

## **A Study on Real-time Graphic Workflow For Achieving The Photorealistic Virtual Influencer**

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### **Abstract**

*With the increasing popularity of computer-generated virtual influencers, the trend is rising especially on social media. Famous virtual influencer characters Lil Miquela and Imma were all created by CGI graphics workflows. The process is typically a linear affair. Iteration is challenging and costly. Development efforts are frequently siloed off from one another. Moreover, it does not provide a real-time interactive experience. In the previous study, a real-time graphic workflow was proposed for the Digital Actor Hologram project while the output graphic quality is less than the results obtained from the CGI graphic workflow. Therefore, a real-time engine graphic workflow for Virtual Influencers is proposed in this paper to facilitate the creation of real-time interactive functions and realistic graphic quality. The real-time graphic workflow is obtained from four processes: Facial Modeling, Facial Texture, Material Shader, and Look-Development. The analysis of performance with real-time graphical workflow for Digital Actor Hologram demonstrates the usefulness of this research result. Our research will be efficient in producing virtual influencers.*

**Keywords:** *Computer Graphics, Photorealistic rendering, Real-time render, Virtual Influencer, Unreal Engine*

### **1. Introduction**

The trend of virtual influencers is on the rise and collaborating with brands. Considering that computer-generated social media influencers are increasing, they are collaborating with big brands due to their enormous popularity online [1].

The first Virtual influencer Lil Miquela was appeared by the company Brud. Lil Miquela, as a marketing tool, has featured product endorsements for streetwear and luxury brands, such as Calvin Klein, Prada, and Samsung Mobile. Imma, which was created by CG company ModelingCafe, transposes her 3D animated head onto a real-life body and background. The brands she mentioned include Valentino, Hermes, Tiffany, and Co. Imma. Gram has more followers from Brazil (35%) than from Japan (15%) [2].

Lil Miquela and Imma are produced through the use of CGI workflows based on structure as follows: 1)

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head geometry is edited through 3D software; 2) texture maps and materials are made to define the character's skin attributes; 3) lighting is set; 4) offline rendering tools are used to obtain the rendered images (everything is synthesized, and the resources obtained from rendering are edited); 5) the final result is exported. This process can produce the best quality visual effects.

However, CGI workflows, which do not provide real-time interactive experiences, can only be used to produce images and video contents, such as poster photos, short movies, and music videos. This limits the ability of Virtual Influencer to deliver more functionality and create greater business value.

According to the previous study of the Digital Actor Hologram, a workflow that can be used to develop digital actors for real-time rendering was proposed in this study. The provided workflow can effectively reduce production time and cost while the graphics quality of output is less than the results Virtual Influencers created by CGI workflows. Moreover, creating believable real-time digital humans is incredibly challenging and time-consuming. Particularly, characterizing facial geometry, facial reflectance properties, and facial expressions present some of the most critical issues.

In this paper, a real-time engine graphic workflow for Virtual Influencers is proposed to create virtual influencers with photorealistic graphic quality and provide real-time interactive experiences. That is radically simpler, faster, and more scalable, without compromising on render quality. In the second chapter, specific implementation approaches are introduced for the Facial Models process, Facial Texture process, Facial Skin material production processes, and Look-Development process. Next, the improvement of specific content regarding Digital Actor Hologram performance is illustrated in Chapter 3. Finally, research results and future works are described in Chapter 4.

## 2. Photorealistic virtual influencer graphic workflow and material shader functionality

This article provides a new method for a graphic workflow. It is more efficient than the Digital Actor Hologram performance graphic workflow. The method for the lighting stage and the 3D scanning process was discussed by the previous research [3]. Photographic data and scan data for the follow-up process can be obtained through preprocessing.

**Table 1. Photorealistic Virtual Influencer work flow**

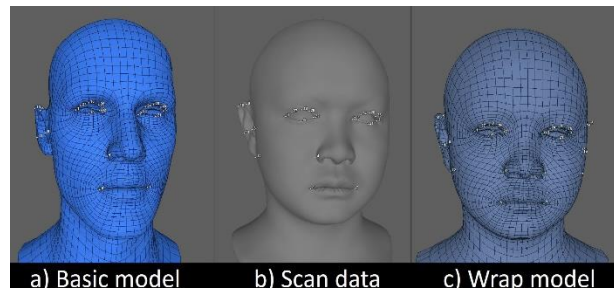
Process Workflow	Pre-process	Facial Modeling process	Facial Texture process	Material Shader process
<i>Digital Actor Hologram Performance Graphic workflow</i>	1. Lighting stage setting	1. Re-topology (Maya Quad Draw)	1. Texture Mapping (Z-Brush, Photoshop)	1. Marmoset2 Render
	2. 3D Scan process	2. High-poly process (Z-brush Sculpt)	2. Texture Refine	2. UE4 Material Setting 3. Material Refine
<i>Photorealistic Virtual Influencer Graphics workflow</i>	1. Lighting stage setting	1. Re-topology (Wrap3 workflow)	1. Texture Baking (Wrap3 workflow)	1. UE4 Material Setting
	2. 3D Scan process	2. High-poly process (Wrap3+Displacement Bake)	2. Texture Mapping (Mari, Photoshop)	2. Material Refine
		3. High-poly process (Z-brush Sculpt)	3. Texture Refine	3. Look-Development

Table 1 explains the overall process of obtaining and rendering photorealistic facial geometry, texture, and material shader as a first step for the Virtual Influencer project. Besides, four processes are adjusted in this study to improve the production efficiency of graphic assets, namely, Facial Modeling, Facial Texture, Material Shader, and Look-Development.

## 2.1 Facial Modeling process

### 2.1.1 Re-topology production for basic modeling

The software R3DS Wrap was employed for the Re-topology process. R3DS Wrap changes the way of processing 3D scan data. The wrap makes it possible to take an existing base mesh and non-rigidly fit it to each scan [4].



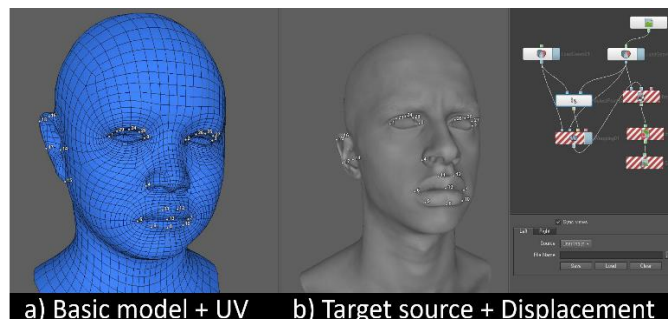
**Figure 1. R3DS Wrap Re-topology work flow**

As illustrated in Fig. 1, the prepared head geometry model (Fig. 1 a) is employed to the processed Scan Data (Fig. 1 b), and Select Points nodes are used to mark multiple points. The required number corresponds to it. For example, the inner and outer corner of the basic model is marked as point 0 and point 1, respectively, and the left corner of the mouth is marked as point 6. The basic model is related to the scan data.

By using the wrapping node for solving, the points marked on the base model will automatically approach the point of scan data until the point position coincides. Then, the base model geometry is completely encapsulated, and the final model (Fig. 1 c) form is obtained. Finally, it is exported as a new base model (Obj format) through the SaveGeom node and imported to Maya for modeling refinement.

### 2.1.2 High-poly production

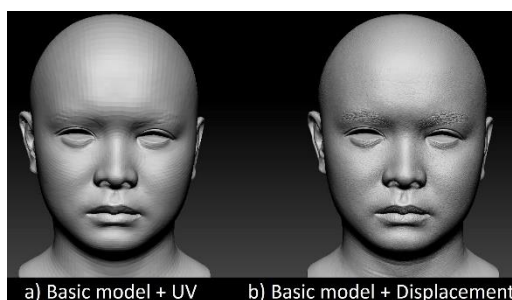
High-poly production requires a set of head sources, including high-poly models, base color texture, specular texture, roughness texture, normal texture, and displacement texture, which can be downloaded from the 3D SCANSTORE website[5].



**Figure 2. R3DS Wrap process and node-graph**

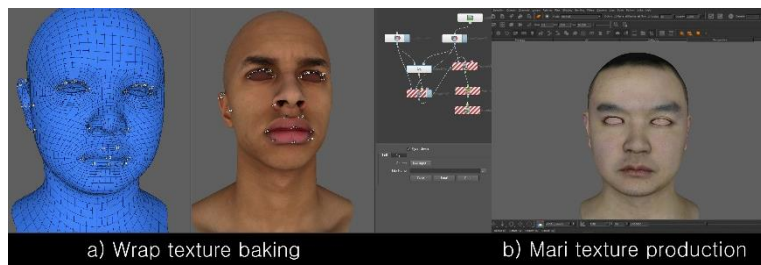
In Fig. 2, the UV data from the basic head model are edited, and the target source model is imported from the software R3DS Wrap. Then, Selected Points and Nodes are used to capture the points, and Wrapping Nodes are employed to capture the base model, and the target source model captures the data. Because the basic model already captures the target source's information, the texture information of the target source can also be baked according to the basic model's UV and be corrected [6]. After this process, the displacement texture needs to be connected with target source model nodes, the TransferTexture node, ExtrapolateImage node, SaveImage node should be added, and the size and quality of the texture to be baked are adjusted.

As exhibited in Fig 3, the basic model with UV information can be imported into the 3D software Z-Brush, and the displacement texture can be assigned to the model and converted into model data, with Brush and Alpha to finish High-Poly Processing [7].



**Figure 3. UV and Z-Brush process**

## 2.2 Facial Texture process



**Figure 4. Facial texture process**

Regarding the Texture process, the same method as R3DS Wrap for baking is used. Then, it is converted to Displacement Texture. Afterward, it is fundamental to import the Base color texture(Fig. 4 a), specular texture, roughness texture, and normal texture from the target source. Next, they are transformed into a map consistent with the basic model of UV information and output textures through R3DS Wrap node graph settings [8].

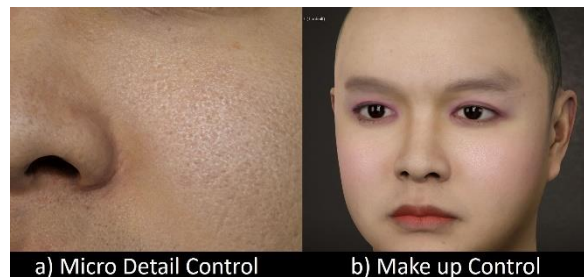
Fig. 4 b illustrates that the output results and the basic model are integrated into the 3D mapping software Mari, and the mapping is based on this. In Mari, the base color texture is projected by using photographic sources to adjust skin texture and remove light and shadow information. Roughness and specular texture are processed with the same method. Then, the textures are exported into Photoshop for refinement [9].

## 2.3 Facial Shader process

The real-time engine material shader consists of 7 elements (Base color, Roughness, Specular, Normal, Displacement, micro detail, and make-up) [10].

In the Base color element, the Base color texture produced from photographic sources can be used to express

the albedo of the character and create realistic skin expression. Depending on the Base color texture, there are additional material nodes for controllable Base Color Lightness and Base Color Solution. In the Roughness element, controllable roughness intensity material nodes are added based on roughness texture. Mask textures were created to mark different parts of the head model to control the roughness of different parts of the face (Cheek, Chin, Forehead, Inner Lid, Mouth, Nose, and Upper Lid). The four channels of the Mask texture should indicate different parts of the head model. Afterward, the creator should add the Roughness Intensity Part material node to control the roughness amount. Besides, controllable Specular Intensity material nodes should be included to control the specular of different parts of the face and indicate different parts of the head mode in the Specular element for the Mask channels. Then, the Specular Intensity Part material node to control the parts of the specular amount should be added in normal and micro-detail elements. With Normal texture obtained from high-poly modeling as a base, 8 layers of micro-detail Normal texture and Roughness texture are obtained from multiplying scalar parameter to TexCoord material expression, and then the CustomRotator Function node is added for controllable rotation.



**Figure 5. Micro Detail and Makeup Function**

As presented in Fig. 5, Micro-detail textures can be customized according to different parts of the model by using Mask textures. Micro-detail texture sources can be downloaded from Texture's XYZ website. The form of modeling is enriched by adding Vertex NormalWS expression and vector or scalar control to the displacement texture. The addition of Display Intensity and Display Tessellation material nodes makes it easier to control the strength of the model shape. Moreover, 8 layers were added to control customizable makeup functions in the make-up element. Each layer corresponds to a set of custom color nodes and amount nodes.

#### 2.4 Facial Look-development process

In the Look-Development process, HDRI Actor and 3 Rect lights need to be set up in the unreal engine to simulate the realistic lighting environment. Besides, the material values should be set to obtain the best rendering result[11].



**Figure 6. Real-time render results**

Fig. 6 suggests that the output results are relatively higher, and the character's graphic quality is natural and realistic. The Re-topology and high-poly processes provide more accurate shapes and structures for the geometric data. The functionality provided by the material shader setup process ensures high-quality visual result output, and customization can be efficiently achieved according to requirements.

### 3. Comparison of graphic workflow and shader function

#### 3.1 Deficiency of Digital Actor Hologram Performance workflow

By the previous research, graphic workflow is to provide the Digital Actor Hologram Performance for obtaining and rendering facial geometry and facial texture. MAYA Quad Draw tool was used to retrieve Scan data, make polygon geometry, and edit UV data; Z-Brush was adopted to make high-quality models [12]. Subsequently, the obtained facial photographs are utilized to map a texture onto the facial geometry. In high-poly production, mask texture is applied to accurately and rapidly express details such as skin, wrinkles, and pores. The Shader for rendering in a real-time engine is composed of 7 elements (Diffuse, Specular, Roughness, Opacity, Subsurface Scattering, Normal, and Displacement).

Table 1 presents the overall process of Digital Actor Hologram Performance Graphic workflow. Using Quad Draw tools for Re-topology, the user needs to edit the polygon vertex, edge, and face to restore the shape of the Scan data while fixing topology and edge flow, so as to guarantee the proper application of the Rigging and Animation process. To make a High-Poly Process in Z-Brush, the creator should use Brush to sculpt facial shapes, wrinkles, and pore details according to the information of the photo reference. Considering that the model generated by the Re-topology Process is an asymmetric structure, the high-poly process cannot be made symmetrically. In the Facial texture process, Photoshop cannot produce multiple types of textures (such as roughness and specular). Thus, textures have to be confirmed by 3D software (Maya, Z-Brush). The material shader is based on texture. The properties of a material can be effectively controlled as a whole, but cannot be controlled individually for different parts.

#### 3.2 Comparison of the results



**Figure 7. Comparison of real-time render results**

As suggested in Fig. 7, the output quality of Photorealistic Virtual Influencers is relatively higher than that of the Digital Actor Hologram workflow, and the character's graphic quality is more natural and realistic. New Re-topology and high-poly processes provide more accurate shapes and structures for the geometric data. Texture processes generate realistic colors and reflection information for texture assets. The functionality provided by the material shader setup process can guarantee high-quality visual result output, and customization can be efficiently achieved according to requirements.

**Table 2. Comparison of Re-topology process**

	Re-topology tool	Production time	Advantage	Deficiency
Digital Actor Hologram Re-topology	Maya Quad Draw	8 Hours	Customize Topology, Convenient to amend, No conversion software required	Symmetry off, long time for production
Photorealistic Virtual Influencer Re-topology	R3DS Wrap + Maya	10min + 1 Hour	Easy operation Reusable node-graph	conversion software required, need to prepare the sources

Table 2 indicates that the new Re-topology process, though requires preparation of the basic model material used by R3DS Wrap and finishing of the output model, can effectively shorten the production time. R3DS Wrap is adopted by editing the model with Node Graph. Users can still capture the model shape quickly when replacing the Scan data. The basic model can produce multiple models after replacing the Scan data with the same topology and UV.

Table 3 suggests that the new high-mode flow data is captured from the target source through R3DS Wrap Node Graph, and the details of the high-mode are refined with Z-Brush.

**Table 3. Comparison of High-poly process**

	High-poly process Tool	Production time	Advantage	Deficiency
Digital Actor Hologram Re-topology	Z-Brush	10 Hours	Customize Sculpting, No conversion software required.	Symmetry off, long time for production
Photorealistic Virtual Influencer Re-topology	R3DS Wrap + Z-Brush	10 Mins + 3 Hours	Easy operation and good quality, Customize Sculpting	Symmetry off , conversion software required, need to prepare the sources

**Table 4. Comparison of texture process**

	Texture process Tool	Production time	Advantage	Deficiency
Digital Actor Hologram Re-topology	Z-Brush Spotlight Tool Photoshop	18 Hours	Image projection	Unable Multi- texture production
Photorealistic Virtual Influencer Re-topology	R3DS Wrap + Mari + Photoshop	10 Mins + 2 Hours + 4 Hours	Easy operation and good quality Image projection, Multi- texture production	conversion software required, need to prepare the sources

As illustrated in Table 4, the new texture process captures multiple texture data from the target source through the R3DS Wrap Node Graph. Then, Mari and Photoshop are used to refine multiple textures with photographic sources. Although the tooling needs to be changed, efficient production can ensure texture quality and save time.

**Table 5. Comparison of skin shader function**

	Digital Actor Hologram Skin Shader	Photorealistic Virtual Influencer Skin Shader
Base color Texture	O	O
Base color Lightness	X	O
Base color Saturation	X	O
Roughness Texture	O	O
Roughness Intensity	O	O
Roughness Intensity Part	X	O
Roughness Intensity Micro Detail	X	O
Specular Texture	O	O
Specular Intensity	O	O
Specular Intensity Part	X	O
Specular Intensity Micro Detail	X	O
Normal Texture	O	O
Normal Intensity	X	O
Normal Intensity Micro Detail	X	O
Makeup color	X	O
Makeup Intensity	X	O
Displacement texture	O	O
Displacement Intensity	X	O
Displacement Tessellation	X	O

As presented in Table 5, the new skin shader material not only retains the function of Base Color Texture, Roughness Texture, Roughness Intensity, Specular Texture, Specular Intensity, Normal Texture, and Displacement Texture but also adds the function of Base Color Lightness, Base Color Saturation, Roughness Intensity Part, Roughness Intensity Micro Detail, Specular Intensity Part, Specular Intensity Micro Detail, Normal Intensity, Normal Intensity Micro Detail, Makeup Color, Makeup Intensity, Displacement Intensity, and Displacement Tessellation. Regarding the new material, more controllable functions are added to the Look-Development process. The basic material data is employed in conjunction with the textures to show various conditions for the character skin.

**Table 6. Comparison of workflow**

	Scanning	Modeling process	Capturing face skin	Texturing source	Shading process
Digital Actor Hologram Re-topology	2 hours total	26 hours, 2 processed scans, 1 artist	2.5 hours total	18 hours, 8 textures, 1 artist	18 hours, 2 material shaders, 1 artist
Photorealistic Virtual Influencer Re-topology	2 hours total	7 hours, 2 processed scans, 1 artist	2.5 hours total	7 hours, 11 textures, 1 artist	15 hours, 2 material shaders, 1 artist



Table 6 presents the time taken for the facial modeling and shading of the Photorealistic Virtual Influencer project, the ultimate goal of the present study. The new workflow effectively reduces production time and improves product quality. When the character target is changed, the Photorealistic Virtual Influencer workflow assists in quickly reconstructing the basic model and textures and adjusts them according to the original material shader setting.

These processes may have lower quality compared to the cases observed in Near-Instant Capture of High-Resolution Facial Geometry and Reflectance [13]. This is in that devices and methods produce diverse facial expressions as described in the digital actor development project in the study made by USC while they can be easily applied to project research on utilizing digital character in both academia and industries [14], [15].

#### **4. Conclusions and future work**

This paper proposes the first step in The Photorealistic Virtual Influencer performance project, a production workflow for high-quality assets, and the customizable skin Shader for digital human characters.

This new workflow requires multiple software using methods and the preparation of a model texture source. However, relative to the Digital Actor Hologram workflow, the overall operation is less difficult, and the production time is reduced. New workflows can enhance production effectiveness in developing graphic assets for different characters. Using Real-time rendering techniques and advanced hardware, computers can render images quickly enough while accepting user input. This reflects that the user can respond to rendered images in real-time while using the Material function to adjust the color value, reflection value, and pore details of a character's face to reduce rendering time and improve feedback efficiency. Customizable skin shaders can contribute to the Look-Development process, change skin properties with simple value for settings, and provide a wide range of pore details for close-up shots of performances.

The next step in the Virtual Influencer performance project involves markerless facial animation and hair simulation. Concerning character rigging, it is necessary to create joints controllers and more than 50 blends of shape data to ensure the natural flow of the animation. Then, the software Motion builder should be adopted to obtain joint animation data and set up in conjunction with the Unreal Engine. XGEN is required to create assets such as hair, eyebrows, and eyelashes for characters, which are outputted with the Alembic format. Furthermore, both hair dynamic simulation and high-quality rendering results can be obtained in this process.

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