Construction of 3D Visualization Platform for Visual Communication Design Based on Virtual Reality Technology

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Abstract. In the era of digital intelligence, the media forms of new media emerge one after another, which not only gives visual communication design more artistic expression space, but also promotes the renewal of visual communication design language and design form. Based on the problems existing in the traditional visual communication design mode, such as single architecture and insufficient expressive ability, this paper puts forward a set of three-dimensional visualization platform construction scheme, aiming at promoting the digital and intelligent transformation and upgrading of visual communication design by using the stereoscopic, immersive and interactive characteristics of virtual reality technology. The whole platform is B/S architecture, with interactive interface at the front end and virtual reality engine and Web server at the back end, which is convenient for users to complete visual communication design and display through online operation on the network. Practice has proved that the system will provide a large number of 3D digital models as design materials, and support online design, style change, free preview and other functions. In addition, DIBR technology will be integrated to strengthen the fineness of visual communication design model, further enhance the WYSIWYG ability of visual communication design, and make contributions to the innovative development of visual communication design.

Keywords: virtual reality technology; visual communication design; 3D visualization; digital modeling; Unity3D

1 Introduction

With the continuous development of digital information technology and the continuous optimization of software and hardware equipment, the application level of new media technology has soared, and its spread and influence have also ushered in explosive growth. The wide application of new media technology not only meets people's multi-dimensional practical needs of self-expression, self-realization and interactive entertainment, but also improves the technical level of related art and design. [1] Among them, visual communication design, as a comprehensive design field that conveys information, expresses concepts and evokes emotional resonance, can be

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integrated with new media technology in terms of design concepts, design methods, design processes and communication applications, which to a certain extent has an impact on the display of visual communication design effects, and also puts forward higher requirements for visual communication design in the new era. [2] In view of this, this paper believes that in the new media era, visual communication design will focus on completing the updating iteration of design language and design form from the perspectives of dynamics, diversification, digitalization and innovation, and at the same time pay attention to interactive participation and user experience, so as to ensure the ability to express information completely and complete the transformation and upgrading of traditional visual communication design mode. [3] The three-dimensional visualization platform of visual communication design can put virtual reality technology into visual communication design, solve the problems of interactive effect and artistic expression of visual communication design by constructing virtual scenes and spaces, promote the transformation of visual communication industry, and realize the digital and intelligent development of the industry.

2 Platform construction

The three-dimensional visualization platform of visual communication design is a distributed application system, and its main structure is divided into three parts: client layer, center layer and database layer. Figure 1 shows the platform architecture. Among them, the client layer is the user interaction interface, which is the basic environment for completing online design and effect display. The center layer consists of resource management center and virtual reality engine, while the database layer contains a large number of design materials and design elements to ensure the application of the platform. [4]

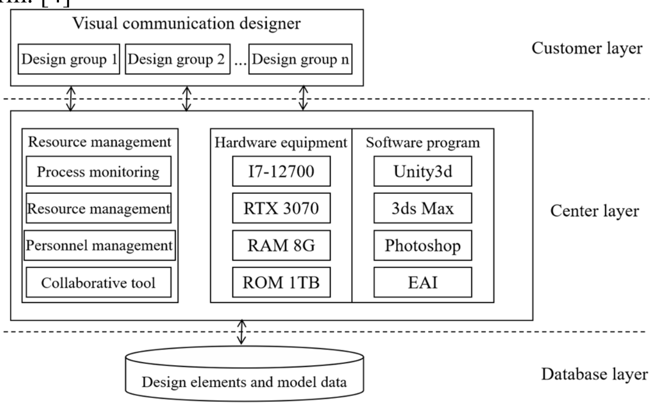

Fig. 1. 3D visualization platform architecture

For the design elements and model data inside the platform, on the one hand, it comes from the collection of three-dimensional data, on the other hand, it comes from the construction of Photoshop, 3ds Max and other software. The steps of virtual model construction include basic geometric model construction, high-mode optimization, lighting deployment, texture baking and effect rendering. [5] When all kinds of models are built, they are exported in FBX file format and introduced into Unity3D to complete virtual scene building, model combination, effect setting, interactive function development and other operations. Among them, the design and implementation of interactive functions need a lot of functional component applications and script code writing, especially for the transition of colors and the guidance of lines in the process of visual communication design, which can support users to freely switch perspectives for observation and processing, and make up for the shortcomings of traditional graphic design.

In addition, the development of the resource management module and the user interface of the platform needs to be completed in ASP.NET environment. The resource management module realizes the process communication with the virtual reality engine by relying on the pipe pipeline under the Libuv class library, which meets the functional requirements of the center layer service framework. [6] In the interactive interface, Soket communication protocol is selected to complete data interaction with the center layer and database layer, and deployment and control are completed by Windows IIS Web server.

3 Functional implementation

3.1 Online design

Under the three-dimensional visualization platform of visual communication design, users can choose corresponding functional modules to operate according to different design contents. Common design function modules include logo design, VI design, album design, poster design, packaging design and new media design. [7] After the user enters a design module, the platform interface will automatically turn into a virtual scene, and relevant tool panels will pop up in the field of vision, and the user can select and use them through input devices such as keyboard and mouse.

Take the packaging design of a product as an example. Before the design, users import the description documents and plane reference drawings into the platform, use polygon modeling and editing tools to create the model, and refine the size and position of the model by setting deformation parameters, so that the model is consistent with the plane design drawings. [8] The external packaging is based on a rectangular box, which is the same as the internal packaging design. By adjusting the shape through circular edges and using symmetrical modeling tools, the other half is copied to speed up the design. The design process is shown in Figure 2.

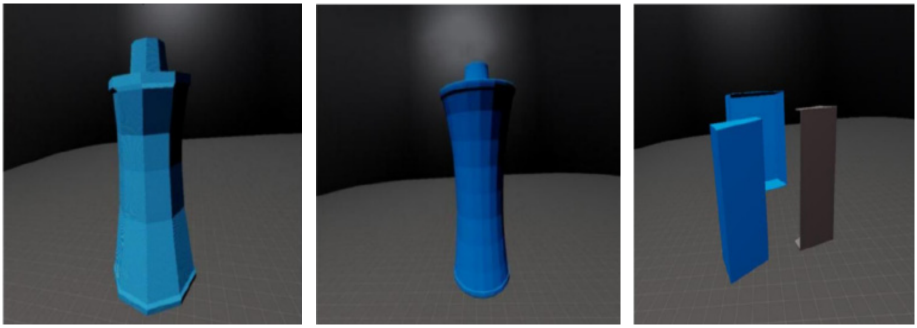

Fig. 2. Modeling process of a product packaging design

At the same time, users can choose different lighting models in the virtual scene to enhance 3D visual effects. Common standard lighting models include ambient light, self-luminescence, diffuse reflection and specular reflection. Among them, the physical process of diffuse reflection illumination is shown in Figure 3, where W is the brightness of light source, m is the diffuse reflection coefficient, θ is the incident angle, the illumination model is $W_d = W_p m \cos\theta$.

In the Unity3Shader module, the calculation formula of diffuse reflection illumination is shown in Formula 1, the color and intensity of incident light are C, the diffuse reflection coefficient of model material is m, the surface normal is n and the light source direction is I. [9]

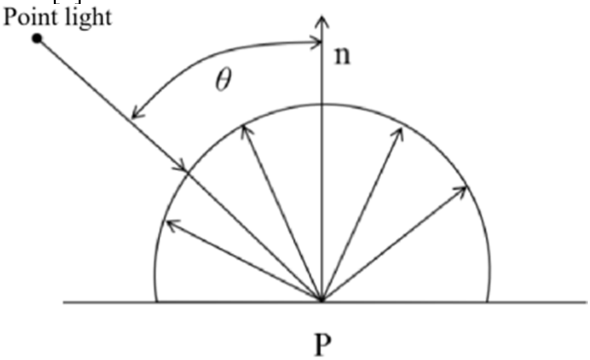

Fig. 3. Physical process of diffuse reflection illumination

$$C_{diffuse} = \left(C_{light} \cdot m_{diffuse}\right) \max\left(0, \hat{n} \cdot I\right) \tag{1}$$

After the model design is completed, users can further optimize the model and complete the effect rendering. Among them, the platform can use DIBR technology to match the color of the model under complex lighting conditions, and use sensitivity coefficient and collocation conversion coefficient to determine the pixel value under limited conditions and complete color filling. [10] As shown in Formula 2, it is a color filling formula, I is a filling parameter, k represents the color of the target image, t represents the background color, φ represents the control parameter, and w represents the segmentation frequency.

$$I_i = \sum_{n=1}^{m} \sqrt{\frac{k}{t}} \varphi[w\text{-}e] \tag{2}$$

In order to verify the improvement of model accuracy by DIBR technology, the smoothness of visual area and the fineness of image texture will be tested. The test results are shown in Table 1. The results show that the smoothness of the visual area and the fineness of the image texture are obviously improved in the experimental group after the model is optimized and rendered.

Table 1. Test results

Project	Model number	Experimental group	Control group 1	Control group 2
Smoothness of visual area	B-0254	0.9436	0.8870	0.8541
	B-0267	0.9428	0.8897	0.8572
Fineness of image texture	C-1157	0.9873	0.9223	0.9047
	C-1269	0.9776	0.9314	0.9077

3.2 Virtual scene display

The platform can combine visual communication design with display in a "what you see is what you get" mode, and support users to view visual communication design in a multi-dimensional way in a "naked-eye 3D" mode. Figure 4 shows all the elements involved in the virtual scene presentation.

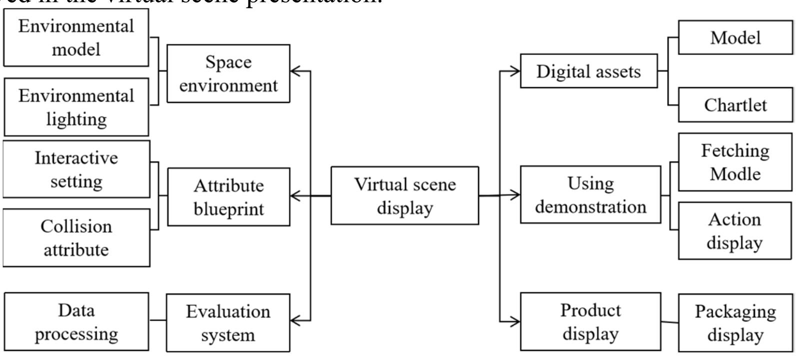

Fig. 4. Elements involved in virtual scene presentation

When the user enters the self-presentation mode, the user can zoom in or out of the visual angle through the mouse wheel, or realize the translation or rotation of the visual angle through the sliding of the mouse, and can also directly switch between the first-person visual angle and the third-person visual angle. Some codes are shown below. [11]

```
public class cameraSwitch: MonoBehaviour
{   public GameObject P1; public GameObject P3; private bool camerastatus = true;
    void Update()
    {   if (Input.GetKeyUp(KeyCode.O))
        {   if (camerastatus = true)
            {   P1.SetActive(false); P3.SetActive(true); camerastatus = false; }
            else {   P1.SetActive(true); P3.SetActive(false); camerastatus = true; }
```

4 Conclusions

In order to promote the transformation of visual communication design mode, this paper aims at many requirements of visual communication design in the new media era, constructs a three-dimensional visualization platform of visual communication design, and urges virtual reality technology to intervene in visual communication design. It effectively improves the design efficiency, strengthens the interactive participation and application experience of users, and solves the problems of interactive effect and artistic expression in visual communication design. In the follow-up research, the platform will further optimize the process of model construction, improve the model fineness, further enrich the interactive operation content, and make contributions to the innovative development of visual communication design.

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