**3D Modelling in Computer Game Production**

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BSc (Hons)in Applied

**3D Game Assets**

# Declaration

I declare that the work which follows is my own, and that any quotations from any sources (e.g. books, journals, the Internet) are clearly identified by the use of single quotation marks for shorter excerpts and indented italics for longer quotations. All quotations and paraphrases are accompanied by (date, author) in the text and a fuller citation in the bibliography. I have read and understood the rules on paraphrasing and referencing and followed these conventions carefully.

Signed: Cían Daly

Date: 04/03/2019

# 1. Introduction

This document will discuss the topic of 3D modelling in computer game production using the following, but not restricted to, processes in the workflow of asset creation to game engine, Modelling, Animation, Rigging, Lighting, Rendering and specific issues relating to these areas. This document will also explore the new technologies used for 3D modelling in the modelling software and game engine software. All citations will be in the Harvard format and a bibliography of references will follow at the end of this document in alphabetical order of surname.

# 2. Processes and issues regarding workflows

## 2.1 Modelling

3D modelling is when a person(s) uses a computer program to create images that look like they are three dimensional. This process consists of connecting points with lines and curved surfaces and other geometric properties using 3D animation software like Autodesk Maya and Blender to create wireframe models (2018, GameDesigner). “3D assets make up the bulk of any major game released today. Thanks to improvements in technology, almost all games are 3D”, (2018, Tushar Tajane). Modelling software makes it possible for solo designers and small teams and larger studios studios to create game models and worlds. For example PhotoModeler, which was released end of 2017, an award wining program allows you to use photos to create 3D models (2018, PhotoModeler Technologies).

When creating character models this usually begins with artists drawing concept art of the model before being given to modellers to realise. While some creative liberty can be taken in the design process there are some rules that should be followed to help make believable characters.

“*If the character is human, paying attention to human proportions and anatomy is important. However, this does not mean that the design has to be realistic. The proportions can be exaggerated to make the character more dynamic and interesting, or to achieve a specific stylized look. If the character is an animal or a monster of some sort, it is important that the creature remains believable, even if the design is highly stylized” (2017, Terava).*

There are also some problems that can occur when making assets. Naming materials with strange names, creating meshes with no distinct names nor grouping pieces of a model appropriately. This can make it difficult to move the model as a whole or when dealing with complex assets which piece relates to the given name if you were to import someone’s work to edit(2018, Gonzalez)

## 2.2 Animation

*“Computer 3D animation refers to the work of creating moving pictures in a digital environment that is three-dimensional. Through the careful manipulation of objects (3D models) within the 3D software, we can then export picture sequences which will give the illusion of movement (animation) based on how we manipulate the objects”, (2018, Chang).*

Creating animations in video games is not the same as animating in movies. This is because the processes for each are different even though they may use the same software and principles. For movies the animator is only responsible for animating what is in the view of the camera. There is only one angle that needs to look well. Whereas with video games every camera angle needs to look well as the player is in control of the camera and can change the view at any moment, (2014, Pluralsight). While video game graphics are continually improving and becoming photo-realistic in quality the animation of a character taking off clothing is still one of the hardest animations to create.

“Physics-wise, it’s hard to simulate floppy things that wrap smoothly around complex shapes/and ultimately it just doesn’t matter enough”, (2018, Grayson). There are still scenes in video games where characters remove/change clothing but the act is done off camera. For example in The Witcher 3: Wild Hunt the main protagonist, Geralt, begins unbuttoning his shirt, the camera swaps to another room and he enters holding the shirt. This creates the illusion in our mind of the character performing the task fully.

Similarly difficult to animate is a character walking around with their hands in their pockets. In a Ubisoft behind the scenes video for the game Watch Dogs, Colin Graham, animation director, said that it is very difficult to animate hands in pockets and moving believably due to the clothing also needing to move with the character. This caused his hands to appear through the clothing sometimes as the cloth of his coat is simulated in the game. This was achieved though through the use of motion capture which is an industry technique for difficult or subtle animations, (2018, Grayson)

## 2.3 Rigging

“A rig is the process in which you will take apart the multiple pieces of your character and then reattach them together to get them to move individually”, (2019, Harmony-14). “Specifically, rigging refers to the process of creating the bone structure of a 3D model. This bone structure is used to manipulate the 3D model like a puppet for animation”, (2019, Petty). There are two types of rigging techniques used to create realistic behaviour and movement of 3D models for animating; Forward kinematics, FK, and Inverse kinematics, IK. These terms of movement came from robotic engineering movement, (2018, Cerny).

FK rigging makes each bone follow the parent bone’s movements. FK rigs move in arcs which are more realistic to movement in nature. If you rotate the shoulder of a 3D model the elbow, wrist and hand follow accordingly. If you rotate the elbow, the shoulder will be unaffected but its children will be. In IK rigging the movement of objects follow a line trajectory where all parts in the hierarchy move together. This movement is useful for legs or if a model is pushing something, as the body moves the hands act as the target bone and the elbows bend accordingly, (2016, Doody).

The rigging process can be broken down into smaller sections in order to create an object of high quality.

“*Preparation – What you need to do before starting a rig Joint and Control Layout – You planned your rig, now let's get stuff done Deformation -What it takes to make your rig look believable and dynamic Tips and Tricks – Scripts, skinning and muscles”, (2014, Pluralsight).*

## 2.4 Lighting

Lighting is an important aspect in 3D modelling. It is used to convey how the player should feel in certain situations; Low lighting and dark colours – tense, scared, well lit, sunny and bright – eager to explore and confident. It is also needed to provide visibility for characters in the game and any action that is occurring. While lighting is needed for the project it uses up a lot of the computing power to generate in the game worlds and affects the models and animations also. Due to the 3D models being adjusted and finalised until this point lighting is one of the last aspects to be added to the project.

*“Lighting can be placed around the scene and baked without it slowing down the entire project thanks to the 3D Modelling pipeline. Lighting will be affected by the model, animation and texturing, which is the specific reason it had to come after everything else”, (2018, Colins).*

Lighting can also be used to guide a players attention to a certain object or area and can be used to help guide them through the level. “Overall there are four types of lights which are used in 3D graphics: ambient, directional, omnidirectional, spotlight”, (2012, Prall). Ambient lighting is also called general lighting and it acts as the primary source of light. It offers a suitable amount of light for the scene without excess glare, (2017, ModernPlace). Ambient light is different from the others though as it has no real source. Directional light is the generation of light in a specific direction only. Directional light is used to highlight a single object or surface as it provides a stronger light source, (2019, Gray). “Omni lights casts rays in all directions from a single source. Omni lights are useful for adding ‘fill lighting to your scene, or simulating point source lights”, (2014, Autodesk). Spotlight generates light in a cone shape, limiting the angle of spread of the light and the direction it goes, (2012, Prall).

However, there are problems with ambient lighting as it applies light to one side, the opposite side is completely dark which is unrealistic as some light will reflect back. The most realistic version of computer generated light is raytracing. It is also computationally very difficult to generate in real-time.

“*Ray tracing, which has long been used for non-real-time rendering, provides realistic lighting by simulating the physical behavior of light. Ray tracing calculates the color of pixels by tracing the path that light would take if it were to travel from the eye of the viewer through the virtual 3D scene. As it traverses the scene, the light may reflect from one object to another (causing reflections), be blocked by objects (causing shadows), or pass through transparent or semi- transparent objects (causing refractions).*

On August 14th Nvidia debuted a new set of graphics cards that would allow raytracing in real-time. “The new Quadro RTX range lets you see raytraced renders of your scenes in realtime in your 3D application or renderer’s view”, (2018, Bennett).

## 2.5 Rendering

The rendering process can be analogous to the development of pictures and printing them. “The term rendering refers to the calculations performed by a 3D software package’s render engine to translate the scene from a mathematical approximation to a finalized 2D image”, (2019, Slick).

As the quality of 3D game productions continually improves through more advanced graphics cards so too are the capabilities these cards can perform. AMD’s latest graphics card the Radeon Pro WX 8200 is the most powerful graphics card for under $1000, US. It allows you to render in the background while you work on 3D scenes. AMD claims their card is 13x faster than equivalent rival Nvidia’s Quadro P5000, (2018, Bennett).

Rendering is one of the final steps to 3D modelling production, composition is after this where you show the finished product in vfx reels. Rendering displays the 3D model and the scene’s spatial, lighting and textural information together to display a more detailed and realistic model, (2019, Slick).

A leading area of rendering is photorealism in video games. “Photorealism simply means that a simulated scene appears indistinguishable from a photograph, or by extension, from real life. The main obstacle to photorealism is processing power”, (2013, Scharr). These computational challenges are decreasing though with hardware improvement as mentioned above with regards to this.

While the humans depicted in video games are significantly more realistic and complex than ever before, they still are not capable of capturing fully the ‘humanness’ of real life. This issue is known as “the Uncanny Valley, coined by robotics professor Masahiro Mori”, (2015, Stuart). Mr. Mori’s hypothesis, published in 1970, was that the more realistic the reproduction of a human is the more disturbing the inaccuracies are to us and can cause a sense of unease and revulsion, in some cases exceeding the level of seeing a corpse. This problem can be overcome by making the reproduction more cartoonish, (2016, Rouse).

# 3. Conclusion

I have learned a lot about this topic and the workflow of creation from asset to game engine after doing this research essay and feel I have only scraped the surface of what is a huge field of work.

The process of 3D modelling in computer game production is very technical and covers a wide range of areas that require their own level of expertise and understanding to enable a product to be of the best quality. The challenges needed to overcome in this field of work are plentiful but lessened to some extent with ever evolving hardware and software to meet the demands of this industry.

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