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Research on the Protection System of Tangka Intangible Cultural Heritage Based on VR Technology

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Abstract: Currently, most intangible cultural heritage protection methods are preserved and presented in digital forms such as text, audio recordings, images, and videos, which lack situational display, interesting interaction, and widespread dissemination. If action capture, 3D scanning, film and television special effects, and 3D models are used to construct a virtual world, and its immersion, interactivity, and conceptualization are utilized to dynamically and stereoscopically present the static state, which provides a new form for the protection and inheritance of intangible cultural heritage. Based on this, the paper explores the protection and inheritance of traditional Thangka techniques through virtual reality technology, constructs a new development direction for intangible cultural heritage protection, and utilizes the power of the Internet to expand dissemination, allowing it to truly go global and face the future.

Keywords: Intangible cultural heritage, Thangka, Virtual reality (VR) technology.

1. Introduction

At present, most intangible cultural heritage protection methods are preserved and presented in digital forms such as text, recordings, images, and videos, which lack situational display, interesting interaction, and widespread dissemination. If action capture, 3D scanning, film and television special effects, and 3D models are used to construct a virtual world, and its immersion, interactivity, and conceptualization are utilized to dynamically and stereoscopically present the static state, which provides a new form for the protection and inheritance of intangible cultural heritage.

Tangka is a treasure in traditional Tibetan craftsmanship and an encyclopedia of the Tibetan people. It is a collection of paintings, narratives, teachings, and teachings deeply infused into the vitality, creativity, faith, and cohesion of the Tibetan people. It records the civilization, history, and development of Tibet, embodies the wisdom of sustainable development of the Tibetan people, and permeates a spirit of vitality, It embodies the unparalleled admiration of the Tibetan people for Buddha and Bodhisattva, as well as their infinite love for their spiritual home, and is a "portable Buddhist niche" for Tibetan Buddhist believers. [1] According to different production methods, Jue Bao Tang Ka can be divided into six categories: cloth painting Tang Ka, stacked embroidery Tang Ka, embroidery Tang Ka, printmaking Tang Ka, brocade Tang Ka, and tapestry Tang Ka. Simply put, the drawing process of Thangka includes material selection, line drawing, fabric color, rendering, double line drawing, golden layout, decoration and arrangement, and light mounting.

Based on this, the paper explores the protection and inheritance of traditional Thangka techniques through virtual reality technology, constructs a new development direction for intangible cultural heritage protection, and utilizes the power of the Internet to expand dissemination, allowing it to truly go global and face the future.

2. Tangka Production Process Intangible Cultural Heritage Protection System Development Framework

The entire system development hardware uses HTC VIVE devices, and the software uses the Unity3D game engine. The SteamVR Plugin plugin provided by Unity is used as the interface to connect the software and hardware, with PS and 3dsMax as the main modeling tools. The system development framework is shown in Figure 1. Mainly including raw data collection, scene modeling, virtual scene construction, and interaction design.

Raw data collection is the process of collecting materials according to the Thangka production process, and storing the collected materials into a database. The materials include a canvas size library, a pigment library, a Thangka pattern library, a work library, and a Thangka inheritor library, among others; Classify and save the collected data, and use the second step to construct model materials for further processing into usable materials; After the preparation work is completed, you can create a Tangka production virtual scene and import the materials prepared in the previous step into UNITY3D software for modeling; Due to the continuous interaction with tourists throughout the Thangka game, interaction scripts are written after setting up the virtual scene.

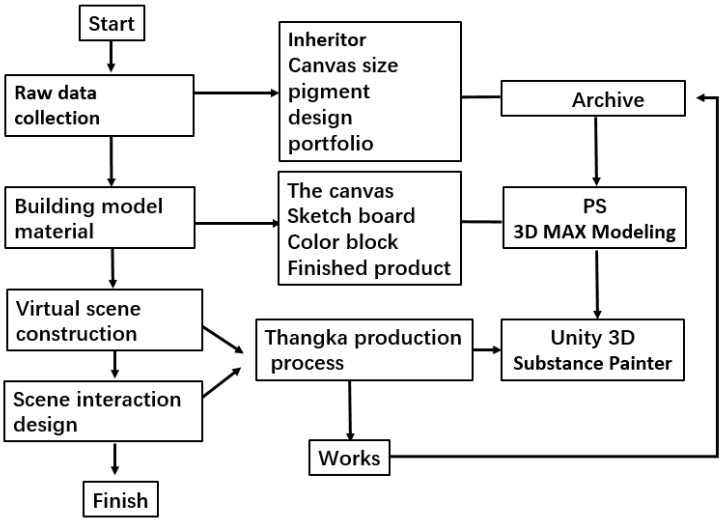

Figure 1. System Development Framework

3. Design and Implementation of Tangka Intangible Cultural Heritage Protection System

The main interface of the intangible cultural heritage protection system consists of four modules: Thangka historical and cultural display, Thangka workshop, work display, and mall. As shown in Figure 2, enter the historical and cultural display system from the "History" section, enter the Thangka workshop from the "Production" section, enter the work display module from the "Appreciation" section, and purchase tourists' works from the "Mall" section. The main scene is mainly used to guide users to experience the virtual environment after wearing VR helmets, and use the joystick operation to click on the UI interface to enter the corresponding scene.

Figure 2. UI main interface

3.1. Thangka history and culture display module

This module will tell the historical origin of Jaw Nang Thangka with the famous representative of Jaw Nang Thangka as the clue. Jangang Thangka has been living in snowy Tibet for 1027 years and has always been closely related to the Jangang school culture of Tibetan Buddhism. The 17th century Buddhist master Dorona he is the 28th generation of the Dharma master of the Jangang school, he painted many exquisite murals and thangka for the Jangang Zuting Temple in Latze County, later Dorona he was sent by the Dalai Lama to outer Mongolia to teach the Dharma, and its reincarnated living Buddha changed to Gelugpa, the status of the Jangang school in the later Tibetan with the decline, and its painting tradition gradually developed eastward. The traditional skills of the Jangang painting school have been passed down to the cultural center of Jangtang Jangang in Rangtang County since the middle of the 14th century and the middle of the 16th century.

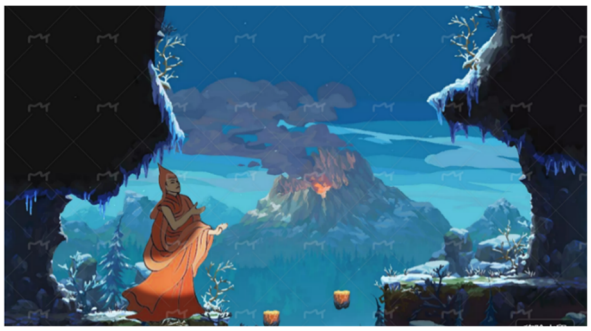

Figure 3. 3D Interactive Scene of Dorona in the 17th Century

Visitors wear helmets, feel the master's way of spreading culture through sound and images, interact with the master through the handle, the master spreads culture from Razi to Rangtang Jangang Temple more than 2,000 kilometers, understand the difficulty of cultural transmission through the path game, and understand the development history of Thangka. Dynamic environment modeling technology can be used to create virtual scenes in this module, image-based modeling method can be used to create large virtual environments, and specific interactive scenes are constructed based on three-dimensional geometric models. The image-based modeling method uses a panoramic camera to capture images, preprocesses the images, uses PTGUI software to process the processed images into panoramas, uses Pano2VR software to link the processed scenes along the way into roaming mode, and uses the helmet to watch the deeds of the masters. Figure 3 shows a three-dimensional geometric model of Doronatha in the 17th century.

3.2. (Thangka workshop module) Thangka traditional production process and system design flow

The Thangka workshop module is the most important link for visitors to experience the Thangka production process. Every step, from reciting sutras and preparing materials to opening eyes and mounting, is to achieve the effect of making visitors deeply impressed with the Thangka production process through interaction.

3.2.1. Recite sutras and prepare materials

Reciting sutras and preparing materials is the first and most important step in the modular system of Thangka workshop, which gives special cultural meaning to the entire production process. Thangka's creative process is very sophisticated and complex. Before that, ask questions, choose an auspicious day, bathe, burn incense and pray, recite the sutra, and prepare materials. Then it goes through the process of preparing the canvas, positioning the draft, coloring, drawing, tracing, and opening the light. In the process of chanting and praying, the system will prompt visitors to prepare painting materials, and use the interactive way of games to let visitors match the raw materials with the text selection. Here, if people want to achieve a sincere, solemn and pious experience, they must use immersive equipment, so that culture can be transmitted to tourists through eyes, ears, nose and sound. The UI interface for chanting sutras and preparing materials is shown in Figure 5. Thangka paintings are mostly heavy color paintings, and the preparation of pigments is very particular. The pigments for painting Thangka are traditionally made of gold, silver (the golden part of the picture is made of gold, the silver part is made of silver), coral, pearl, malachite, cinnabar and other precious mineral raw materials, as well as saffron, rhubarb, blue indigo and other plant raw materials, drawn on polished cotton cloth after drawing lines and coloring.

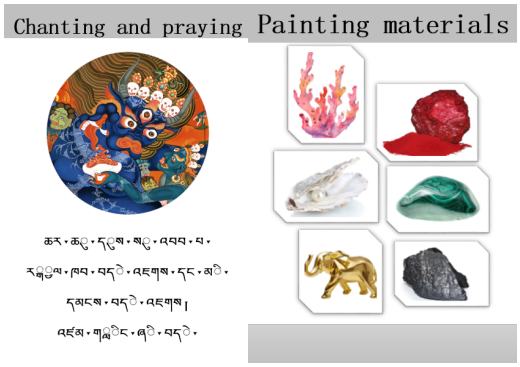

Figure 4. Scripture recitation and material preparation UI interface

3.2.2. Processing canvas

Processing the canvas mainly includes selecting the canvas size and the processing of the canvas. Canvas treatment mainly includes stretching the canvas and polishing the cloth surface. The details are as follows:

Stretch canvas: The canvas fabric is a smooth and slightly thick white cotton cloth, which should not have any stains, holes or cracks. Wash and dry the cut canvas, and stretch it to the stretch rack. The glue is then applied to both sides of the canvas, and the quality of the glue determines the coloring quality of the color pigments of the Thangka picture. After the canvas has been coated with glue and dried, it can be put on a white background. Apply warm water clay evenly on both sides of the dry canvas, so that the fine holes of the cloth are filled and the surface becomes smooth.

Grinding the cloth: Grinding the canvas requires two processes, namely rough grinding and fine grinding. First several times of rough grinding, a good white canvas dry, with a slightly rough grinding stone, grinding the order is always from top to bottom, from left to right, each grinding to dry once. Fine grinding is the last process of the canvas production, in order to facilitate the composition of the color, first in cold water into a small amount of glue, evenly spread on the front of the canvas, after drying with a smooth grinding stone three to five times.

Figure 5. Select the canvas UI interface

Figure 5 is the UI interface for processing the canvas. Select the canvas size, stretch the canvas after selecting, apply glue to both sides of the canvas, apply the glue to the white background after drying, and then polish the cloth surface. Although the whole step is completed by interaction with tourists, the operation procedure is very simple and easy to implement.

3.2.3. 勾勒底稿 Sketch paper

After the canvas is processed, the Thangka manuscript drawing process is entered. Visitors can choose ready-made patterns in the gallery or create their own. As shown in Figure 6, if you choose the existing pattern, select the button "Please select the picture number", if you create by yourself, click the button "created by tourists", and then draw the pattern on the manuscript. At this time, the system will prompt the visitor to draw again and again until the manuscript is completed.

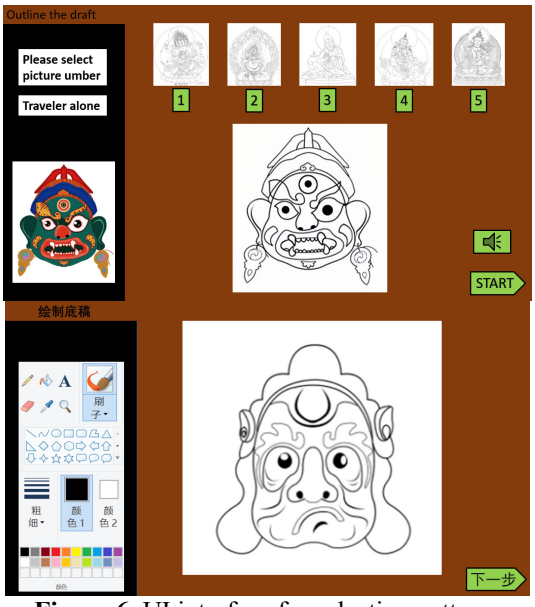

Figure 6. UI interface for selecting patterns

3.2.4. Dyeing cross

The painting of thangka in accordance with the previous draft composition is a very detailed work. The artist colored the larger pieces of clothing first, then the sky, the still life, the ground, and the face until the end. In order to change the color depth of each part, powder treatment should be applied to various colors after color, so that it has light and dark changes.

After sketching the manuscript, you will enter the coloring stage. Figure 7 is the coloring UI interface. Visitors choose the color palette on the left side of the interface to draw the corresponding manuscript area according to the finished product displayed.

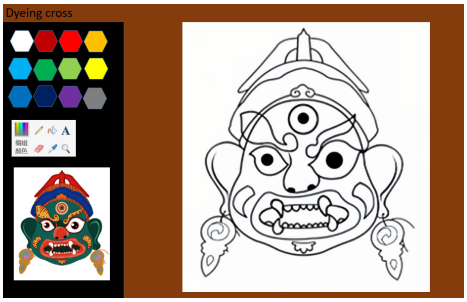

Figure 7. Dye UI interface

3.2.5. Open eyes mounted

"Three points painting seven points mounting", through the mounting of the Thangka, can make the Thangka more solemn and gorgeous, dazzling. The mounting of Thangka is not only the decoration and beautification of Thangka, but also contains profound religious significance and symbolic connotation. If it is a home decoration, it can be framed, easy to take care of, and does not need to be cleaned frequently, but it occupies a large space and is not convenient to transport. If it is used for offering, you can choose Tibetan mounting, easy to carry, occupy small space, the disadvantage is that it is easy to stick to dust, need to wipe with a clean dry towel often. In this section, two mounting effects will be displayed for visitors to choose from. After tourists choose the mounting method, it means that the entire Thangka production process is basically over.

3.3. Danka workshop module database application

The Thangka intangible heritage protection system uses a large number of database data. The Thangka history module includes inheritors, famous figures and portfolios. In the Thangka production module, materials such as canvases, pigments, manuscripts, patterns and portfolios need to be stored in the database for easy invocation. As shown in the figure.

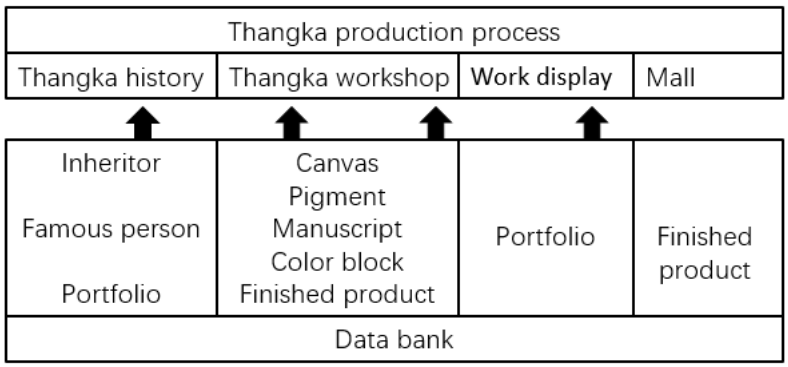

Figure 8. Tangka production database

3.4. Thangka workshop module interactive implementation

Each link in the production process of Thangka is two-dimensional animation, and the difficulty is mainly concentrated in the writing of interactive programs using pigments. The most primitive method of coloring the same manuscript is to prepare multiple resource diagrams, which will cause waste of resources, and the size of resources will be limited, and it is not easy to maintain and reuse. In this case, the material is rendered by changing it, replacing the original material with a dyed material. Then assign the main texture and transparent texture of the original material to the new material. In this way, the program can dynamically switch colors. And only one basic resource is required, which saves resources and is easy to maintain.

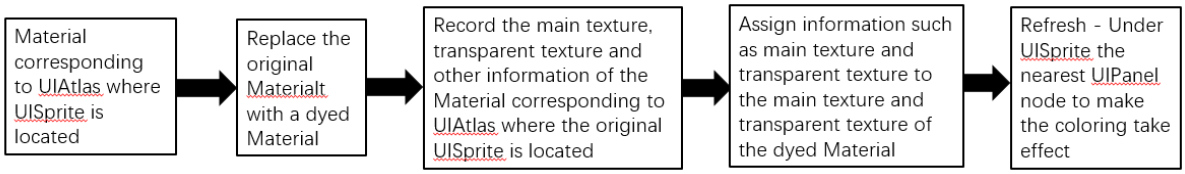

Figure 9. Dyeing interaction implementation process

In the dyeing module, visitors use the handle to click the color on the paint board, and then click the corresponding area on the manuscript to fill in the color. In Shader, three properties are defined :MainTex, which stores the main texture of the material; Brush, to control the size of the brush; Color, used to control the brush color. In the vertex shader, you only need to pass the vertex coordinates and texture coordinates. In the fragment shader, first obtain the texture coordinates uv of the current pixel. The brush size is then converted to the size in the texture coordinate system, the

distance from the current pixel to the center point of the brush is calculated, and if the distance is less than the brush size, the color of that pixel is set to the brush color. Also need to write the relevant script code, to achieve user input, brush size, color control.

```
SubShader {
    Tags { "RenderType"="Opaque" }
    LOD 100
      Pass};
    CGPROGRAM
    #pragma vertex vert
    #pragma fragment frag
```

Here is a SubShader, Tags and L. OD used to define the rendering options for the SubShader. Pass is used to define the render phase of the current SubShader. Here we define a CGPROGRAM block and use the #pragma vertex vert and #pragmafragment frag directives to tell the compiler which functions to use as vertex shaders and fragment shaders.

```
    struct appdata {
        float4 vertex : POSITION;
        float2 uv : TEXCOORD0;
                    };
    struct v2f {
        float2 uv : TEXCOORD0;
        float4 vertex : SV POSITION;
              };
    sampler2D MainTex;
    float4 MainTex ST;
    sampler2D BrushTex;
    float4 BrushTex ST;
    float BrushScale;
    float4 BrushColor;
```

Two structures are defined here, appdata and v2f, representing the vertex data and the vertex shader output data, respectively. sampler2D is a type representing the texture, MainTex and BrushTex are two texture variables, MainTex ST and BrushTex ST represent the scaling and offset of the texture, BrushScale and BrushColor represent the scaling and color of the brush respectively.

4. Conclusion

In the era of intelligence, the application of new technologies in the dissemination of intangible cultural heritage is itself an innovation in means of protection and transmission. Only through innovation in inheritance can intangible cultural heritage continue to inject new vitality and promote the continuous development of Chinese civilization. VR technology is a kind of computer simulation technology that can create and experience the virtual world. It uses the computer to collect big data to generate a simulation environment, and the user is immersed in the environment. The application of VR technology to the intangible heritage Thangka production process can break the barriers of regional space and professional skills, so that ordinary people can also experience the entire process of thangka production.

Acknowledgment

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