



The Design and Implementation of Digital Virtual Exhibition Platform for Arts and Crafts Design Based on 3D Web3D Technology

Linyu Li^(✉)

Weifang Engineering Vocational College Qingzhou City, Weifang City 262500, Shandong, China
872099563@qq.com

Abstract. In order to show the artistic beauty of arts and crafts design works more conveniently and comprehensively, this paper studies the digital virtual display platform of arts and crafts design based on Web3D technology. In this system, the sculpture model is established by 3dsmax, the scene is rendered by WebGL and three.js technology, and various business functions of the application system are developed by JS language. The database server is built by Oracle, and the web server is Apache Tomcat. And in the design of scene interaction, a reusable roaming algorithm is adopted, which can complete the rapid construction of a stable roaming path only by configuring parameters, thus improving the development efficiency.

Keywords: Web3D · Virtual reality · Three.js · WebGL · Arts and crafts design

1 Introduction

Arts and crafts works, because of their numerous visual elements, often contain richer design ideas, which are the inspiration and design materials in many design fields, and have an important impact on the promotion of regional cultural aesthetics. However, due to the limited space and time, it is difficult for many lovers of arts and crafts to participate in related exhibitions on the spot, and it is difficult for the audience to immerse themselves in the explanation of video materials on the Internet. And the design of digital virtual exhibition platform of arts and crafts design based on Web3D technology can help related lovers of arts and crafts design works to watch their works from different angles through network immersion. The more intuitive experience and convenient communication mode in 3D scenes are conducive to the dissemination of arts and crafts works, enhance aesthetic ability, promote the exchange and integration of artistic ideas, and help arts and crafts to better adapt to the development of the information age [1].

2 Key Technologies

2.1 Three.js

The Three.js is a third-party library whose class written based on JavaScript belongs to the WebGL library. The developer can use simple code to encapsulate the underlying graphical interface, so as to achieve the purpose of rendering the 3D scene. The digital

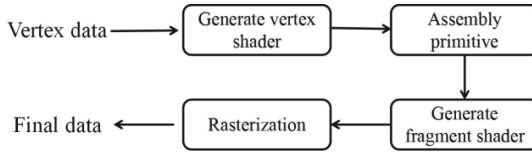


Fig. 1. WebGL workflow (original)

virtual exhibition platform of arts and crafts design studied in this paper can make the development process faster by using the framework of three.js. In the process of building a 3D scene, three.js can be used to deal with the problems of renderer, model and light source in the scene [2].

2.2 WebGL

The WebGL is a set of professional 3D drawing standard protocols, which is called the Web Graphics Library. The WebGL can combine JavaScript with OpenGL ES. As for the scene rendering problem in web3D technology, it can be solved by WebGL technology. Because WebGL can provide the required hardware for 3D accelerated rendering. The workflow of GL is shown in Fig. 1. Firstly, input vertex data to generate a shader for vertices. The vertex data refers to the vertex coordinate data passed in by the developer. After that, there is the work of primitive assembly, that is, the vertex graph that calculates the coordinates of three-dimensional scene into screen coordinates. And then the shader of the fragment is used to rasterize the primitive. The fragment shader is responsible for defining the pixel color values of primitives. Finally, the final data such as scene texture and lighting are input to complete the rendering of 3D scene [3].

2.3 Development Environment

The development operating system of digital virtual exhibition platform of arts and crafts design based on 3D web technology is Windows 10 version, the modeling technology is supported by 3DSMAX software, the development language of the system is Java at the back end, CSS + HTML + JavaScript at the front end, and the page writing language of 3D scene display is JS language. The relational database uses Oracle to build the database server, and the web server uses Apache Tomcat. The application development framework is SSM framework which combines Spring, SpringMVC and MyBatis, and the development environment tool is IDEA. The functional design framework of the 3D Web3D part is three.js, and the editor is used for secondary development [4].

3 Overall Design

The overall design planning of digital virtual exhibition platform of arts and crafts design based on 3D web technology can be divided into two parts, one part is the overall system framework, and the other part is the related functional framework of Web3D. The core development tools of 3D web function subsystem are three.js and WebGL. Firstly,

3DSmax builds the 3D model and outputs the .Obj file. Then use three.js to build the running environment of web3D. After that, the .Obj file is called through the input of js statement in the established web page, and the scene is rendered by combining with WebGL, and finally the scene is built [5].

4 Function Realization

The digital virtual display platform of arts and crafts design based on 3D technology mainly needs to display arts and crafts works in virtual scenes in all directions, and it needs the function of viewing arts and crafts works from different perspectives in dynamic distance. So, the interactive aspect of the system needs to design the function of adjusting the distance from the perspective, and the implementation code is shown in Fig. 2 [6].

When designing the function of scene interaction, some plug-ins are needed to control the scene moving and zooming by mouse and keyboard. For example, the abstract class MouseControl receives the control operation data of the camera and renderer in the 3D scene [7]. Through the OrbitControl class, we inherit the mouse-controlled control object creation method createControl. The factory class MouseFactory with internal control method can also pass in parameters to create objects. The orbitControl object can be created through the Orbit parameter, and the same is true for the track parameter [8].

In this paper, in order to achieve the effect of rapid reuse of visual angle cameras, the general scene roaming algorithm is used to realize the roaming path configuration of the scene. The roaming algorithm is implemented as follows: Set the starting point coordinate position of the roaming route to $P_0 (X_0, Y_0, Z_0)$, and set the moving distance of the X axis distancesX and the moving Z of the distances Z axis respectively. The movement weights of the x-axis and z-axis can then be calculated wrightX and wrightZ, the calculation formulas are shown in Formula (1) and Formula (2). Finally, the best moving position of the camera can be calculated according to the moving weight, and

```

<script>
var scene = new THREE.Scene();
var camera = new THREE.PerspectiveCamera(45,
window.innerWidth / window.innerHeight, 1,
1000);
var renderer = new THREE.WebGLRenderer();
renderer.setClearColor(0xffffff);
renderer.setSize(window.innerWidth,
window.innerHeight);
document.body.appendChild(renderer.dom
Element)
var geometry = new THREE.CubeGeometry(10,
10, 10)
var material = new THREE.MeshBasicMaterial(
{color:0xf0000});
var cube = new THREE.Mesh(geometry,
material)
scene.add(cube);
camera.position.x = -30;
camera.position.y = 50;
camera.position.z = 30;
camera.lookAt(scene.position)
function render() {
requestAnimationFrame(render);
rotate();
MouseControl_Drag0,
MouseControl_Scaling;
renderer.render(scene, camera);
function rotate() {
cube.rotation.x = 0.0;
function MouseControl_Drag0 {..}
function MouseControl_Scaling {..}
render()
</script>

```

Fig. 2. Code implementation of angle adjustment function (original)

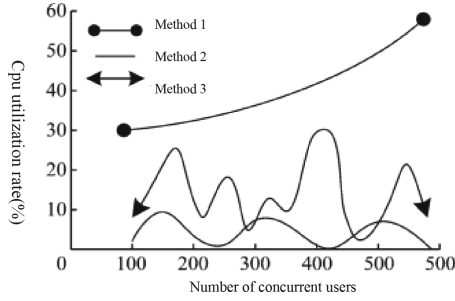


Fig. 3. Comparison of CPU occupancy rate under different methods (original)

the calculating formula of the moving position is shown in formula (3) [9].

$$\text{wrightX} = \text{weightX} / \sqrt{\text{distancesX}^2 + \text{distanceZ}^2} \tag{1}$$

$$\text{wrightZ} = \text{weightZ} / \sqrt{\text{distancesX}^2 + \text{distanceZ}^2} \tag{2}$$

$$P_{cam} = P_0(x_0 + \text{step} \times \text{weightX}, k, z_0 + \text{step} \times \text{weightZ}) \tag{3}$$

In order to verify the effectiveness of the system design of the digital virtual exhibition platform for arts and crafts design, the performance of the system was tested. The first method is the design method of web3D digital virtual exhibition platform for arts and crafts design with scene roaming algorithm, the second method is the design algorithm without algorithm, and the third method is the system design method of playing arts and crafts design videos with ordinary streaming media without web3D technology. In this study, there are 500 concurrent users, and the CPU utilization of the three methods are tested and the data are compared. The comparison test results are shown in Fig. 3. In the case of high concurrency of 500 users, the CPU utilization rate still does not exceed 60%, and the performance requirements can be guaranteed when higher functional requirements are met [10].

5 Conclusion

In this paper, the digital virtual exhibition platform of arts and crafts design is realized by combining 3D model development technology and web page technology. From the perspective of modeling, scene rendering and visualization in virtual reality technology, and according to the characteristics of web page implementation, 3D arts and crafts scene display is realized. But due to the limited ability and time of the author, this system still has great shortcomings. For example, in the absence of the development of related functional interfaces of mobile users, it is necessary to get rid of the shackles of PC clients, and visually display enhanced multimedia information on target objects through the identification of on-site objects and signs by mobile phones.

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