Optimization Design of Virtual Reality Technology in Indoor Activity Space of Children

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Abstract. Combining VR virtual reality technology with the design of indoor activity space of children's rooms, interactive research is carried out to improve the immersion, interaction and interest of indoor activity space design. In view of the lack of virtual reality technology in the interaction design of children's rooms and indoor activity space at home and abroad, the paper analyzes the important elements of the indoor interaction design of VR children's rooms, and explains and explains the innovation points and design content of the indoor interaction design of children's rooms. It is expected that virtual reality technology will be applied to children's indoor activities, so that children can improve their ability of independent thinking and active learning in an interactive environment.

Keyword: VR virtual technology; Children's room; Interactivity; space design

1. Introduction

VR technology is based on the computer, generating and integrating multiple information sources and interactive 3 D dynamic view of the touch you bargain. In fact, the simulation function of physical behavior brings users an immersive experience. Virtual reality technology enhances the interaction ability between reality and virtual three-dimensional space through human-computer interaction. Starting from the characteristics of children's psychological and physiological development, this paper analyzes the differences of different children's interaction elements of indoor space, and takes children as the center of the design to improve the space interaction of children's room design.

At present, there is some research on the use of VR technology at home and abroad. At present, the use of VR technology in construction decoration engineering is mainly combining BIM and other technologies to design architectural models, while there are few studies on the interactive design of VR virtual technology in children's rooms in China. Based on this, this paper makes a study on the interactive design of VR technology in the activity space of children's room, and puts forward the practical scheme to optimize the interaction of children's activity space to promote the development of children's subjective initiative [1].

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2. Contrivance

Use VR to design children's interactive activity space, so that children can feel the interest of indoor space activities. Construct a virtual environment by putting VR technology indoors with 3D unity technology. Let the children in the virtual environment through the VR equipment to feel the hearing, vision, smell and touch of the different indoor space environment. Children can get immersive feelings in the simulated 3D virtual environment, and improve their initiative to explore the surrounding environment. Through the interactive operation in VR children's room, they can understand children's ideas on space design [2].

2.1 3Ds Max for modeling

Using 3Ds Max modeling is an important basis for the virtual scene, using 3Ds Max modeling tools, from the CAD design software for children room space design data, the CAD of two-dimensional drawings import to 3Ds Max modeling tools, according to the size of the two-dimensional space data, from interior space model to interior space soft assembly design, according to the characteristics of children's physiological development design material, finally realize children room virtual reality space model production[3].

2.2 Unity 3D virtual scene

The completed 3D model is imported into the Unity 3D software, and the materials needed for the children's room space design are integrated into the software, and the material of the three-dimensional model scene is set. The specific process is shown in Figure 1. The material design in the children's room is an important element to realize the aesthetic feeling of the children's room design, such as the wall explanation of the white latex paint material and part of the wall is made of light blue wall paint material, and the elements of the design materials are put in the software. According to the subjective will of children to adjust the material design and lighting adjustment in the space design, then complete the virtual design of the children's room.

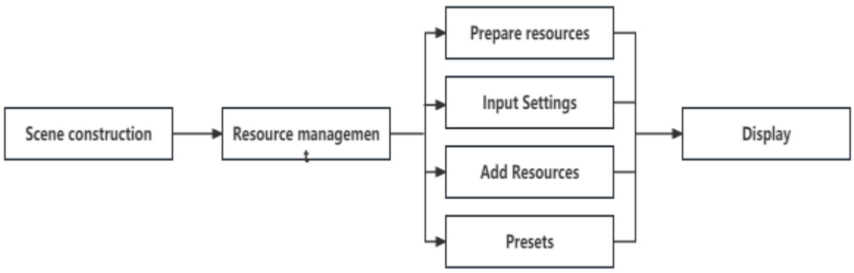

Figure 1 Unity 3D Flow chart of model construction

3. Principles for implementing interactive VR scenarios

Using the appropriate layout elements in the model database in Unity 3D software, and the editing, positioning and editing interface in the platform is used to generate the interactive effect of the indoor space layout scene in line with the characteristics of children. Through the running window and binocular camera for collaborative roaming control, so as to realize the indoor taste of the children's room interactive layout scene $P_{rs}P_{ls}$[4]. According to the movement characteristics of children combined with the controller control, the virtual robot to replace the roaming control of the camera. The turn-back angle vector and the line-of-sight vector are expressed by and, and these two parameters are used instead of the roaming position of the camera, and the obtained parameter values are implemented in the z-axis and x-axis, respectively.

T The position change matrix between the virtual positions is determined according to the motion relationship between the different remote control rods of the virtual robot. It is described by the following formula:

$$ {}_0^4T = \left[\frac{R\ (Z_3,\ \partial)}{0}\middle|\frac{P_0^4}{1}\right] \quad (1)$$

$$ {}_4^5T = \left[\frac{R\ (Y_4,\ -\frac{\pi}{2})}{0}\middle|\frac{0}{1}\right]\left[\frac{R\ (Z_4,\ \Phi)}{0}\middle|\frac{0}{1}\right] \quad (2)$$

$$ {}_5^6T = \left[\frac{0}{0}\middle|\frac{T_{rans}\ (X_5,\ D_5)}{1}\right]\left[\frac{R\ (X_5,\ -\frac{\pi}{2})}{0}\middle|\frac{0}{1}\right]\left[\frac{R\ (Z_5,\ \sigma)}{0}\middle|\frac{0}{1}\right] \quad (3)$$

$R(Z_3, \partial)T_{rans}\partial$The ones and the above formulas respectively are matrices obtained after the angle around axis A in the local coordinate system. According to the process described by the above formula, then the control VR roaming position is obtained according to the kinematic method, and finally it can be expressed by formula (4).

$$ {}_0^6T = {}_0^4T\,{}_4^5T\,{}_5^6T \quad (4)$$

Through the interactive change of the interior space layout scene, the change and adjustment function of different elements of the interior decoration can be realized. According to the characteristics of children's psychological development, different layout effects are realized, from the optimization of concealment, replacement and adjustment between different layout elements. According to children's own preferences to adjust and layout of different elements and materials, to enhance children's immersive experience.

4. 3D interaction design

4.1 Scene design optimization

Using the listening handle plug-in in Steam VR software, the handle is used to realize the interactive operation of children's room activity space design. First, through the Steam VR_Tracked Object script, input it into the Controller, a subdirectory of Camera Rig, Later, the code input is implemented through the attribute accessor to build the virtual handle. After completing the corresponding device connection, the handle VR operation is realized [5].

According to the physical and psychological development of children's strong curiosity about activities, the sound effects of activities are set in the virtual scene to enhance children's interest in understanding the story background and carrying out virtual operations. In the VR virtual children's room, children can change or add furniture according to their own interests, furniture material can be adjusted through the rendering function.

In order to meet the characteristics of children's development in the virtual scene of children's room. In the constructed model, Unity function is used to transform the style of original furniture materials, and then adjust the interior space design according to the previous stickers and material resources imported in the software, such as floor wood texture, marble texture; the nylon, glass and other solid wood resources of furniture. After the child replacement is completed, click finished will pop up: "Good, you turn the sofa into bright blue, your room looks beautiful again." The interactive operation of other objects in this virtual scene can be operated in this way.

4.2 Color rendering optimization

After constructing the indoor scene model, the color of the indoor scene is optimized by using the oblique section ring harmonic method (as shown in Figure 2).

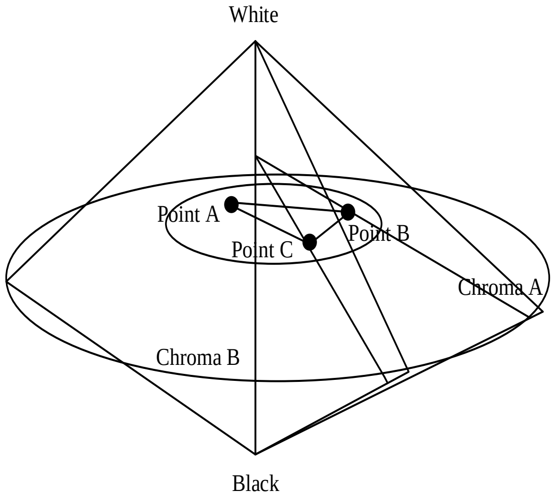

Figure 2. Circular and harmonic structure diagram of the inclined section

As can be seen from FIG. 2, the target in the scene is reconciled with A, B and C, and $O_{a0b0}[M_0]$is taken as the basic color point, and the corresponding two harmonic colors are $O_{a1\ b1}[M_1]$ and $O_{a2b2}[M_2]$ (where $a_0=a_1=a_2$, $b_0=b_1=b_2$), but $M_0\neq M_1\neq M_2$. Moreover, the color ring radius of the corresponding base color point in the figure is R, so the color ring radius is $x^2+y^2=R^2$, and $z=z_0$. Finally, the angle at b=0 is calculated according to formula (5)

$$\gamma = \arctan\ (y_0/x_0) \tag{5}$$

After getting the color matching of the plane, it is necessary to match the color conversion of the 3D space according to formula (6).

$$\begin{cases} O'_{ab}[M] = O_{ab}[M] \times z \\ O'_{a_1b_1}[M_1] = \left(-\frac{\sqrt{3}}{2}R,\ \ -\frac{1}{2}R, z_0, 1\right) \\ O'_{a_2b_2}[M_2] = \left(\frac{\sqrt{3}}{2}R,\ \ -\frac{1}{2}R, z_0, 1\right) \end{cases} \tag{6}$$

Where z is the corresponding fixed point, and the corresponding color harmonic coordinate can be calculated according to the formula. Through the above steps, optimize the color optimization of the indoor scene of the children's room, and improve the indoor color scheme design of the children's room.

4.3 Light optimization design

light and background light lighting. Main light lighting determines the brightness of the room, creating a bright atmosphere for the children's room. Through the principle of indoor light refraction and reflection to optimize the brightness of 3D scene light, so as to realize the main light rendering of the overall scene, the corresponding formula such as Equation (7).

$$\mathrm{W}(x,\rho)= W^{p}(x,\rho)+\int_{\psi} W\begin{pmatrix} \vartheta((x,\rho^{'}),\rho^{'}) \\ \cos\beta^{'} f_{r}(x,\rho^{'}),\rho \end{pmatrix} d\rho^{'} \tag{7}$$

In VR scenes, the lighting rendering of indoor color is directly related to the important factor of the restoration degree of virtual simulation. Therefore, the simulation processing of lighting rendering can improve the rendering effect of lighting in indoor space[6].

5. Simulation test

5.1 Reduction degree test

After experimental test, the model constructed by the Unity 3D has strong spatial accuracy, and the 3D model constructed in this paper has achieved good results in terms of reduction degree and performance. The reduction degree test in the paper is within the value interval of the reduction degree of [0,100]. The higher the value, the better the simulation effect. The results of the experiment are shown in Figure 3.

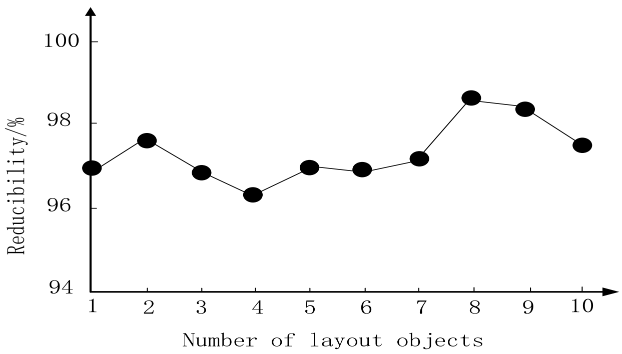

Figure 3. Reduction degree test results

5.2 Performance test

This paper detects the properties and efficiency of the spatial layout of the model, and the performance test results of the color saturation and spatial information saturation of the spatial design elements and the saturation of the spatial design are shown in the table 1.

Table 1: Model performance test results

Contrast item	bear fruit
Layout runs for computational efficiency / s	2.45
Layout element saturation	0.89
Planning location error	0.02

According to the test results of this paper, the reduction degree and performance of the virtual simulation model of children's room constructed by using unity 3D modeling software show good use characteristics, which provides an effective reference for the future VR space design of children's room.

6. Conclusion

To sum up, the article through Unity 3D modeling software building children room virtual activity space optimization design method, according to the development of children's physiological and psychological characteristics to build the layout of the elements three-dimensional model, the layout of the complete elements inventory, with sound, picture, enhance the project space design layout visual effect and auditory effect, promote the virtual technology in children room indoor space design flexibility and interesting.

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