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Three Methods for Making of Character Facial Animation based on Game Engine

Focused on Scene Composition of Machinima Game 'Walking Dead'

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Abstract

Machinima is digital visuals created with game engines that build real-time 3D CG (computer graphic) environment. Composition of scene and facial animation play important role in composition of Machinima's videos. Character facial animation is frequently used in scene composition that mainly displays face and upper body of the character. Expressing character's emotion is an important factor in describing story of the animation. This paper provides three methods for character facial animation based on game engine, and applied them to real facial animation of Machinima characters. Through this process, we could match the most suitable facial animation to three types of scene composition by analyzing scene composition of the most renowned game of Machinima, 'Walking dead-episode1'. Morph animation is suitable for medium close up and medium shot. Motion capture is efficient for over shoulder shot. However, during the process of combining body motion and facial animation, Motion capture was more difficult to reuse resources than morph animation and animated texture. When making pipelines for an independent video content, these findings could contribute to establishment of efficient resource production process based on real time rendering technology, which is a strength of game engine. In addition, this research provides guidelines of suitable production method best suitable to special traits of character animation.

Keywords: Machinima, Character Facial Animation, Game Engine

1 Introduction

Video contents industry is constantly growing thanks to breakthrough of various platform and 3D digital technology. Thanks to growth of the industry, growing number of 3D animation engineers are trying differentiated production methods [1]. One of the differentiated them is Machinima, which takes advantage of real time rendering of game engine.

Machinima (Machine+Animation) means CG videos designed with computer game engines [2]. It is designed out of real-time graphics. In the past, its CG quality was inferior to CG movies, but thanks to recent advancements of game engine technologies, high resolution images can be realized as well in game videos. As its production process is simpler than CG movies/animations with lower costs, and it is possible to design within shorter period of time, it is widely used for UGC (User Generated Contents) [3]. Recently upgraded game engines (unreal, source, unity, cry engine) contain cinematic functions within the engines. Machinima can be utilized as an independent content for videos. It can be utilized to produce cut scenes that do not require player's interactions. Machinima cut scenes can provide game stories, game characters' emotions and dialogues that cannot be provided by player's interactions, thus attracting more engagement of the player to the game [4].

'Red vs Blue' by Rooster Teeth is a good example of an independent video content based on game engines. This game is derived and produced 'Halo', it is a popular game with a great number of fans, with a series of sequels up to Season 12 [5]. In the Machinima video, scene composition and character's facial animation play an important role. Character facial animation is frequently used in scene composition that mainly displays face and upper body of the character. Expressing character's emotion is an important factor in describing story of the animation.

There are three main methods of Facial animation: Facial Capture, Morph Animation, and Animated Texture [6-8].

This paper provides the following findings 1) How to simplify pipelines and enhance efficiency of three methods of Machinima character facial animation based on Unreal Engine 4 by Epic Games. 2) Figure out the most suitable facial animation to scene composition through analysis of 'Walking dead-episode1', the most renowned Machinima game.

2 Machinima

Machinima is produced from game engines that produce graphic images in real-time. Along with breakthrough of computer hardware and software technology, Machinima technology is in rapid development. Machinima technology plays mainly three roles. First, it does storytelling of game with rich scene composition and sound in the cut-scenes during game playing. It also motivates players to take action in the game.

Second, Machinima technology is used as prototype of pre-visualization during pre-production of final video content. It can assist directors and producers as it can provide Pre-viz image feed of time and spatial limit of 2D storyboard.
Third, Machinima technology is not used as part or tool of video contents, it can be produced as an independent video content. There are several examples of media art using Machinima technology; Unreal engine-based 'CAVE' by Jefferey Jacobson, or 'Push' by Lainy Voom, filmed in Second Life [9-10].
Machinima technology takes advantage of real-time rendering, establishes pipelines for re-use of graphic resources, differentiating itself from existing methods of animation production. (See table 1)

Table 1 Comparison of the pipeline in existing 3D animation and Machinima [11]

	Existing pipeline	Machinima pipeline	Comparison
Modeling	· High polygon · Long term process	· Low polygon · Optimization of textures by LOD (level of detail)	· Reduction of production period
Animation	· Impossibility to re-use skeleton setup, key animation, character's motions	· Building a database for reusing character's motions	· Reduction of production period · Possibility of real time rendering
Layout	· Working in animation process	· Division of working process between layout and animation database	· Making outputs by real time testing of various layouts
Lighting	· Depending on director's capability on lighting technics	· Increasing of rendering speed by static shadow (light map) · High performance of lighting setup	· Reduction of lighting process
Camera	· Using of general camera manuals	· Real-time control	· Ease of use shooting and recording

3 Making of character facial animation based on game engine

There are various production methods of Facial Animation depending on ability and tools used by animator. This paper explains 1) Motion Capture using Kinetic devices 2)3Ds Max Morph Animation, and 3) Changing multiple facial textures to produce Animated Texture, and how to apply them to game engines.

3.1 Facial Capture

Facial Capture requires a separate facial capture device. We used Kinect (KINECT for Windows) and a middleware called Faceshift to produce Facial Animation [12-13]. Figure 1 depicts production process of Facial Animation through Facial Capture.

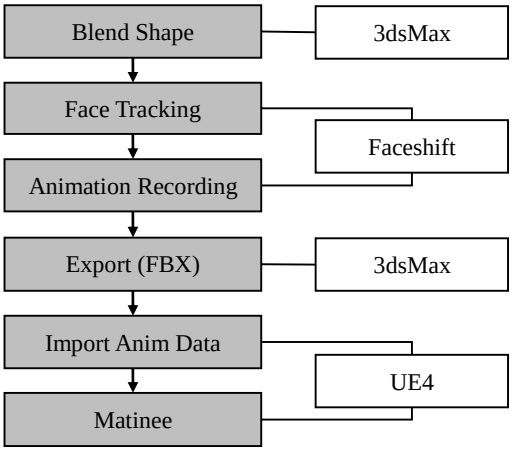


Figure 1 Pipeline of Motion Capture

As depicted in Figure 2, during Motion Capture, 3D Max makes 48 Blendshapes [1] required by Faceshift before the Facial Capture, and imports them to Faceshift.

[1] Blend shape is the most widely used animation method. It basically involves distorting one shape, and at the same time, fading into another through marking corresponding points and vectors on the 'before' and 'after' shapes used in the morph.

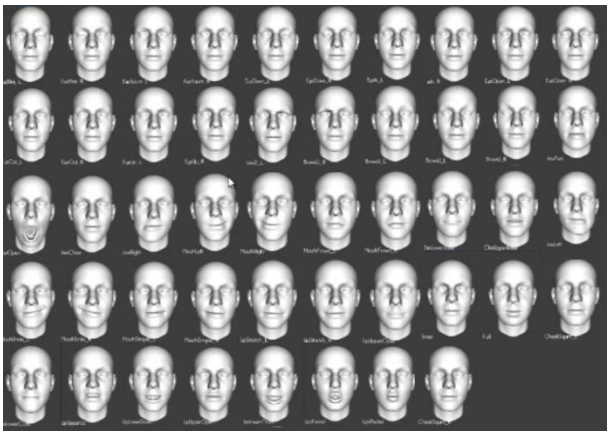


Figure 2 Blend Shape List in Faceshift

As depicted in Figure 3, Track actor's face, set Blend Shape, and Record facial expressions required. Load the facial data to 3DsMax, confirm, and extract as FBX, which is a proprietary file format (.fbx) developed by Kaydara and owned by Autodesk since 2006.

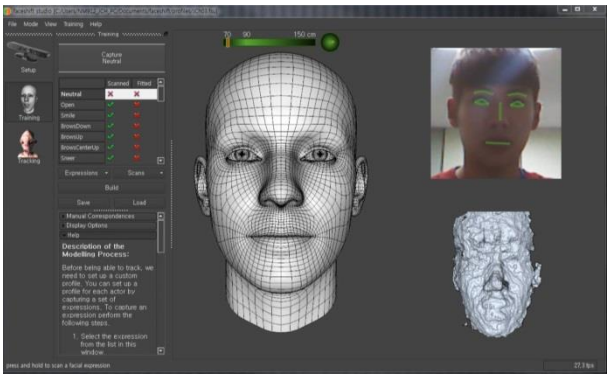


Figure 3 User Face Tracking in Faceshift

As depicted in Figure 4, load Animation data to Unreal Engine 4, complete the data accordingly with Key Frame required by Matinee, the animation tool in Unreal Engine 4 [14].

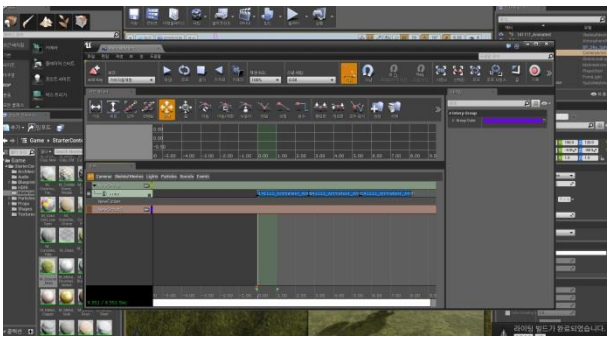


Figure 4 Key Frame Set Up in Matinee of Unreal Engine

3.2 Morph Animation

Figure 5 depicts Facial Animation production process through Morph Animation.

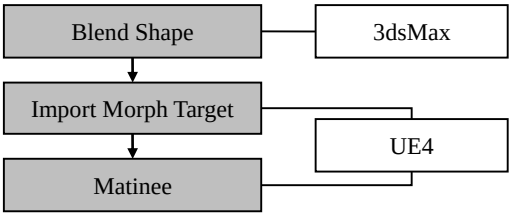


Figure 5 Pipeline of Morph Animation

As depicted in Figure 6, create Morpher data with 3DsMax to describe each part of character's face for Facial Animation.

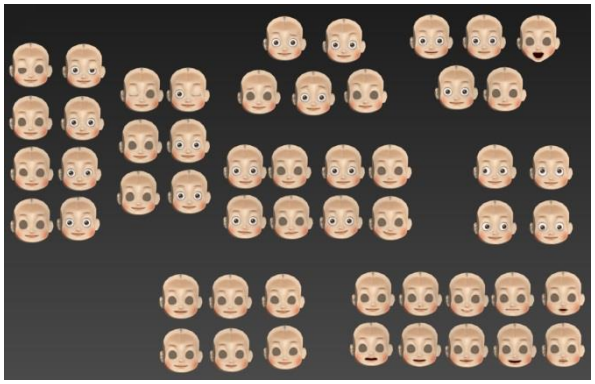
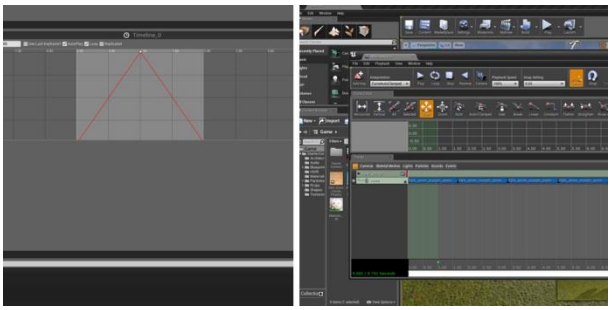


Figure 6 Morpher Data

Character Mesh by clicking Importing option of Unreal Engine.

Figure 7 Import Morph Target Data

As depicted in Figure 8, calibrate Morph Target data imported from the engine to Key Frame by combining Weight between 0.0-1.0 in the Cinematic tool, set Facial Animation, and produce it by combining with Body Animation.



[2] Morph targets allow the animator to blend several models together using differing weightings on selected areas of the face models.

Figure 8 Morph Value Set Up in Unreal Engine

3.3 Animated texture

Figure 9 depicts Facial Animation production process through Animated Texture.

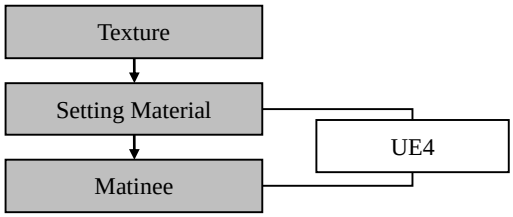


Figure 9 Pipeline of Animated Texture

As Figure 10 depicts, to produce animated texture, make various facial texture for character's faces, and switch textures in the game engine when realizing facial expressions.

Figure 10 Multiple Expression Texture

Import the texture to Unreal Engine 4, and produce the Material as depicted in Figure 11.

Set Values to each facial texture of the Material with Linear Interpolate and Scalar Parameter. Set Value that matches Key Frame of Float Material Parameter in the Matinee Tool, and complete Facial Animation.

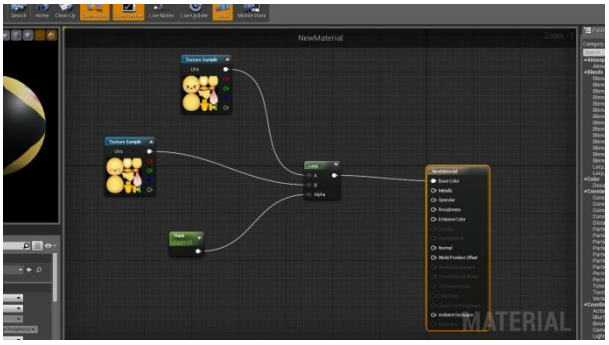


Figure 11 Float Material Set Up

4 Facial animation in scene composition of 'walking dead'

Walking Dead series (by Tell Tale Games) consist of game play based on cut scenes that describe scenarios including game characters' dialogues and emotional expression. We comprehend the scene from Walking Dead ep1 and divided into 10 kinds of scene composition [15-16]. Most frequently used scene compositions were Medium Close Shot, Medium Shot, and Over Shoulder Shot. They comprised 64.5% of the whole scenes, while there is relatively fewer number of scene composition consist of body animation due to use shortly in dramatic situations (See Table 2).

Table 1 Comparison of the pipeline in existing 3D animation and Machinima

Scene Composition	Duration Time	Proportion (%)
Extreme Close Up	00:05:12	0.1
Big Close Up	00:01:28	0.1
Close Up	10:37:09	13.9
Over Shoulder Shot	18:21:07	24.1
Medium Close Up	19:03:28	25.1
Medium Shot	11:40:21	15.3
Medium Long Shot	07:09:10	9.4
Long Shot	05:34:04	7.3
Very Long Shot	02:42:04	3.5
Extreme Long Shot	00:56:12	1.2

As shown in Table 1, since Extreme Close UP (focusing character's facial expressions) and Medium Shot account for 78.5% of the whole scene composition, we could confirm that Facial Animation plays an important role in character animation. Elapsed time for character animation was 76minutes and 13 seconds, most frequently used methods of scene composition were Medium Close Up, Medium Shot, and Over Shoulder Shot.

4.1 Medium Close Up

Medium Close Up makes some head-room, which is the space between the upper edge of the picture and character's head, and the picture encompasses the part down to the character's armpit on the lower edge of the picture. Medium Close Up is used to depict short dialogues, and mainly used for scenes that include facial expressions. As facial expressions and short dialogues involve short frames, it is more efficient to use morph animation, which can be designed within the game engine, than facial capture that requires more time.

Figure 12 Medium Close Up

4.2 Medium Shot

As depicted in Figure 3, Medium Shot is a picture focusing on character's upper body. It focuses on simple facial expressions involved with body motion, rather than dialogues between characters. It is almost used no detailed facial animation because of focusing more body motion than character's face.

It is necessary to combine facial animation and body motion in this scene with Medium Shot. Therefore, we assess that morph animation or animated texture is a suitable method for this type of scene

Figure 13 Medium Shot

4.3 Over Shoulder Shot

As depicted in figure 4, Over Shoulder Shot is mainly used to describe a dialogue between characters; it shoots a character's face from behind the shoulder of another character. It emphasizes the character that is facing the camera, and proportion of the character in the picture is similar to Medium Close Up. In contrast, only shoulder and neck of another character are exposed in the picture. Facial animation is produced as a long frame in dialogue scene. Therefore, facial capture is more efficient due to an easy method for long frame animation recording rather than morph animation and animated texture applied. Morph animation takes long time to adjust weight value of morph data in game engines. Also, animated texture involves the process to make multiple textures and difficulties in producing complex facial expressions.

Figure 14 Over Shoulder Shot

5 Discussion

As Facial Capture is derived from real facial actions, it allows more sophisticated animation with longer frames than Facial Animation. However, as Facial capture is produced with middleware, it takes longer time. In addition, Facial Capture constantly makes facial data, requires combination with Body Motion within 3D tools, and importing process to the engine during every production. Therefore, Facial Capture is more suitable for long facial animation or dialogues than simple facial animations.

- Medium Close Up closed up character's face, it requires short facial animation. However, it takes long time to produce.
- Scenes in Medium Shot focused on upper body motion. Combining Short Facial Animation and Body Motion undermines efficiency of production.
- Over Shoulder Shot was concluded with mostly two-person dialogues. Scene Close Ups the face of character over the shoulder. This is the most suitable as it is combined with simple Body Motions.

When Morph animation uses 3D graphic tool to produce Morpher (Blend Shape) data, it is easy to realize in the game engine. In addition, combining and using existing Morph Target data enables various facial animations, and it does not require separate process to produce it again. This is most frequently used method in Facial Animation, and it is also easy to combine with Body Motion.

- Medium Close Up was most suitable for making facial expressions, when producing long Frames, it takes long time in the engine.
- Medium Shot was most suitable. After producing Body Animation, smooth combination with Facial Animation in the game engine.
- Over Shoulder Shot was mainly used for dialogues. Slightly more difficulties in production than using motion capture. Takes long time as multiple Morph Targets and Weights in the Matinee have to be input for sophisticated production.

Animated Texture is easy to apply for realizing faces in order to portray special traits of scenes, but difficult to apply for dialogues or a series of facial realization. In particular, it is difficult when producing Lip Sync animation, existing CG animations do not use Animated Texture alone, but combine it with Morph Animation to produce the final content.

- Medium Close Up was more difficult to realize character's single facial expression and also difficult to utilize in dialogues because of weight of data, difficulties in creating Texture and setting Material.
- Medium Shot was possible to produce Facial Animation with slow Frames, no difficulties in realizing simple facial expressions.
- Over Shoulder Shot had difficulties in animation of lip Sync, and clumsy transition during transition of sequences of animation. When producing multiple Textures, it is difficult to realize smooth transition of dialogues due to weight of data, Material setting, and fast flow of Frame.

6. Conclusion

This research provides utility of Machinima technology as an independent content by actually producing Character Facial Animation with game engines. By analyzing character production in the most renowned Machinima game 'Walking dead', in which gameplay is mainly based on storylines, Over Shoulder Shot, Medium Close Up, and Medium Shot are most frequently used. Machinima videos are focused on storytelling, and scenes are composed with emotional expression and

dialogue based on faces and upper body of characters. These three main shots were tested through Unreal game engine-based facial animation, and derived the most efficient shot for production.

During production process, data within the game engine is subject to control and reuse, and refinement for Facial Animation, reducing production process and time, and thus differentiating Machinima technology from existing production methods of 3D animation. It is difficult to reuse resources in combining Body Motion and Facial Animation during Motion Capture. However, if Blend Animation of game engine is upgraded, existing Animation Sequences will be reusable. As it is easy to combine Body Motion and Facial Animation in Morph Animation and Animated Texture, these two methods are efficient in reusing resources. Findings of the research yields efficient resource production process based on real-time rendering technology, which is a strength of the game engine when composing pipelines for an independent video content. Also, producers can acquire suitable guidelines for producing character animation.

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