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Retraction

Retracted: Interior Soft Decoration Product Design Based on 3D Modeling and Image Processing Technology

Mobile Information Systems

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] Y. Jin, Y. Chen, and J. Qu, "Interior Soft Decoration Product Design Based on 3D Modeling and Image processing Technology," *Mobile Information Systems*, vol. 2022, Article ID 9095614, 7 pages, 2022.

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Research Article

Interior Soft Decoration Product Design Based on 3D Modeling and Image Processing Technology

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In order to solve the problems of the traditional 3D simulation system of indoor soft decoration, such as the lack of effective enrichment, rendering means, and poor authenticity when selecting the geometric modeling method to simulate the effect of indoor soft decoration, this paper proposes a 3D simulation system of indoor soft decoration based on OpenGL and Direct3D. The system uses 3DMAX software to establish the indoor model, imports the model into the OpenGL 3D graphics standard library module, draws the indoor soft decoration scene elements using the basic geometric elements, and constrains the scene elements through the wall, overlap, and size constraint functions, so as to ensure the reasonable layout of the indoor soft decoration agent area and enrich the indoor model. After enrichment, the indoor model is transmitted to the Direct3D rendering engine module transformation unit to implement the soft decoration layout, and the lighting unit and rasterization unit are used to render the indoor after layout so as to obtain the optimal indoor soft decoration effect and output the 3D simulation image of indoor soft decoration. The experimental results show that the favorability, operation sensitivity, design portability, design satisfaction, and soft fitting effect score of the system are higher than those of the Untiy3D system and Smart3D system. The average score of this system is about 95, while the average score of the Untiy3D system is lower than 89, and the average score of the Smart3D system is lower than 85. *Conclusion*. The three-dimensional simulation effect of indoor soft decoration of this system is good, the design is convenient, the operation is sensitive, and the user satisfaction is high, which provides a reliable analysis basis for indoor design.

1. Introduction

With rapid economic development, people's living standards have greatly improved, and the requirements for living quality are becoming higher and higher. Therefore, the interior soft decoration design is the key to interior design, which has become more and more important in the overall decoration in recent years [1]. However, when displaying the interior soft decoration design scheme, the designer needs to collect samples from different manufacturers to design the interior soft decoration that meets the needs of users, which consumes a lot of manpower and material resources. Therefore, it is of great significance to design a three-dimensional simulation system for interior soft decoration, which can bring great convenience to interior soft decoration designers and enable users to understand the designed soft decoration more intuitively. With the rapid economic development, people's living standards have improved, and they gradually pay attention to the quality of their home decoration. The so-called family decoration quality not only refers to the quality of furniture materials but also the color matching and living comfort. The decoration quality can directly reflect the cultural connotation and life taste of residents. Interior design is to create a comfortable and pleasant living environment by using design, technical techniques, and aesthetics according to the use of nature, corresponding standards, and the environment of each building [2]. This indoor space not only has practical value but also reflects the aesthetic needs of personal preferences, cultural atmosphere, and folk feelings. The traditional 3D simulation system for indoor soft decoration usually selects the geometric modeling method to obtain the indoor scene information. Although the cost is low, the performance of the development tools is poor, resulting in the lack of authenticity of the system and the inability to obtain real color matching and decoration materials. Therefore, when formulating the interior soft decoration scheme, designers usually need to communicate with customers and modify the design through software that can directly display the interior design [3]. Therefore, a three-dimensional simulation system capable of accurately simulating the interior soft decoration is of great significance to improve the quality of home decoration design.

2. Literature Review

The three-dimensional modeling technology is a three-dimensional virtual modeling technology. Its principle is to use the camera to take 360° ring shots so as to master the detailed status of the building's interior landscape and then use computer technology to restore the building's interior landscape in a real and three-dimensional way [4]. As an advanced virtual reality technology, the introduction of three-dimensional modeling technology can realize the three-dimensional display and virtual display design of the building interior landscape by creating a three-dimensional indoor scene [5]. Therefore, this paper proposes an interior landscape design system based on three-dimensional modeling that realizes the virtual display design of an interior landscape by generating image workflow, analysis result splicing, information digital analysis, panoramic information recording, etc. [6]. The interior landscape design system based on three-dimensional modeling can not only draw the plane interior landscape image but also generate the three-dimensional interior landscape image through three-dimensional modeling. Through three-dimensional modeling, it can provide customers with more clear and three-dimensional interior landscape details, which is convenient for customers to choose from. In the design communication stage, communication and negotiation are the most important links in the preparation stage. We will obtain the design-related intentions from customers and clarify the basic conditions, style intentions, functional requirements, modeling requirements, and other contents of the design. Make a general assessment of the physical and geographical environment around the building and the style characteristics of the building. Second, in the design conception stage, the overall design of the space is considered according to the functional requirements and design intention proposed by the customer. The design concept should be considered in relation to the indoor function layout, the style and genre of interior design, the use of decorative materials, soft decoration, and color matching. The third stage is the design and drawing stage. After communicating with the customer, the design scheme will be drawn up into detailed construction drawings using relevant software. Then, according to the construction drawing, draw the effect drawing with software and finalize the scheme. CAD software can be used in the industry to draw the design plan. The construction drawing belongs to the early-stage auxiliary software. After completing the plan according to the customer's requirements, 3DMAX is used to turn the plan into a three-dimensional space effect drawing so that the customer can more intuitively and objectively understand the design content, print it into a position drawing, and bind it into a volume [7]. The fourth is the construction stage, which is the implementation stage of the whole design. Each type of work completes the whole decoration process according to the early design drawings, construction drawings, and effect drawings. Fifth, in the stage of soft decoration, the designer arranges the indoor living space according to the principle of design style. "In the soft decoration design, no matter which type the design style belongs to, we should grasp the background color, main color, embellishment color, and their proportional relationship" [8].

On the basis of current research, this paper designs a 3D simulation system of indoor soft decoration based on OpenGL and Direct3D. The system combines OpenGL software with Direct3D software, which effectively improves the authenticity of 3D simulation of indoor soft decoration, makes customers truly feel the effect of indoor soft decoration design and layout, and improves the quality of indoor soft decoration design.

3. Research Methods

3.1. System R&D Platform

To determine the R&D platform of the system, a Windows7 system is adopted as the operating system, OpenGL and Direct3D are used as 3D program development tools, and 3dsMAX7.0 is used as a 3D model and animation tool [9]. OpenGL and Direct3D are both program interfaces. In the process of modeling, the OpenGL graphics library can provide simple point, line, and polygon drawing functions, as well as relatively complex curve and surface drawing functions. In the process of cross-platform application research and development, OpenGL can work on UNIX, Windows7, and MAC platforms, and its architecture can enable the desktop system to transfer the indoor software graphics processing to the server. Direct3D is a 3D drawing programming interface developed through the Microsoft Windows operating system, which is a part of DirectX. Direct3dapi abstracts hardware features in the same way, so that different 3D acceleration hardware features can be hidden.

In order to make the soft model more realistic, the most commonly used 3dsMAX7.0 software is used as the production tool for the 3D model. For more complex models, plug-ins related to 3DMAX may be used [10].

3.1.1. Direct3D Architecture. Figure 1 depicts the Direct3D architecture.

Direct3D is mainly composed of two types of drivers: the first type is implemented through the hardware abstraction layer Hal [11]. Hal is an abstraction layer directly related to hardware, and it is also a driver, which is generally provided by the manufacturer. When the hardware can directly support the required functions, the hardware abstraction

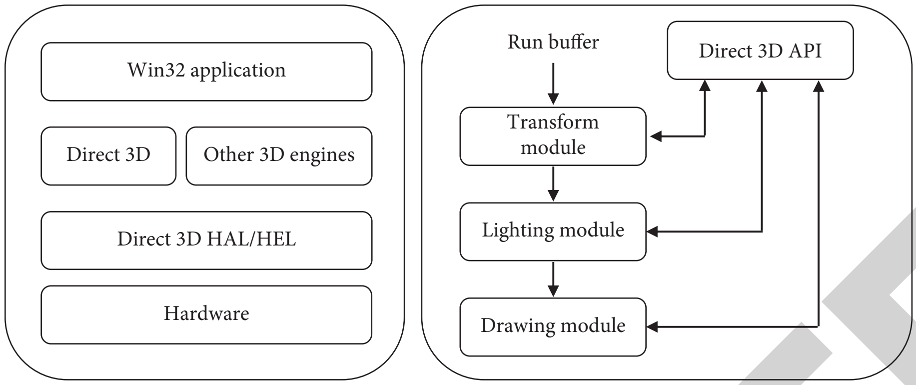

Figure 1: Direct3D architecture diagram.

layer will be applied so as to achieve acceleration; the other type of driver is realized through the hardware simulation layer HEL. When the hardware cannot support the required functions, the hardware simulation layer will simulate these functions through software to complete the specified tasks.

Direct3D includes a large number of c/c++ header files and interfaces for component object models [12]. Among them, there are many kinds and data structures in the header file, which transmit device information to the operating system and control the appearance of the 3D model according to this information. The 3D scene production of indoor soft decorations is realized through Direct3D. The whole process is divided into three levels, and each level is an independent dynamic loading software module. At the beginning of production, build corresponding graphics for each module through direct3dapi calls, and then introduce the running cache [13]. The first-floor module is the transformation module, which processes the geometric transformation of interior decoration. The lighting module is located on the second floor, which mainly calculates the indoor lighting and can process different types of light sources. The third layer is the rendering module, which constructs the final indoor soft decoration scene according to the output content of the upper two layers. For the above modules, the software can be used to convert them, so modules with strong functions can be used to replace the corresponding modules. Some modules can communicate with the hardware accelerator. At this time, any level in the whole process can be accelerated by hardware.

3.1.2. Design of User Login Registration Module. The user can enter the user's name and password in the login box in the system login interface to log in to the system. Unregistered users can log in to the system through registration. After successful login, they can perform various operations on the system. The user registration and login diagrams are shown in Figure 2.

3.2. Layout of Indoor Soft Decoration Agency Area. Soft decoration includes indoor furniture, household appliances, lamps, ornaments, and other objects, which are defined as scene elements, and on this basis, the agent area is defined, which refers to a group of objects that can realize a certain function together.

The essence of rational distribution of agent regions is to determine the optimal distribution position in the target space. Collect prior knowledge from interior decoration, combine it with functional requirements to determine constraint conditions, form a constraint cost function based on this, and solve this function so as to realize a soft decoration layout [14].

Use $A = (Q, S)$ to describe the layout of the proxy area in the target space, use Q to describe the proxy area set, $Q_i = \{Q_1, Q_2, \ldots, Q_k\}$, and use s to describe the feature set of the target space. Let the i-th proxy region $Q_i = (g, (a, b), \alpha, l, w)$, where G is the function type, (a, b) is the location, α is the direction, l is the length of the rectangle, and w is the width of the rectangle. The vertex coordinates at the lower left corner of the rectangle are the position of the proxy area [15].

The constraint function refers to the compliance with the layout constraints of the proxy area layout. For indoor soft decoration, the element layout must meet the requirements of function and vision [16]. This section gives three constraint functions to ensure the support and visual effect of indoor activities.

Constraint 1: through wall constraint [17]. Indoor soft objects need to be in the scope of the layout container. In the agent area layout problem, the phenomenon that the agent area penetrates outside the wall is punished by the above constraints, and the through wall constraint is obtained by the difference between the rectangle describing the agent area and the polygon describing the indoor contour:

$$M_1(A) = \frac{\sum_i B(Q_i - S)}{\sum_i B(Q_i)}, \tag{1}$$

where $B(*)\cdot$ is used to describe the polygon area calculation function.

Constraint 2: overlapping constraint [18]. When determining the optimal layout position, the objects shall be reasonably arranged; that is, the indoor soft fittings shall not overlap, and this shall be taken as a constraint. In the process of indoor soft decoration, for the layout of objects, the overlapping of agent areas will reduce the

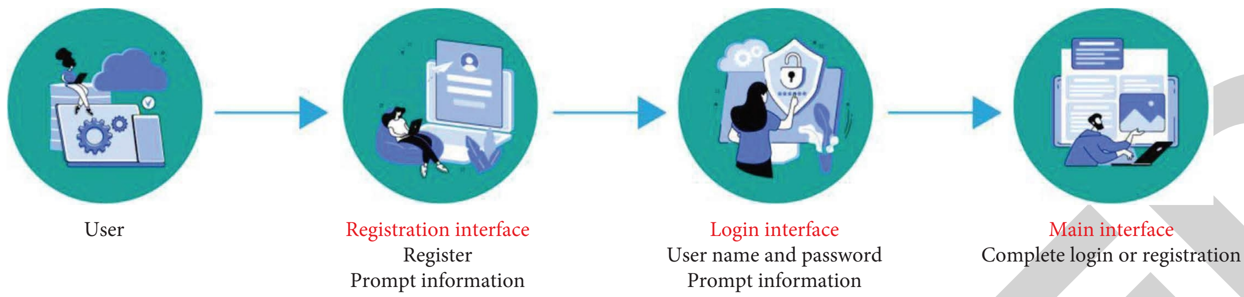

Figure 2: User registration and login diagram.

functions of objects in the area and affect the traffic, so it is necessary to prevent the overlapping of agent areas. The constraint function formed at this time is

$$M_1(A) = \frac{\sum_{1<i,j\in i<j} B\left(Q_i \cap Q_j\right)}{\sum_i B\left(Q_i\right)}. \quad (2)$$

Constraint 3: dimensional constraint [19]. From the aspect of comfort, when arranging indoor soft decorations, attention should be paid to the size of each object. There are certain requirements for its proportion in the interior. According to this constraint condition, the constraint function is determined as follows:

$$M_3(A) = \begin{cases} 1 - \left(\dfrac{A^*}{s_{\min}}\right)^2, & A^* < s_{\min}, \\ 0, & s_{\min} \leqslant A^* \leqslant s_{\max}, \\ 1 - \left(\dfrac{s_{\max}}{A^*}\right)^2, & A^* > s_{\max}, \end{cases} \quad (3)$$

$$A^* = \frac{\sum_i B\left(Q_i\right)}{B(S)},$$

where $s_{\max}$ is the maximum value of indoor area ratio and $s_{\min}$ is the minimum value of indoor area ratio. Here, $s_{\max} = 0.48$ and $s_{\min} = 0.36$ are taken.

According to the above three constraints, the total cost function is determined by a linear combination, $M(A) = \sum_{i=1}^{3} \omega_i M_i(A)$, and the indoor soft decoration layout can be realized by solving this function [20].

4. Result Analysis

In order to test the three-dimensional simulation of indoor soft decoration by the three-dimensional simulation system of indoor soft decoration based on OpenGL and Direct3D, this system is used to simulate the three-dimensional simulation of indoor soft decoration of a residential model room in a community. The sample room includes two bedrooms, a kitchen, and a living room. The system in this paper is compared with the Untiy3D system and the Smart3D system.

The system is mainly operated with the mouse and keyboard. It edits the three systems with different functions and counts the function operations and time consumption of the three systems. The test results of the operation of the three systems are shown in Table 1. By comparing the operation results of the three systems in Table 1, it can be seen that the three systems can achieve the basic operation of the system. The average running time of editing operations in this system is 327 ms, while the average running times of editing operations in the Untiy3D system and the Smart3D system are 755 ms and 637 ms, respectively. According to the statistical results, this system runs faster for editing operations and has better operation performance.

Make statistics on the indoor soft decoration of each room in the 3D simulation sample room of the system and compare the system with the Untiy3D system and the Smart3D system. The statistical results are shown in Figure 3. It can be seen from the statistical results in Figure 3 that the time used for indoor soft decoration 3D simulation of the system in this paper for 4 rooms is significantly lower than that of the Untiy3D system and the Smart3D system, and the time used for simulation of 4 rooms does not exceed 8000 ms. It shows that the system in this paper can complete the soft decoration 3D simulation of the target room in a short time and verifies the 3D simulation performance of the system in this paper.

Select 200 home decoration designers and divide them into 10 groups, so that the 10 groups can use the three systems for interior soft decoration design. After the completion of the design, 200 home decoration designers were counted, and the satisfaction of the three systems was verified by questionnaire. The survey's contents include favorable impression, operation sensitivity, design convenience, design satisfaction, and soft-fitting effect. The scoring results of 10 groups on the three systems are shown in Tables 2–4.

According to the survey results in Tables 2–4, the favorability, operation sensitivity, design portability, design satisfaction, and soft decoration effect of the system in this paper are higher than those of the Untiy3D system and the Smart3D system. The average score of the system in this paper is about 95, while the average score of the Untiy3D system is lower than 89, and the average score of the Smart3D system is lower than 85, indicating that the indoor soft decoration 3D simulation effect of this system is good, the design is convenient, the operation is sensitive, and the user satisfaction is high.

Table 1: Comparison of system operation.

Function	Text system		Untiy3D system		Smart3D system	
	Function operation key	Operation time (ms)	Function operation key	Operation time (ms)	Function operation key	Operation time (ms)
Shift left	4	251	4	725	4	574
Shift right	6	275	6	765	6	562
Forward	8	316	8	718	8	581
Back off	2	328	2	811	2	628
Narrow	q	298	q	765	q	647
Enlarge	W	364	W	724	W	685
Rotate	e	385	e	764	e	617
Pick operand	r	374	r	728	r	721
Distance measurement	t	396	t	734	t	768
Direction discrimination	u	374	y	807	a	592
Object tracking	o	285	u	826	S	648
Object search	p	274	i	698	d	624

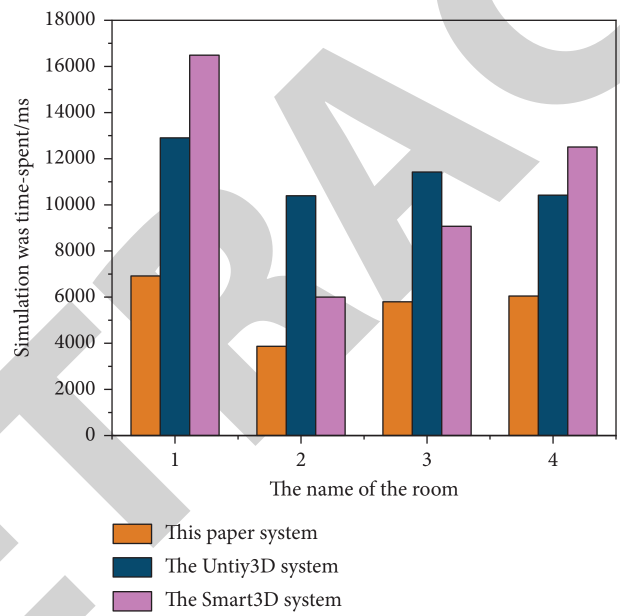

Figure 3: Time comparison among 3D simulation samples of three systems.

Table 2: Scoring results of the system.

Group number	Favorability	Operating sensitivity	Design convenience	Design satisfaction	Soft effect
1	95.85	95.74	94.85	95.27	94.28
2	96.85	94.28	95.27	94.38	93.58
3	93.54	96.85	96.37	96.38	96.58
4	94.71	95.47	95.74	92.68	95.37
5	96.27	93.28	93.27	93.58	94.57
6	95.17	93.47	94.85	94.69	95.69
7	94.85	95.74	96.37	95.74	94.37
8	95.68	94.85	94.28	94.68	92.58
9	96.74	95.27	93.68	96.28	96.57
10	93.87	96.04	94.58	95.47	94.58
Mean value	95.35	95.10	94.93	94.92	94.82

Table 3: Scoring results of Untiy3D system.

Group number	Favorability	Operating sensitivity	Design convenience	Design satisfaction	Soft effect
1	87.52	86.54	89.04	88.29	86.25
2	86.74	89.57	87.49	89.49	87.19
3	82.47	87.59	88.49	86.19	89.28
4	83.57	88.57	87.59	85.49	90.18
5	86.57	85.16	85.49	87.29	88.49
6	85.27	87.59	86.28	91.08	87.49
7	86.75	88.29	88.27	89.27	86.29
8	87.57	87.28	89.27	88.17	85.19
9	89.57	86.27	87.59	89.28	84.27
10	88.57	87.19	86.28	86.18	86.25
Mean value	86.46	87.41	87.58	88.07	87.09

Table 4: Scoring results of Smart3D system.

Group number	Favorability	Operating sensitivity	Design convenience	Design satisfaction	Soft effect
1	87.18	88.18	89.18	85.17	86.18
2	85.18	83.54	84.28	83.16	84.15
3	83.17	87.67	83.16	84.23	83.26
4	82.49	86.18	82.47	80.27	81.48
5	83.16	85.67	81.68	86.18	83.58
6	85.49	81.69	86.37	85.19	84.75
7	86.37	82.47	85.18	86.27	79.68
8	81.28	84.58	81.25	81.27	86.27
9	80.16	83.68	80.18	82.48	87.18
10	81.68	82.68	81.68	83.25	88.92
Mean value	83.62	84.63	83.54	83.75	84.54

5. Conclusion

In order to facilitate the interior designers in better designing the interior soft decoration and improve the authenticity and real-time performance of the 3D simulation effect of the interior soft decoration, this paper designs the 3D simulation system of the interior soft decoration based on OpenGL and Direct3D. The system combines OpenGL software with Direct3D software. Firstly, 3dMAX software is used to establish the indoor model, and then OpenGL software is used to add and constrain the indoor scene elements to enrich the indoor model. Finally, this paper carries out the final layout and rendering of furniture through Direct3D software to realize an effective three-dimensional simulation of indoor soft decoration and provide a reliable analysis basis for indoor design.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest.

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