

Technical Aspects of Creating Complex Character Details: Modeling Metal, Hair using ZBrush, Substance Painter and Marmoset

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Abstract - The article is devoted to the study of modern technical methods for creating realistic details of characters in digital modeling: metal textures, hair structure, as well as other complex elements. The purpose of the work is to consider the technical aspects of the process of creating complex details of characters, using programs such as: ZBrush, Substance Painter, Marmoset Toolbag, which are considered as key tools that perform their function: from the formation of geometry, textures to the final visualization. ZBrush is used for sculpting, allowing you to control the microstructure and shape of the model. Substance Painter simulates the properties of materials, creating believable metal textures with reflections, traces of wear. At the final stage, visualization in the Marmoset Toolbag provides a realistic representation of the model with flexible adjustment of lighting and material parameters, enhancing photorealism. The results of the work demonstrate the existence of certain standards in the visualization of complex components. The integration of several software tools has demonstrated effectiveness in creating detailed characters, which is useful for specialists in 3D graphics, digital art, and interactive design. The article is of interest to professional artists, fashion designers, as well as researchers interested in the technical aspects of designing digital characters. The applied methods contribute to high-quality visualization, realism, which corresponds to the goals of the study.

Keywords - ZBrush, Substance Painter, Marmoset, 3D modeling, textures, rendering, digital characters, metal, hair.

I. INTRODUCTION

The development of technology and increasing demands for visualization quality drive the creation of new methods capable of providing realism and expressiveness in digital models. Modeling details, such as metallic surfaces, organic elements, and hair structure, is particularly labor-intensive. These elements require accurate representation of the physical properties of materials, such as light reflection, roughness, and texture. Achieving component realism necessitates an integrated approach using specialized software, including ZBrush, Substance Painter, and Marmoset Toolbag.

These tools are utilized in 3D modeling for their capabilities in handling tasks of varying complexity. ZBrush offers an extensive set of sculpting and surface texturing tools, allowing for the creation of models with detailed forms. Substance Painter provides flexible material texture customization, creating effects of wear, reflections, and interaction with lighting. At the final stage, visualization in Marmoset Toolbag enables photorealistic rendering, adding depth and brightness to the image, which is essential for project presentation.

The need for detailed digital characters for video games, film, and virtual reality highlights the relevance of this topic. Modern graphics requirements drive the development of modeling and visualization methods. This creates a need to examine the capabilities and limitations of popular tools for working with 3D models, enabling optimal approaches for different projects to be identified.

The aim of this study is to examine the technical aspects of creating complex character details using software such as ZBrush, Substance Painter, and Marmoset Toolbag.

II. MATERIALS AND METHODS

To examine the technical aspects of creating complex character details, methods included literature review and analysis of scientific research on digital sculpting, texturing, and rendering, which helped identify effective modeling approaches. The practical aspect of the topic was explored through case studies by other researchers.

The literature review includes analysis of approaches to modeling and texturing 3D characters, as well as research on conveying emotions and realism in virtual models. Zhang C. et al. in [1] proposed a method for interactive 3D modeling and texturing, which creates characters based on colored drawings. The "CreatureShop" method transforms a 2D image into a 3D object using computer vision algorithms and machine learning to accurately reproduce the character's form and texture.

Karabchevsky V. V. and Mazurov A. S. [2] investigated geometric modeling of emotions for virtual characters. Their work describes the application of geometric transformations and parametric models to convey emotional states in characters, enhancing user interaction.

Kumar A. and Kumar A. [3] examined texturing in Substance Painter, emphasizing its applicability for creating high-quality textures in cultural heritage projects. They noted the advantages of the program's integration with platforms like Blender and Unreal Engine, which enhances the textural detail of objects and characters in VR environments.

The work of Habermann M. et al. [4] focuses on the creation of "dynamic" characters in real time. They proposed a deep learning-based method that models character movements and deformations with high accuracy and realism.

Koposovich R. Y. [5] describes the 3D modeling process using Autodesk Maya, Pixologic ZBrush, Adobe Substance Painter, and Marmoset Toolbag. The article outlines the stages

of model creation and texturing approaches, underscoring the importance of comprehensive software use for producing detailed objects.

Practical sources examining existing technical aspects of creating complex character details using ZBrush, Substance Painter, and Marmoset included the article from [6] titled "The Huntress: Modeling & Texturing a 3D Character in Maya, ZBrush, and Substance 3D Painter," which discusses the process of creating a 3D character using Maya, ZBrush, and Substance 3D Painter. It also describes sculpting and texturing techniques that help achieve high character detail.

An article on [7] titled "How to Create Realistic Hair, Peach Fuzz, and Eyes - A Guide from Marmoset" reveals methods for creating realistic hair, skin peach fuzz, and eyes in 3D models. Techniques are provided to ensure a natural appearance of these elements, contributing to the photorealism of characters. These sources formed the foundation for a comprehensive review of the chosen topic. The following sections will examine the technical aspects of creating complex character details in greater detail.

III. RESULTS AND DISCUSSION

In modeling with ZBrush, emphasis is placed on maintaining proportions, as achieving precise proportions requires significant time. Creating complex metallic elements begins with detailing microgeometry and textures that define the material's character. Using DynaMesh in the initial stages helps establish a base shape with a high polygon density, allowing for detailed structure later. Brushes such as Trim Dynamic and Orb Cracks convey texture and small metal imperfections. Trim Dynamic adds hard edges, emphasizing the material's strength, which is essential for creating convincing metallic details.

High-resolution alpha maps add micro-scratches and imperfections, enhancing the tactile realism of the material. Masks and NoiseMaker introduce random roughness, capturing natural metal variations—from polished surfaces to corrosion spots.

For organic components like stylized hair, it is essential to structure them in large clusters, followed by refining smaller segments. This approach creates a harmonious composition, following the "Big, Medium, Small" principle. Working in subdivisions facilitates retopology, especially necessary for fine details like hair strands. Brushes such as Groom Lengthen and Groom Clump help simulate real hair structure, defining direction, thickness, and style, providing naturalness and realism to the hairstyle, avoiding a static appearance.

To give the skin a natural look, subsurface scattering (SSS) is applied, providing softness and depth. This approach, recommended in tutorials by Magdalena Dadel and Marmoset guides, helps avoid excessive shine and a "plastic" effect, making the skin stand out from other materials, giving it a "tangible" appearance.

Substance Painter provides tools for texturing with roughness and metalness settings that control light reflection and scattering. Using layers with variations in roughness creates a dynamic material structure that accurately conveys metal's interaction with light. Adjusting specular and normal maps

achieves the desired gloss and texture level, simulating different hair types—from smooth to coarser. These adjustments balance diffuse and specular reflections, which is especially important for lighter shades.

Specular and ambient occlusion (AO) settings ensure detailed rendering even on small areas, making Substance Painter optimal for creating complex metallic textures.

Final visualization in Marmoset Toolbag allows for material evaluation using flexible lighting parameters and an HDRI environment. By adjusting scene parameters in real-time, it is possible to observe how metal reacts to various lighting conditions, which is essential for presenting the final result. Subsurface Scattering (SSS) settings add translucency, creating soft light reflections that give hair volume and a lifelike appearance. Using HDRI maps and adjustable light sources reveals how hair responds to light, creating the effect of natural glow and layered strands. Transparency and gloss level adjustments allow for highly detailed hair representation [5].

As a practical example, the "Huntress" project, inspired by concept art studies, notably the work of Yi Tang [6], is examined. This mystical character with horns and wooden limbs provided an excellent opportunity to explore organic sculpting and create complex real-time hairstyles. References were collected to capture the concept accurately, including textures of mushrooms, tree bark, fur, and bones, helping to structure the character's image. An example of the "Huntress" project is shown below in Figure 1.

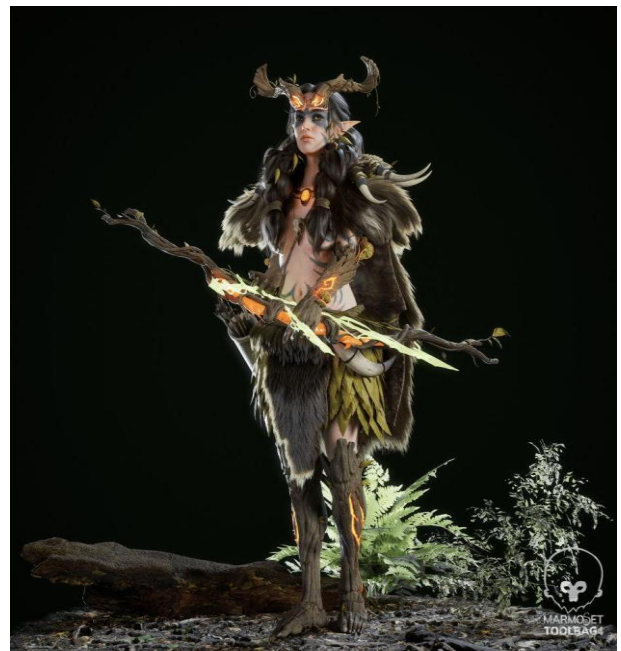


Fig.1. An example of the Huntress project [6]

Concepts in PureRef were organized by category: body and head anatomy, inspirational images such as actress Katheryn Winnick as Lagertha from the series *Vikings*, as well as makeup and additional elements. Anatomy 4 Sculptors was a primary resource for studying anatomical details, aiding in character work.

Modeling began in ZBrush by establishing basic volumes and maintaining low polycount, which simplified shape adjustments. The character's face was modeled based on a base model, gradually detailed to include elements such as the eyes, nose, and mouth, and enhanced with elven ears to amplify the mystical appearance. Skin micro-details were created using XYZ face textures and Wrap3D projections, adding realism to eyelid, nose, and lip contours.

The eyes were created using a hybrid method from Think Tank and lessons by Jared Chavez. Multi-Channel Iris processing from TexturingXYZ in Substance 3D Painter gave the eyes a magical effect. Hairstyling was based on real and stylized references. The main hair volumes were created in ZBrush, while GS CurveTools for Maya was used for texturing. The hairstyle was structured in layers: base, mid-layer for volume, a growth direction layer, and a final layer for stray strands. FiberShop added flexibility in working with individual strands.

The horns were created in ZBrush to allow for maximum control over details, including energy cracks. Brushes like Orb Clay Tubes, Dam Standard, and Orb Cracks were used for detailing, along with Trim Dynamic for leveling. Wooden limbs were designed to align with muscle anatomy, creating harmony with the character's body.

The costume was developed with UV mapping of low-poly versions for applying worn texture effects. XGen was used for the fur, while the skirt was crafted from individual leaves baked in Substance 3D Painter and assembled on a UV map using Atlas Map. Below, Figure 2 demonstrates the use of the Standard and Dam Standard brushes in ZBrush.

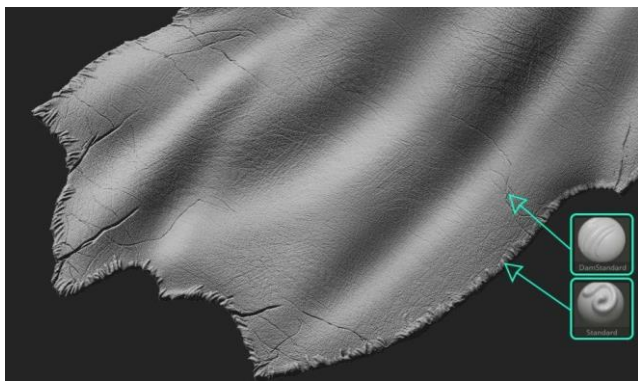


Fig. 2. An example of using the Standard and Dam Standard brushes from ZBrush [6]

Texturing began with projections from Texturing XYZ and 3D Scan Store, after which the textures were refined in Substance 3D Painter using layers for precise adjustments. Applying Cavity Map added detail, while filters such as HSV allowed flexible texture adjustments, maintaining a non-destructive workflow. Rendering was performed in Marmoset Toolbag using HDRI lighting from Poly Haven, which added the desired atmosphere to the scene. For some angles, color correction and post-processing were applied: blurring, chromatic aberration, and slight grain, giving the image texture [6,7]. Table 1 below presents the advantages and disadvantages of using ZBrush, Substance Painter, and Marmoset Toolbag to create complex character details.

TABLE 1. Advantages and disadvantages of using ZBrush, Substance Painter, and Marmoset Toolbag programs to create complex character details [5-7]

Tool	Advantages	Disadvantages
ZBrush	<ul style="list-style-type: none"> - Tools for creating high-poly models, complex details (e.g., fine cracks on metal, skin textures). - Sculpting capabilities ideal for modeling details such as hair, creating realistic elements. - Flexibility in creating details using alpha masks, brushes, interactive tools. 	<ul style="list-style-type: none"> - Lack of built-in texture layers, limited texturing capabilities, requiring export to other programs (e.g., Substance Painter). - Complex learning process, requiring time to master tools. - Not suitable for real-time materials, limiting preview capabilities.
Substance Painter	<ul style="list-style-type: none"> - Numerous options for creating photorealistic textures, useful for metal with added highlights, scratches. - Works with PBR (Physically Based Rendering), ideal for metals and other complex materials. - Ability to texture complex shapes using smart materials, layers, significantly saving time. - Easy texture export to game engines and other rendering software (e.g., Marmoset). 	<ul style="list-style-type: none"> - Limited modeling and sculpting capabilities, requiring other programs (e.g., ZBrush for high-poly models). - Working with very detailed textures may demand significant computer resources. - Depending on the project, may require prior UV unwrapping, adding additional steps.
Marmoset Toolbag	<ul style="list-style-type: none"> - Real-time preview of the final result, useful for adjusting metal or hair. - Easy setup for lighting, shadows, reflections, allowing for an accurate view of how materials (e.g., metal) will look under different lighting conditions. - Optimized for textures created in Substance Painter, providing quality texture rendering. - Supports animation for checking how hair and other details appear in motion. 	<ul style="list-style-type: none"> - Limited capabilities for creating and editing 3D models or textures (requires model import from other programs). - Resource-intensive for computers when working with large files or complex textures. - Adjustment parameters limit control over detailed aspects of textures and materials, requiring additional adjustments in other software.

The combined use of these technologies enables the creation of detailed and realistic effects that meet the high standards of 3D graphics and character visualization professionals.

IV. CONCLUSION

As a result, key technical aspects of creating complex character details, including the modeling of metal and organic structures such as hair, were analyzed and systematized using modern tools: ZBrush, Substance Painter, and Marmoset Toolbag. Each tool demonstrated its unique capabilities. The integration of these programs proved effective in achieving a high level of realism and aesthetic quality, underscoring the importance of a comprehensive approach in creating digital characters. The proposed methods may serve as a useful guide for 3D modeling and digital art specialists working on the creation of high-quality, realistic models for various visual projects.

REFERENCES

[1] Zhang S. et al. CreatureShop: Interactive 3D character modeling and texturing based on monochrome drawing //IEEE Transactions on

- Visualization and Computer Graphics, tom. 29. No. 12. pp. 4874-4890, 2022
- [2] Karabchevsky V. V., Mazurov A. S. Geometric modeling of emotions of virtual characters //Graphicon-Conference on computer graphics and vision, vol. 31. pp. 63-74, 2021.
- [3] Kumar A., Kumar A. Texturing objects using Substance Painter //VR Integrated Heritage Recreation: Using Blender and Unreal Engine 4, pp. 153-211, 2020.
- [4] Haberman M. et al. Characters with deep real-time dynamics //ACM Transactions on Graphics (ToG), vol. 40. No. 4. pp. 1-16, 2021.
- [5] Co-author R. J. Roebing created a 3d model of the highest quality using additional programs Autodesk Maya, Pixologic Zbrush, Adobe Substance Painter, Marmoset Toolbag. 2022.
- [6] Huntress: Modeling and texturing a 3D character in Maya, ZBrush and Substance 3D Painter. [Electronic resource] Access mode: <https://80.lv/articles/the-huntress-modeling-texturing-a-3d-character-in-maya-zbrush-and-substance-3d-painter/> / (date of application: 10/27/2024).
- [7] How to create realistic hair, peach fuzz and eyes. [Electronic resource] Access mode: <https://marmoset.co/posts/how-to-create-realistic-hair-peach-fuzz-and-eyes/> / (accessed: 10/27/2024).