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Real-Time Visual Production using Unity 3D

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Abstract

Generally, the animation and image production process consists of three stages: Pre-Production, Main-Production, and Post-Production. Real-time video production is also made based on this configuration. On the premise of the increase of productivity by reducing the production time effectively in the main production stage that takes the most time, this study aims to summarize the process of producing videos, focusing on the concrete main production stage. To do this, we propose a method for creating a real-time image from the point of view of the general user using Unity 3D, one of the game engines. Also, this study utilizes the Cinemachine feature provided by Unity 3D, which is suitable for the implementation of the proposed module structure.

Keywords: *Unity 3D, Real-time, Visual Effects*

1. Introduction

The process of video production with the existing method, including the 3D technique is supposed to go through a rendering process. The rendering time makes up a lot of production time, and in the broadcasting, film and animation industries, the production time is 6.2 months on average, starting from the pre-production stage and is 11.4 months on average as shown in Figure 1.

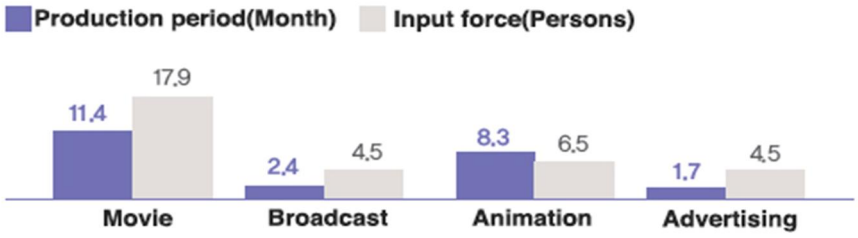

Figure 1. The average production period and manpower allocated in the field of the domestic video production.(2018 Film Busan Vol 25 (No. 65) Special 01. http://www.filmbusan.kr/)

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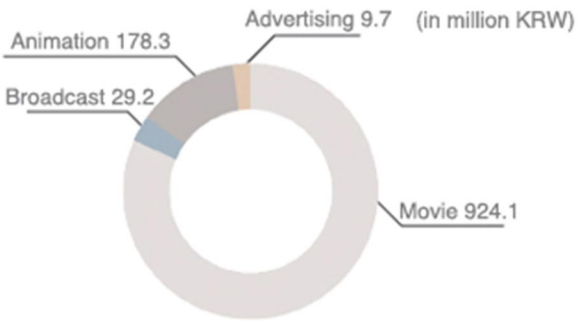
The main production costs, too, are 355.4 million won on average as shown in Table 1. The main production costs and the main.

Table 1.The average production period, manpower allocated and production costs in each field of the domestic industries. (2018 Film Busan Vol 25 (No. 65) Special 01. http://www.filmbusan.kr/)

Division	Entirety (Quantity)	Production period (Month)	Input force (Persons)	Production cost (in million KRW)
Movie	19	11.4	17.9	924.1
Broadcast	15	2.4	4.5	29.2
Animation	8	8.3	6.5	178.3
Advertising	13	1.7	4.5	9.7
Entirety	55	6.2	9.4	355.4



As for negative factors, the adverse effect on the main production was the lack of funds and investment difficulties (56.1%), which acted as the highest difficulty along with labor cost and other production costs (25.8%). To improve this, render farm equipment is used, which can improve the main production process and increase the efficiency of rendering like Fig. 2, but with the development of video production technology and the spread of high definition TVs with 4K resolution and high definition mobile devices supporting 2K resolution, the burden on the rendering time is aggravating for the main producers who produce videos with over 4K resolution day by day.[1]

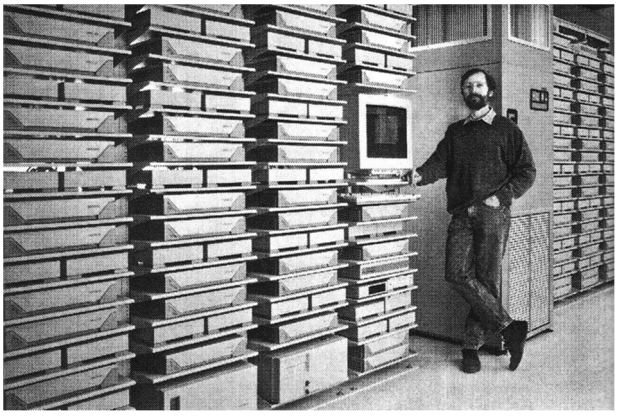


Figure 2. Render Farm for Pixar Toy Story CG. (What the Render Farm for Toy Story CG tells Us – Tech Holic)

2. Research Methods and Scope

To solve the fundamental issue of rendering time, utilizing a physics engine, like game engine enable working on the rendering time without burdens in the main production of videos. The game engine makes it possible to reuse the software components required for the configuration of the game software. The engine provides the functions necessary for development immediately, reducing the cost and complexity of development and allowing complex games to be released on the right schedule. In the early days of game

development, developers had to directly produce all tools; however, the term "game engine was used for the first time as the Doom series of ID Software Company was released in 1993. Like Figure 3, the graphic of the Doom series was innovative at the time but did not reach the level of the production of videos.[3]

Figure 3. ID Software's DOOM Series.
(From Doom to Dunia: History of Game Engines (1). https://sergeswin.com/374)

With the development of computer hardware, the Uncharted 4, released in 2016 as shown in Figure 4, has developed to such an extent that it can not distinguish between cinematic image and game play screen.

Figure 4. Naughty Dog's PS4 Uncharted 4 Play Video.
(Naughty Dog's Homepage. https://www.unchartedthegame.com/en-us/)

Through this, this study would improve the limitations of the present video production system and present a direction of connection to video production through the physics engine.

3. Video production through the optimization of physics engine

This study produced videos and applied a nonlinear method as shown in Figure 6 breaking from the existing linear production method like Figure 5 so that it could be utilized in practical work.

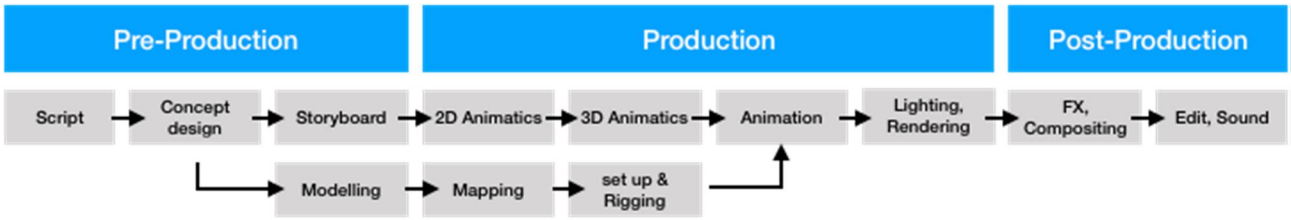


Figure 5. Existing methods for producing videos and animations

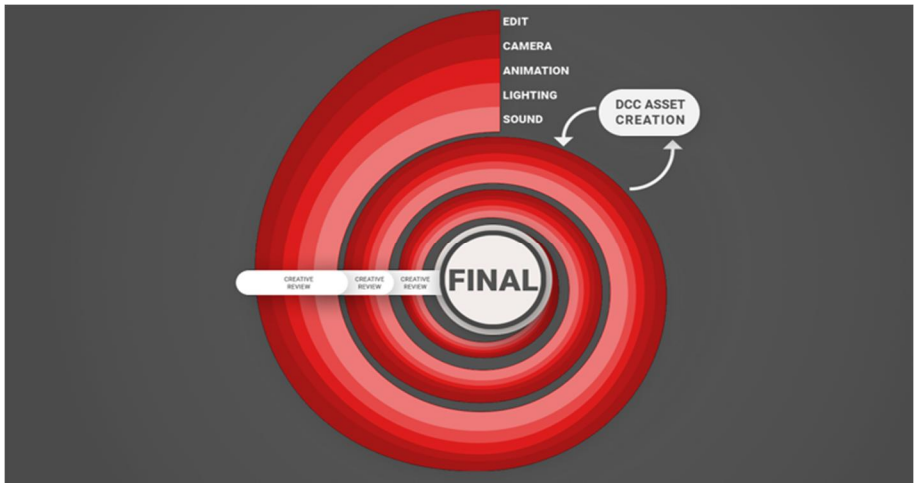


Figure 6. Unity's real-time workflow for animation is based on iterative cycles, instead of a waterfall process. (Unity Hompage. https://unity.com/)

If you skip the traditional storyboarding process and use the Unity engine, you can start compositing from the beginning and complete the work without using the render farm. As shown in Figure 7, the TV series, "Baymax Dreams" by Walt Disney Company is produced by using the Unity engine.

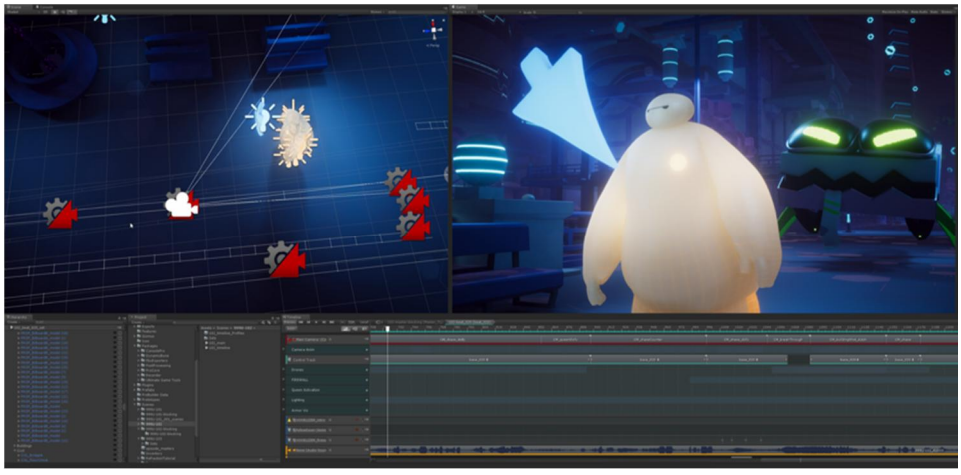


Figure 7. Scenes were laid out as "Stageplays" in Timeline to create an environment where cameras and animation could be edited and timed during development. (Unity Hompage. https://unity.com/)

To produce a real-time video through a physics-based engine, it is necessary to approach with a different modeling production method. Mostly, in 3D animations, videos are produced using high polygons; however, in games, where videos are produced using an engine, they should be operated in real time, so the optimization of the capacity that could lessen the burden to hardware has been studied. Since the parts that take the most capacity of a game are those related to graphic, that is, image, low polygons have been used from the modeling stage, and the accuracy of images has been increased utilizing a normal map to increase the visual effect. In the modeling part,

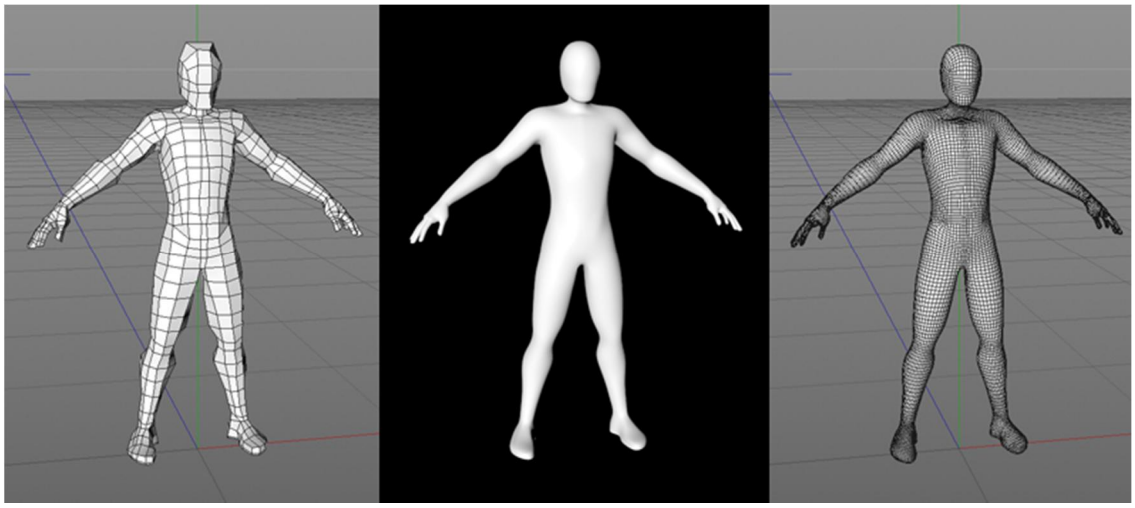


Figure 8. Stage of the application of subdivision to 3D

approach is made differently from 3D animation modeling in the order of subdivision, rigging and facial. Like Figure 8, in 3D animation modeling, production is made on the premise of the application of subdivision to increase the accuracy of images in the modeling stage.

Like Figure 8, in the 3D animation modeling stage, about 30,000 polygons are used, and if subdivision is applied, the number increases up to 600,000. In 3D animations, no matter how many polygons there are, the increase in the volume does not matter since there is conversion to a video file in the rendering process while in games, bringing the modeling of over 600,000 polygons to the engine acts as a big burden with the overload on the hardware.

To produce the modeling that can be utilized in the engine, a normal map is used, and the normal map should generally go through the rendering pipeline projecting a three-dimensional object consisting of virtual peaks and polygons on the computer monitor screen to show the surface of an object rendered on the computer screen. In this process, shading is calculated, and shading is the process in which how the shading of objects would be shown is processed. As shown in Figure 9, in the modeling of high polygons, a normal map is produced, and if the modeling of low polygons is applied, the data on low polygons show the shading of high polygons. It comes to have a volume of low polygons, but you can see the effect like the image of high polygons in the image projected on the screen.

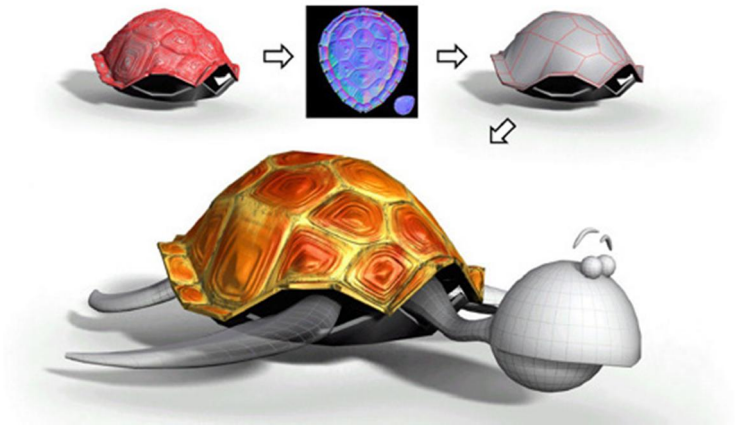


Figure 9. Conceptual diagram of the application of a normal map of low polygons. (CGLAND- [Pre-production Feature] What is a Normal Map?)

If a normal map is applied, low polygons and shadows are applied, so there is no gap actually, but the image projected on the screen looks as if it has a gap. However, since you can see that there is no height of form when seen up close, tessellation technique was used to solve this problem.

The tessellation function of the shader, tessFixed, returns four Tessellation factors to one float4 value. There are three factors on each corner of a triangle and one factor inside the triangle. It simply returns the integer value set in the material properties. after the application like this, you can see that it is printed out like Figure 10.

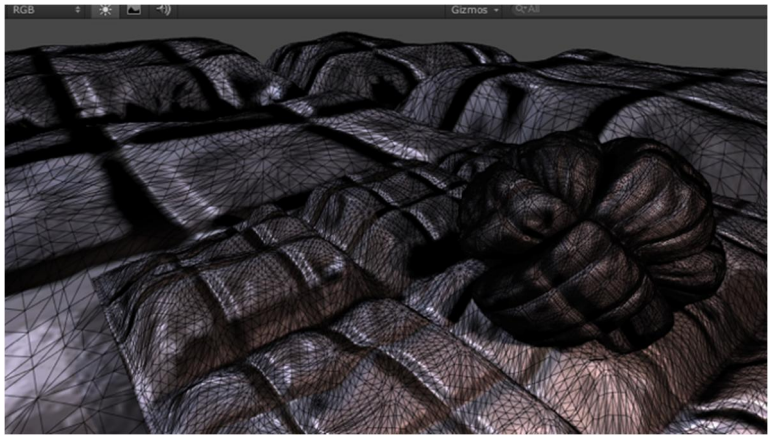


Figure 10. Fixed amount of tessellation.(Unity Manual. https://unity.com/)

Like this, it is necessary to produce accurate and delicate modeling structures, bearing in mind the application of an engine in the early stage of pre-production. This study proposed a method for implementing real-time videos for graphic designers to apply that to the physics engine.

4. Implementation and Results

This study produces modeling so that it can be applied to the engine as shown in Figure 11 and implements an animation in the Unity engine, applying an effective rigging system, accordingly.

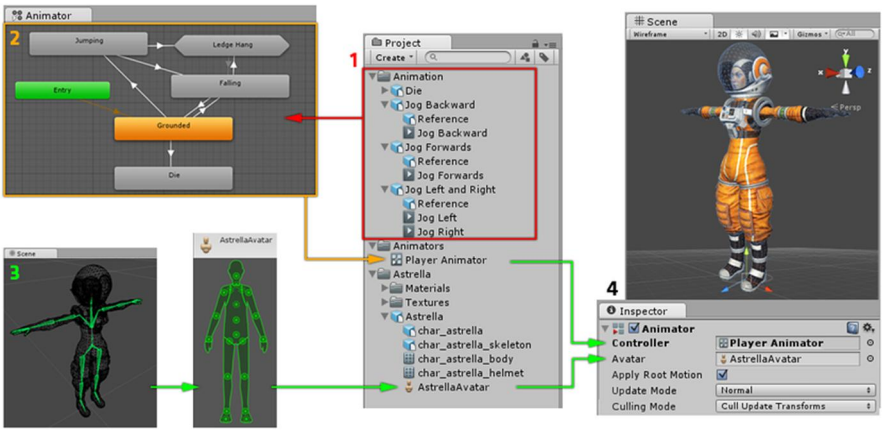


Figure 11. Diagram showing the connection between the parts of the animation system. (Unity Manual. https://unity.com/)

To implement real-time rendering in physics engines like Unity 3D, the engine needs optimization. Thus, like below, a separate lighting setting is needed if a modeling source is brought from the outside. The effect of the basic lighting is like the example of the arrangement of a point lighting in the following figure.

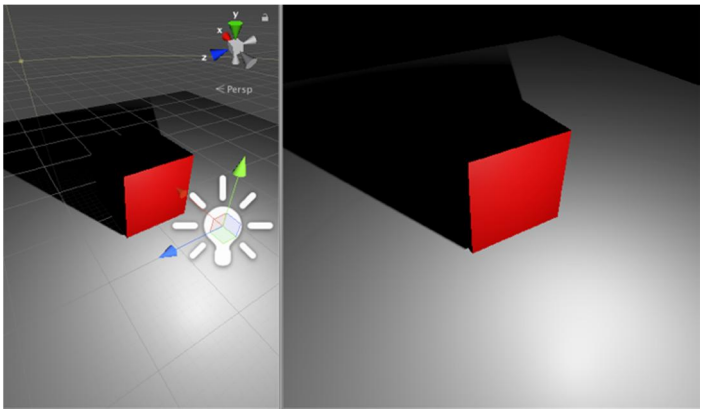


Figure 12. Lighting settings in Unity 3D

Here, to create a more realistic feeling, an effect like Global Illumination (GI) is needed, and GI is one of the methods for expressing and calculating light in CG. t is possible to create a more realistic feeling by calculating all, including the direct light from the light source and indirect light reflected on other materials, objects, or walls, using GI." In the past, for rendering through GI, a rendering server was needed like render farm, but now, it came to be possible to implement that even in hardware with high specifications with the development of hardware.

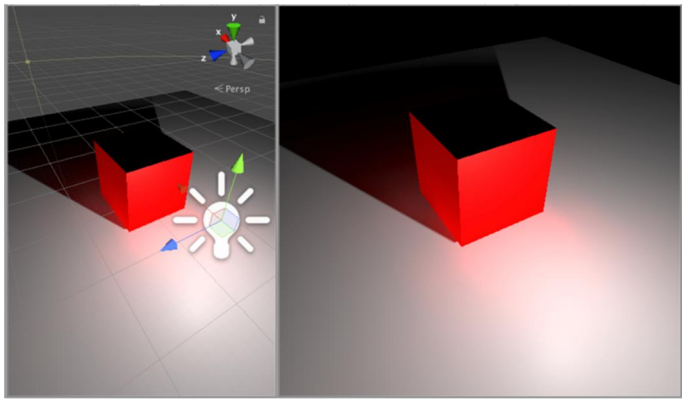


Figure 13. Lighting settings in Unity 3D

It is possible to lessen the burden on the hardware, utilizing Lightmapping. Lightmapping can have a lighting-like effect, though not being the actual lighting by printing out the fixed lighting by mapping.

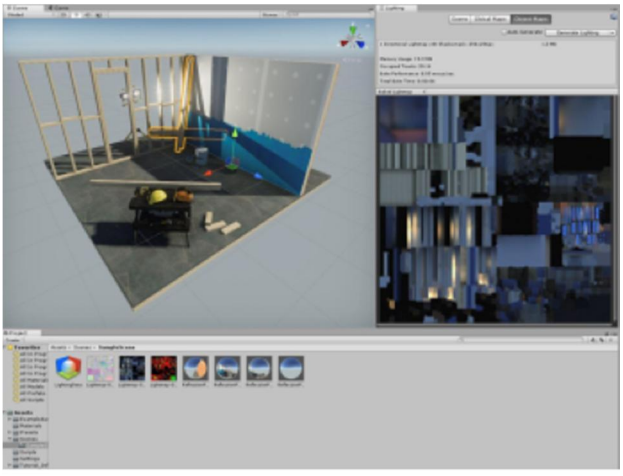


Figure 14. Lightmapping in Unity 3D.(Unity Manual. https://unity.com/)

If Lightmapping is printed out, it is fixed to the mapping, so it cannot affect the object or character. Thus, utilizing Light Probes, a lighting effect can be made on the character or object appearing in the scene. Light Probes are a function to reconstitute the result value of the object or character by the arithmetic operation of the position of Lightmapping already printed out.

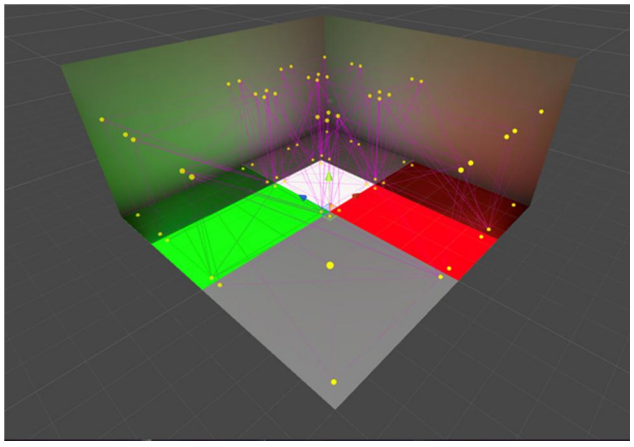


Figure 15. Light Probes in Unity 3D.(Unity Manual. https://unity.com/)

The result like Figure 15 can be produced, utilizing Lightmapping and Light Probes. It can operate the arithmetic operation of lighting effect of the character and can also be applied to the parts like the surrounding shadows.

5. Conclusion

As compared to the existing method, it is found that the method used in this study has an effect on the reduction of production costs since it can save rendering costs/time and no massive rendering is needed. The jobs that have not been possible in the existing CG works like Full Quality Previz, Realtime Performance Capture. In addition, using a physics engine allows the conversion to a multi-platform, and it has a merit that it is possible to develop contents based on various platforms such as VR, AR, Hologram, and smart device app, etc. it is possible to expand to various technologies such as deep running and big data by lowering the risk caused by the long production period of the manufacturing method as shown in Figure 5.

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