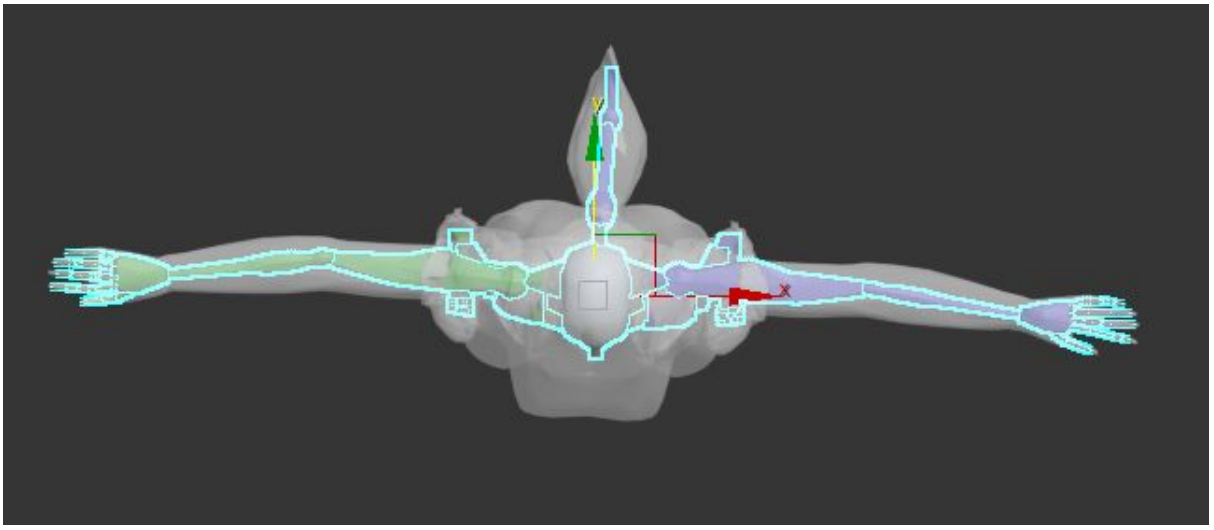
As a starting point, the 3DS Max default skeleton biped object was chosen to be used as the biped for the character. This allows for easier, more bespoke customisation of the biped, as the skeletons body parts can be easily manipulated to suit the characters skin. Customisations made to the skeleton include: adding fingers and toes, adding ponytail links, and scaling and transforming limbs to suit the skin. By customising the biped to better fit the skin, the skin can be more accurately controlled and will generate fewer extreme deformations.









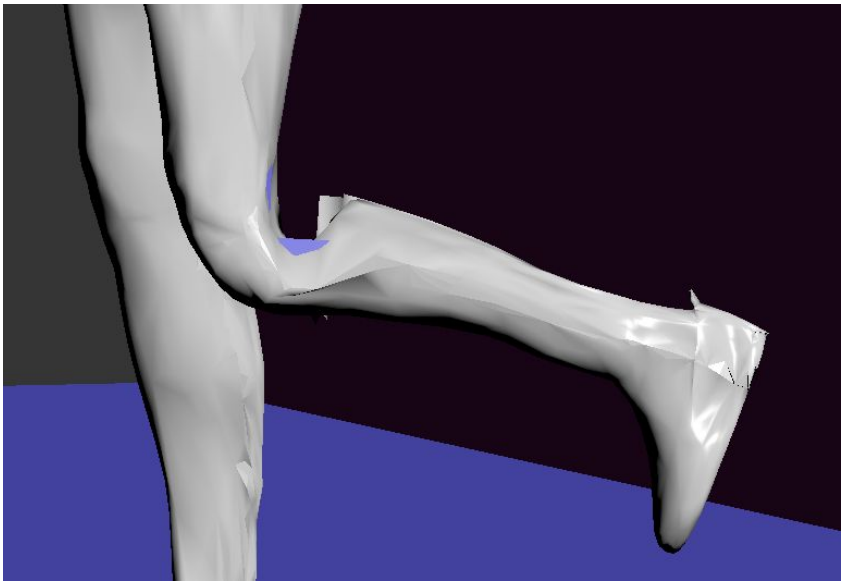


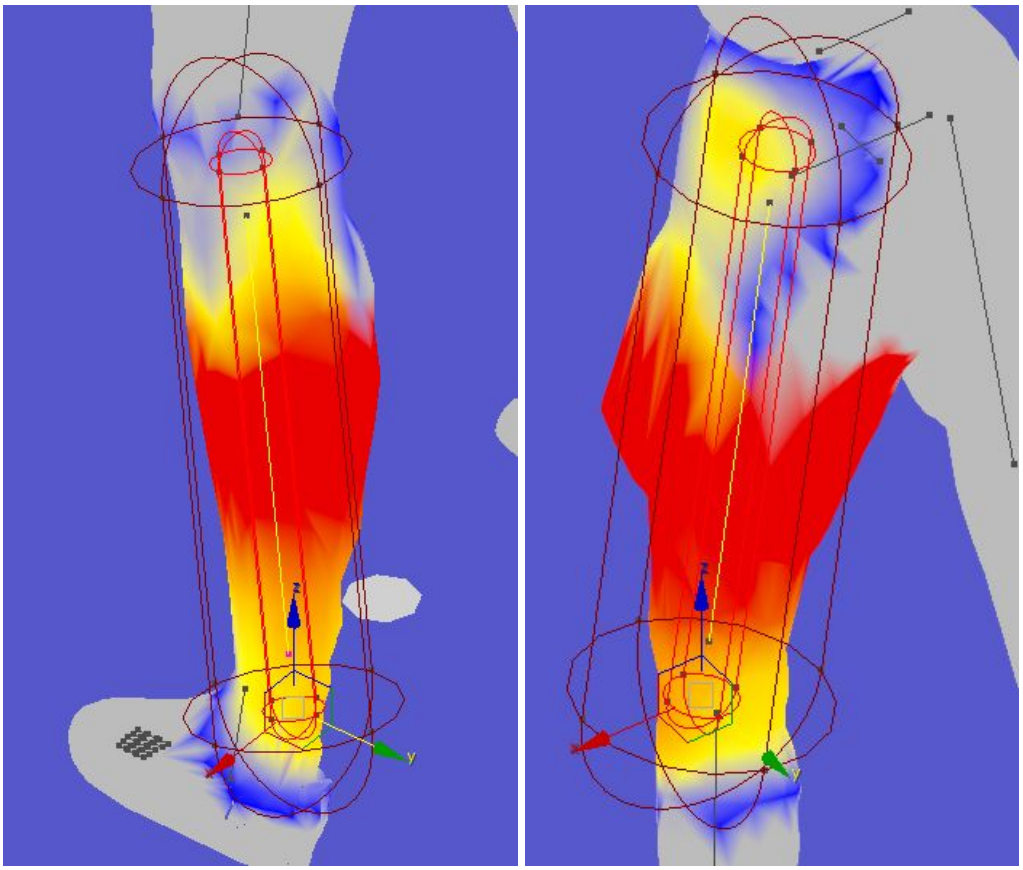
Skin Binding

Skin binding is initialized by applying the skin modifier to the provided woman.max skin and selecting all of the bones in the customised biped. It is then improved by modifying the default skin envelopes such that there is less abnormal deformation of the skin when the links are transformed. It is important to ensure that all of the skin is enveloped by the bone envelopes so that the skin moves accurately as the biped moves.

Before Modifying Envelopes

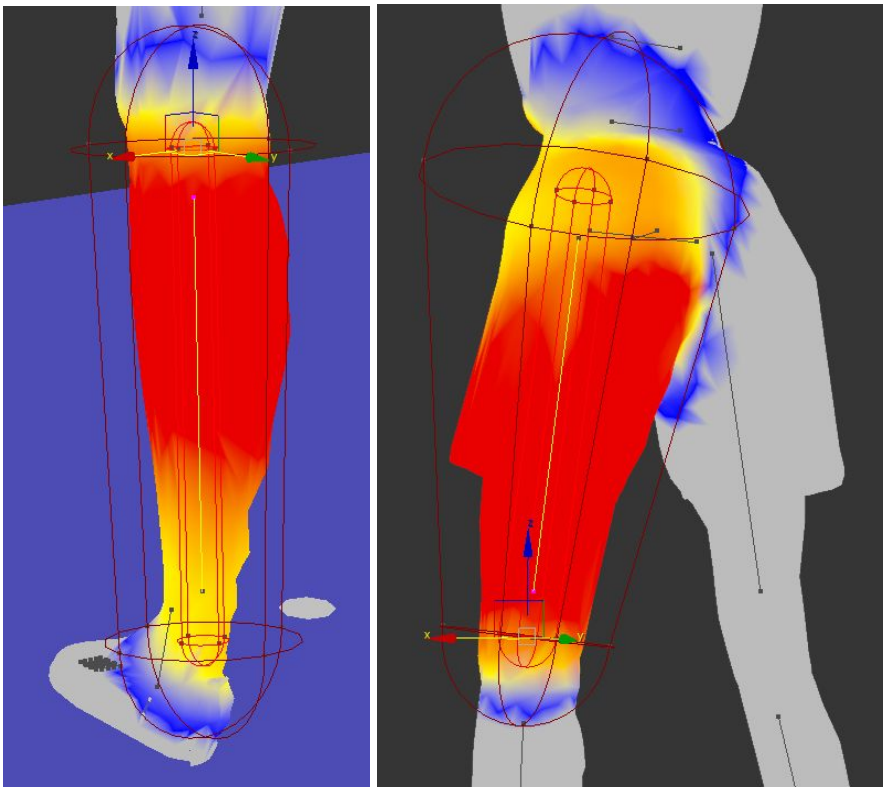
It can be seen here that due to the envelopes not covering the top part of the calf, extreme deformation occurs when the knee is bent.

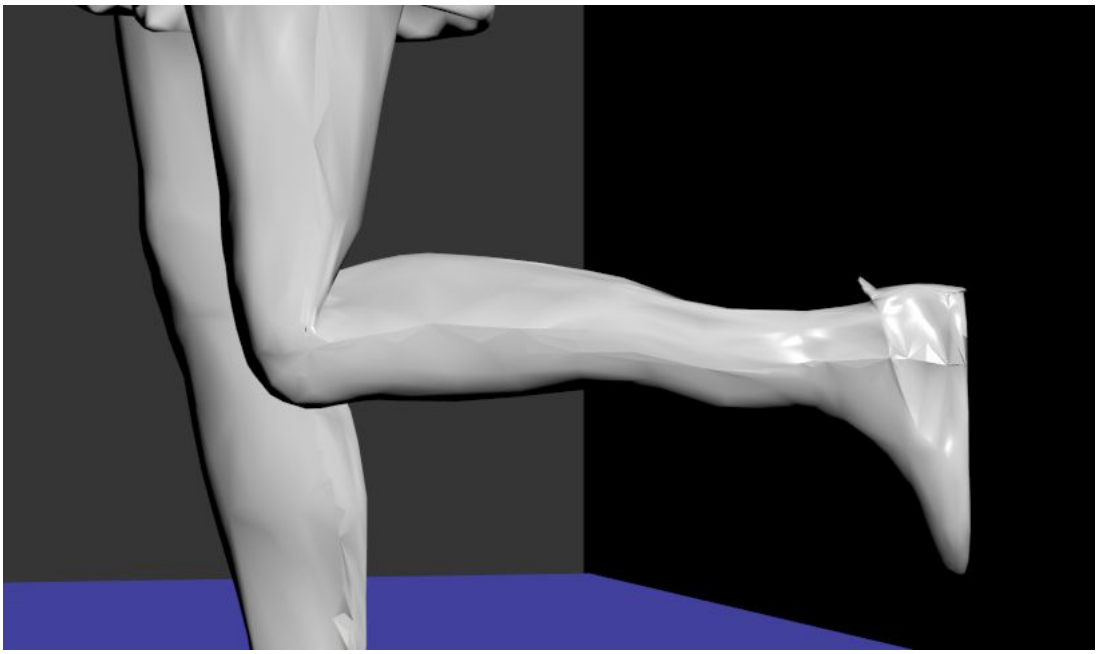




After Modifying Envelopes

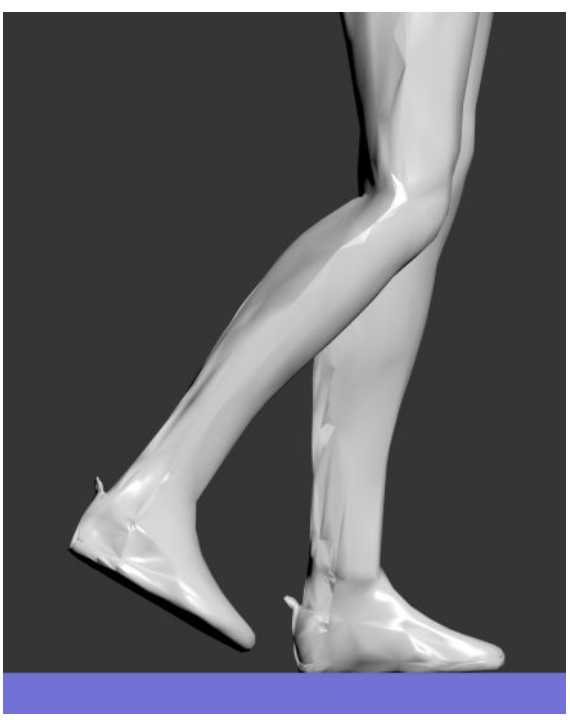
Now that the envelopes are moved to also cover the top part of the calf, the calf deforms more realistically when the knee is bent.

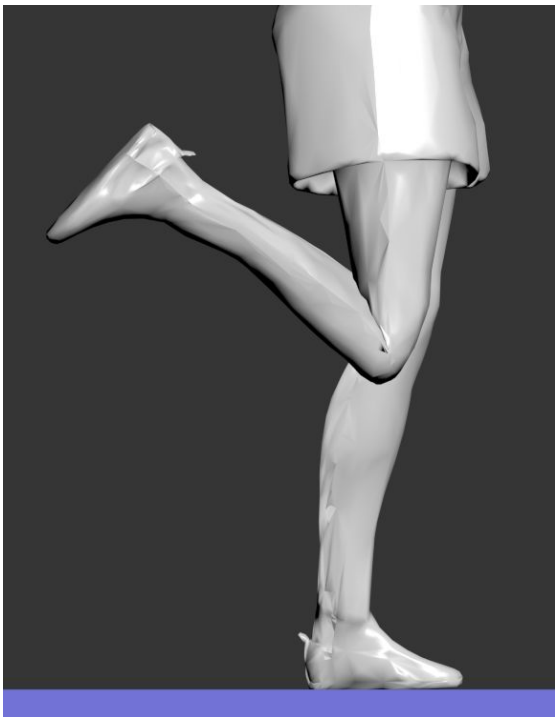




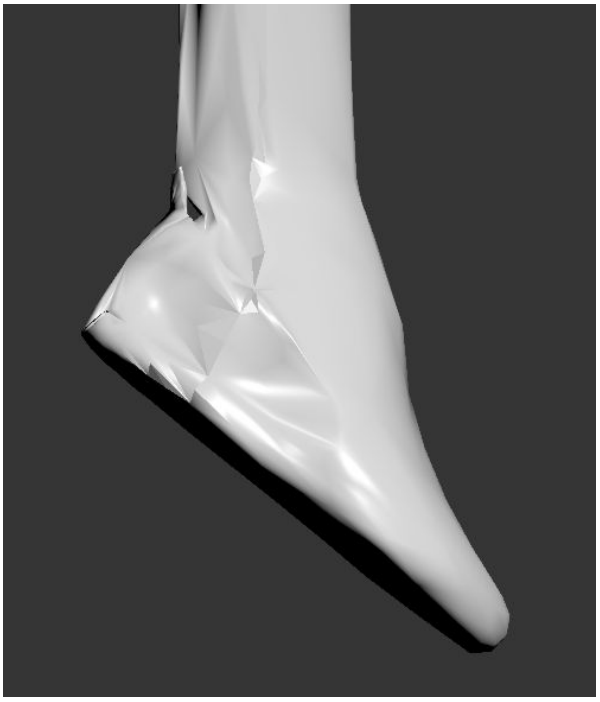
Screenshots of Joints at ~45 degrees (Interior and Exterior Angle Incident to Connected Limb)

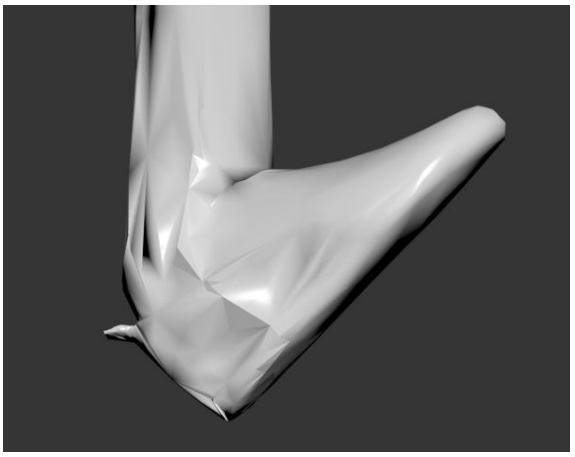
Knee



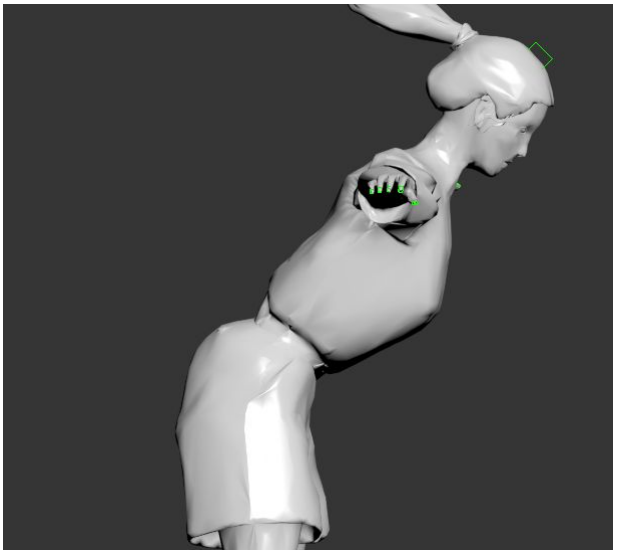


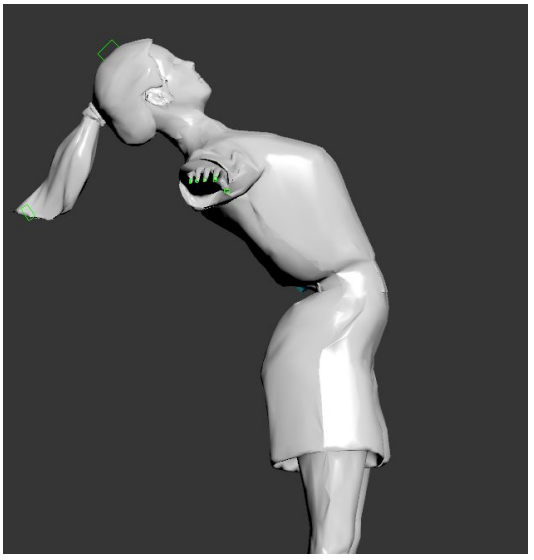
Ankle



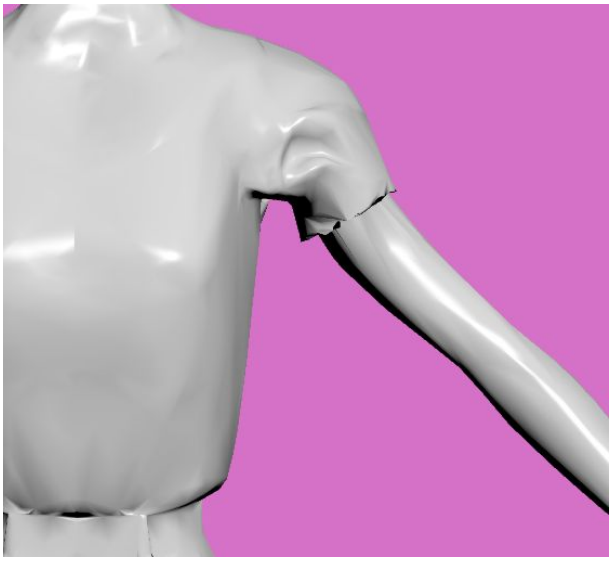


Hip

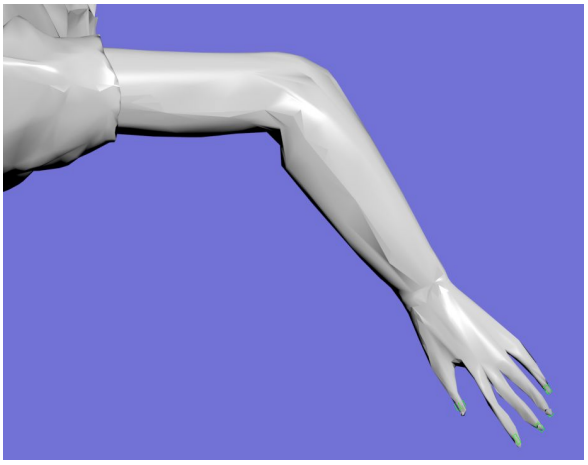


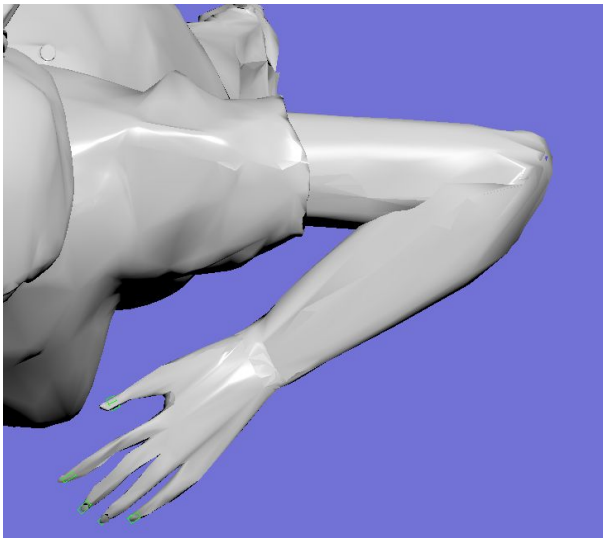


Shoulder



Elbow



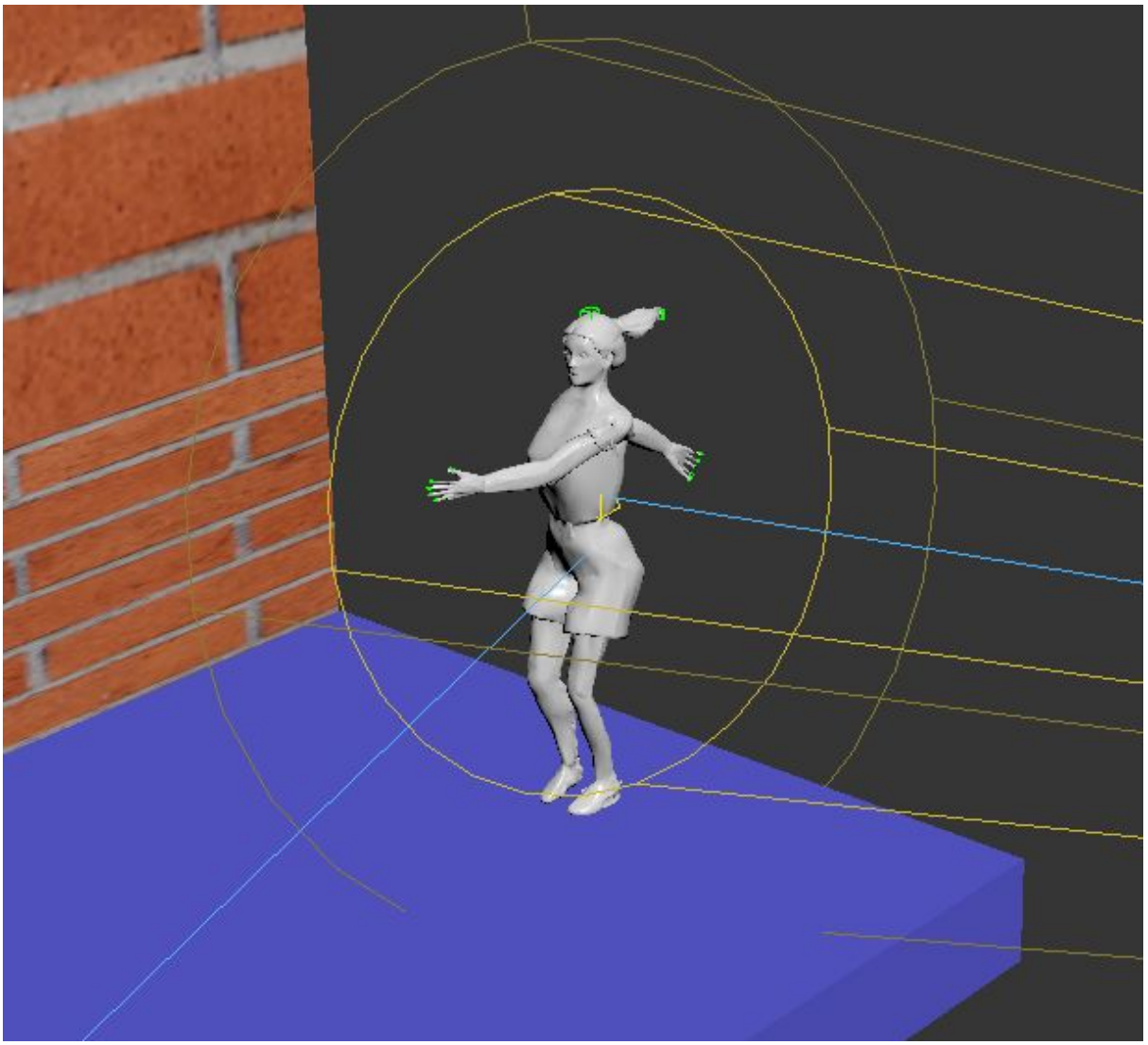


Rendering

Scene and Lighting

A simple background image of a brick wall is chosen for the scene. This is chosen to be representative of a gymnasium or an area where a gymnast may be training. With its material setting set so that Glossiness is 0 and Softness is 1, it provides a good surface to receive the gymnasts shadow. Additionally simple objects for the spring board, vault, landing pad, and ground are created to support the narrative of the scene.

A Target Spot light with an Intensity Multiplier of 0.5 and of a light blue colour is chosen to follow the gymnast as they perform their routine. This is representative of spotlights that may be used during performances to better highlight the movements of the gymnast for an audience or a photographer to see. To follow the gymnast, the Target Spot light's target object is linked with the gymnast using the Select and Link tool. As well as the Target Spot light, an Omni light with an Intensity Multiplier of 0.25 and light yellow colour is used to create the ambient environment lighting. This would be representative of any indoor lighting that the gymnasium the gymnast is performing in may have. Both lights have the option to generate shadows turned on. The Hotspot and Falloff parameters for the Target Spot light are adjusted to more appropriately highlight the gymnast.



Camera Motion

The camera movement is designed to effectively demonstrate the character animation. This is done by setting the camera to follow the gymnast as they perform. The Target Camera is chosen to record the animation then the Select and Link tool is used to link the camera's target object to the gymnast as they perform. A factor in deciding that the camera would be

in a stationary point and follow the gymnast was that this could better simulate a recording of the gymnast as if the animation was taking place at a gymnastics event and that it would be unrealistic for the camera to execute more dynamic flyby maneuvers.