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Retraction

Retracted: Research on Interior Design and Space Layout Optimization Based on Multi-Intelligent Decision-Making

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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) Manipulated or compromised peer review

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.

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[1] J. Dong and M. Ran, "Research on Interior Design and Space Layout Optimization Based on Multi-Intelligent Decision-Making," *Journal of Sensors*, vol. 2022, Article ID 7158921, 10 pages, 2022.

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Research Article

Research on Interior Design and Space Layout Optimization Based on Multi-Intelligent Decision-Making

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In order to meet people's diverse, complex, and changeable living requirements and aesthetic requirements, it is necessary to rationalize the design of indoor three-dimensional space. The optimization of the indoor environmental space layout is affected by the energy consumption and rationality of functional areas, resulting in indoor environmental space The performance of the layout optimization system deteriorates. In order to improve the performance of the indoor environment spatial layout and meet the living needs of more people, this paper proposes an optimal design of a spatial layout based on multi-intelligence decision-making. The research results of the article show that (1) the average confidence and the average recognition time of logo set B are both smaller than those of logo set A, indicating that logo set B is easier to be recognized by users in the same commercial building environment and can be more quickly recognized. In terms of discrimination, the time used to correct the misrecognition of identification set B is shorter than that of identification set A, which means that the different types of identifications in identification set B are easier to distinguish. (2) The spatial positioning algorithm proposed in this paper has good reliability and practicability, high positioning accuracy, and small error for indoor spatial coordinate positioning. Compared with the traditional method, the projection method of this paper has a significantly smaller error, and the maximum error is only 0.272, which makes the indoor space design more rational. (3) Comparing the energy consumption coefficients of the three spatial layout optimization systems, it can be seen that the indoor environmental spatial layout optimization system based on multi-intelligence decision-making has the lowest energy consumption when optimizing the indoor environmental spatial layout, because the system is in the design process. The indoor environment space layout model is designed, which effectively reduces the energy consumption of the indoor environment space layout optimization. When the indoor environment space layout optimization system based on multi-intelligence decision-making is used to optimize the indoor environment space layout, the average optimization accuracy is 98.32%, while the average indoor environment space layout optimization accuracy of the space layout optimization system with curved shading space layout optimization is 42.2% %, the layout optimization of binocular stereo vision space. When optimizing the indoor space layout, the average optimization accuracy is 70.87%.

1. Introduction

The optimal design of indoor environmental space layout refers to the corresponding arrangement of environmental space and home equipment in a given indoor environmental space, so that the indoor items can not only meet people's use functions but also meet people's aesthetic requirements and improve the efficiency of using the indoor environment space. In this paper, an improved point source perturbation method for the optimization of indoor environment spatial layout is designed, which realizes the collimation of the light emitted by the refractive power of a single free surface [1]. The article introduces an optimization tool and optimization algorithm for integrating CAD software in order to

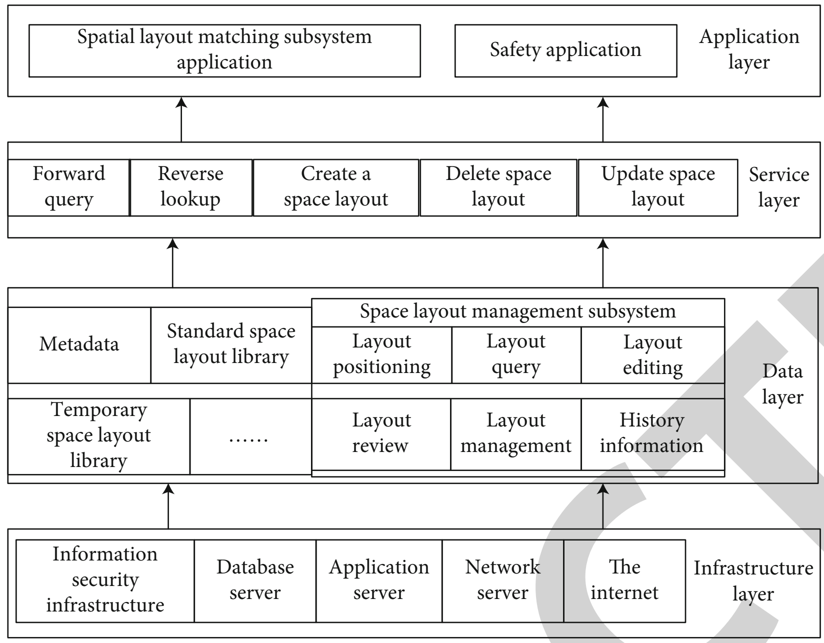


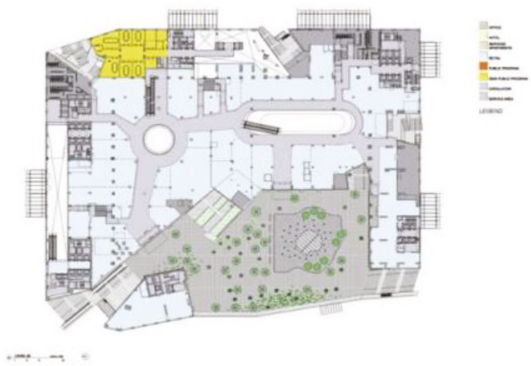
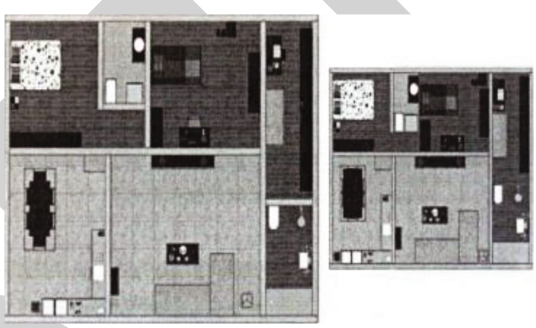
Figure 1: Spatial layout management and matching system.

automatically find the 3D layout of satellite equipment [2]. This article briefly introduces the RV and studies the layout optimization of the interior space of the RV from four aspects [3]. This article analyzes several typical small high-rise apartments in Shenzhen and discusses the optimization of small apartment space from the aspects of overall layout, model design, space utilization, etc. [4]. The article proposes an algorithm for optimal grip planning and fixture synthesis [5]. This paper proposes an optimization method to estimate the 3D indoor Manhattan scene layout from a single input image, and the algorithm can be applied to real images of multiple indoor scenes [6]. The article introduces a virtual environment for the vehicle interior layout design in order to design new defensive and security vehicles [7]. This paper introduces the development status, existing problems, and solutions of spatial layout technology in my country [8]. This paper focuses on the analysis and research on the optimal design of the interior space of the RV from the four aspects of the interior space layout, ergonomics, vehicle balance, and lightweight [9]. The article discusses the specific application of the furniture design in the interior space and the specific application of the furniture design in the interior space [10]. Based on the analysis of the limitations of traditional design methods, this paper designs an improved indoor environment spatial layout optimization method [11]. The article describes the gradual decline of the average area of residential commercial housing in my country, illustrating the importance of the layout optimization design [12]. This paper introduces the layout design principles of equipment with better application effect, which provides a friendly human-machine interface and a comfortable environment for radar operators [13]. This paper builds a virtual human body model of a passenger car driver; checks the layout for comfort, field of view, and interior space; and then optimizes design flaws [14]. This paper summarizes the principles of polite design and puts forward the key points of bus optimization design according to the needs of passengers [15].

2. Multi-Intelligent Decision-Making Interior Design and Space Layout

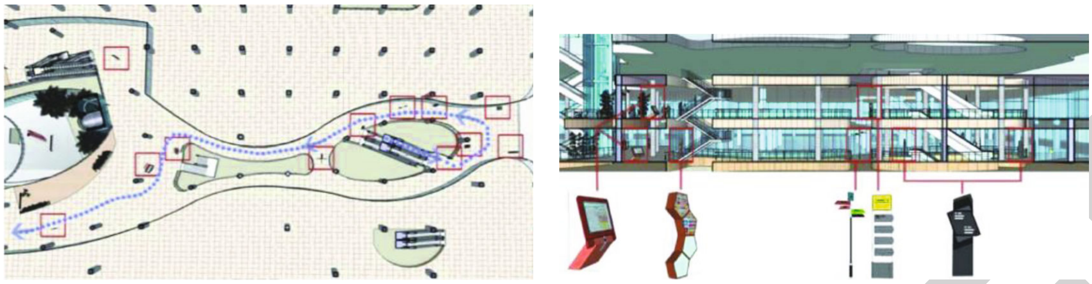
2.1. Basics of Indoor Space Layout. The indoor scene corresponds to the outdoor scene, and it is an important place for people to produce and live. In addition to realizing its basic production and life functions, indoor scenes also need to meet people's spiritual pursuits. Thus, the interior design was born as a professional discipline. The key to interior design is to use the principles of architectural design to endow the interior environment with specific functions according to the nature, environment, and standards of the interior space [16]. Indoor scenes are usually presented in the form of a certain layout. The layout is also the most distinctive feature of indoor scenes, and it is the attribute that best reflects the characteristics of indoor scenes. Therefore, indoor space layout has also become a key link in interior design. With the rapid development of 3D technology, 3D models of indoor scenes are gradually applied to more and more fields, such as CG animation movies, 3D game scenes, and virtual reality environments [17]. These applications often contain interactive indoor scenes that players can enter and explore. The urgent need for indoor scene modeling has directly spawned related research on indoor space layout. Although there are many research works on indoor space layout in academia, few mature research schemes are applied to practical applications.

Table 1: Typical shopping malls and floor plans.

Name	Flat	Interior photo
Shopping mall one		
Shopping mall two		
Shopping mall three		

2.2. Basic Data Module of Indoor Environment Layout. The basic data module of the indoor environment space layout includes the indoor environment space matching system, space layout information portal, space layout metadata service system, and space layout optimization management system. The basic data of the indoor environment space layout is extracted from the above subsystems. The spatial layout matching system is shown in Figure 1.

2.3. Research Significance of Spatial Layout. The automatic design and optimization of indoor space layout has important research significance [18]. On the one hand, due to the important application background of the indoor space layout in many fields, on the other hand, the traditional layout design relies heavily on labor and is inefficient. The existing layout design methods are simple and immature, with unsatisfactory effects and artificial A series of problems such as complex interaction. The automatic design and optimization of interior space layout can greatly reduce the workload of designers and even serve users directly. In the process of space design, simulation follows the designer's design thinking and realizes automatic design, which greatly



(a) Marking distribution plan (b) Sectional drawing of marking location

Figure 2: Schematic diagram of local space identification location.

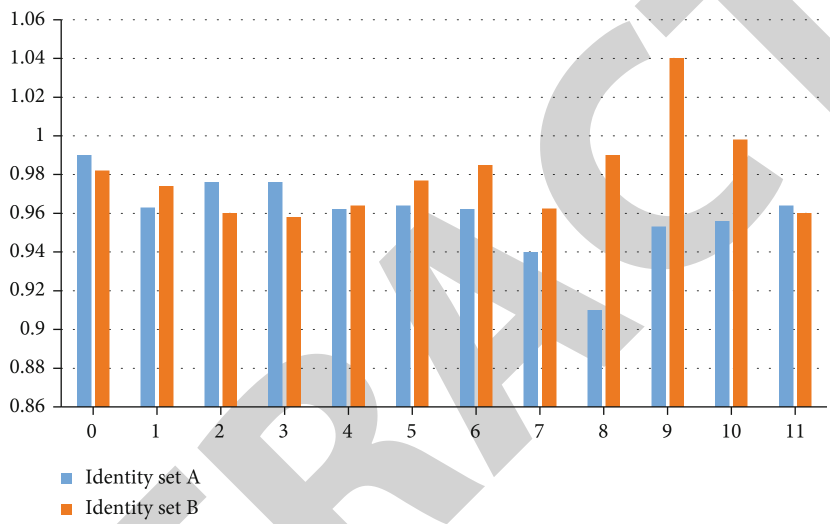


Figure 3: Mean confidence of the two sets of set identifiers.

reduces the designer's workload and improves the efficiency and workload of layout design. The biggest disadvantage of manual layout is that it will be limited by the professional ability and knowledge level of the designer, and the use of computer assistance will often achieve better results than manual design.

3. Interior Design and Space Layout Optimization Research

3.1. Establish the Indoor Environment Spatial Layout Model. The entrance position of the indoor environment space is normalized to obtain the normalized entrance door coordinate (E_x, E_y) of the indoor environment space, the indoor width is W, and the indoor length is L; then, the normalized entrance door coordinate is

$$E_x = \frac{E_{x_0}}{W}, \tag{1}$$

$$E_y = \frac{E_{y_0}}{L}. \tag{2}$$

Table 2: Matrix experimental data.

Spatial location	α_{00}	α_{01}	α_{10}	α_{11}
P1	0.55259	0.46108	-0.68205	0.33671
P2	0.52257	0.48667	-0.66375	0.33970
P3	0.53231	0.48636	-0.66795	0.34525
P4	0.52823	0.46011	-0.69036	0.36952
P	0.53656	0.46935	-0.68923	0.33600

Table 3: The projection error of the marked point picked by the space model.

Projection error	First picture	Second picture	The third
Maximum error	2.21	1.86	1.44
Average error	1.03	0.73	0.76
Standard deviation	0.25	0.52	0.21

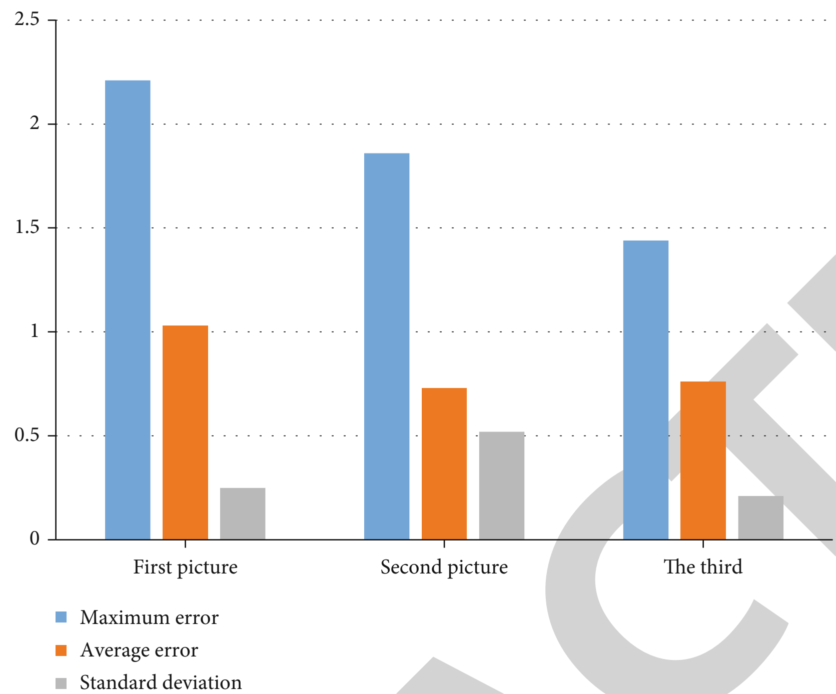


FIGURE 4: Projection error statistics.

The two-dimensional covariance matrix of the indoor environment [19]:

$$C_{2\times 2} = \begin{bmatrix} \mathrm{cov}\,(x, x) & \mathrm{cov}\,(x, y) \\ \mathrm{cov}\,(y, x) & \mathrm{cov}\,(y, y) \end{bmatrix}, \tag{3}$$

$$\mathrm{cov}\,(x, y) = \mathrm{cov}\,(y, x). \tag{4}$$

The geometric feature F of the indoor environment space is [20]

$$F = \left(E_x, E_y, S, R, C\right). \tag{5}$$

Among them, S is the area of the indoor environment space, the ratio of the length to the width of the indoor environment space is R, and the extension of the indoor environment space is C.

The location coordinates of the indoor environment space are

$$x_p = \frac{x}{W}, \tag{6}$$

$$y_p = \frac{y}{L}. \tag{7}$$

Among them, x represents the coordinate value of the position point of the indoor functional area on the x-axis of the indoor environment space layout coordinate system, and y represents the coordinate value of the indoor functional area location point on the y-axis of the indoor environment space layout coordinate system.

TABLE 4: Experimental results of spatial positioning.

Spatial location	Move1	Move2	Move3
P1	X: 21.1246 Y: 61.0321	X: 19.5467 Y: 60.5479	X: 20.8795 Y: 61.35668
P2	X: 80.9624 Y: 98.9722	X: 78.3256 Y: 012356	X: 81.2236 Y: 00.5625
P3	X: 198.9726 Y: 11.3709	X: 11.3546 Y: 209.2153	X: -112.0566 Y: 210.3705
P4	X: -152.0766 Y: 161.7352	X: -149.0324 Y: 158.7886	X: -151.4567 Y: 159.2356

TABLE 5: Automatic extraction of projection errors from spatial models.

Projection error	First picture	Second picture	The third
Maximum error	0.131	0.272	0.084
Average error	0.031	0.035	0.029
Standard deviation	0.026	0.028	0.012

Orientation attribute of indoor environment space:

$$\theta_p = \theta \cdot \frac{2}{\pi} + 1. \tag{8}$$

Indoor environment spatial scale [21]:

$$l_p = \frac{l_y}{L}, \tag{9}$$

$$w_p = \frac{l_x}{W}. \tag{10}$$

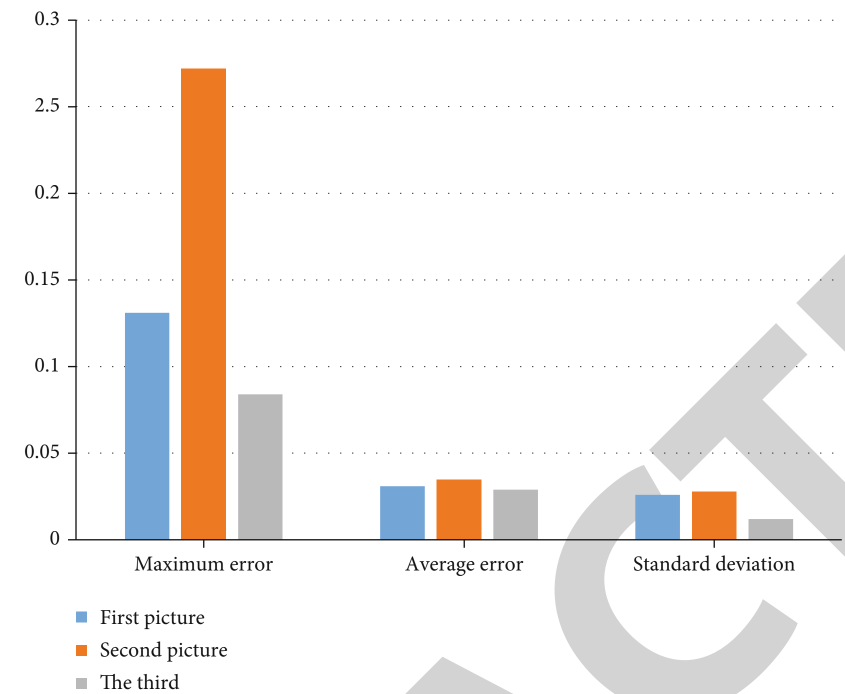


Figure 5: Projection error statistics.

Get the layout properties of the indoor functional area in the indoor environment space:

$$\pi(G) = \left(x_p, y_p, \theta_p, l_p, w_p\right). \tag{11}$$

Energy consumed in indoor environmental space:

$$E = a_1 E_1 + a_2 E_2 + a_3 E_3 + a_4 E_4. \tag{12}$$

Build an indoor environment space layout model:

$$M = \min E(\pi(G), F). \tag{13}$$

Calculate the fitness of a single indoor environment spatial layout:

$$\text{fitness}(i) = \frac{D}{f(R_i)}. \tag{14}$$

The probability that the spatial layout is selected is

$$p_i = \text{fitness}(i) \sum_{i=1} \text{fitness}(i). \tag{15}$$

The cumulative probability of indoor environment spatial layout is

$$Q_i = \sum_{j=1} p_i. \tag{16}$$

Table 6: Test results of energy consumption coefficient.

Time/min	Multi-intelligent decision-making optimization of indoor environment space layout	Surface shading space layout optimization	Binocular stereo vision spatial layout optimization
2	0.8	4.2	2.8
4	1.7	2.8	4
6	1.2	4.2	2.83
8	1.4	3.3	3.1
10	0.4	5.3	1.9
12	1.2	4	3.2
14	0.8	4.2	2.8

The crossover probability for the indoor environment layout is [22]

$$P_0 = \frac{g}{2d} + \frac{f_i \bar{f}}{2\left(f_{\max} \bar{f}\right)}. \tag{17}$$

3.2. Optimizing the Multilevel Layout of Spatial Features. The multilevel simulation model of spatial characteristics is used as the population, the population is initialized, and the fitness of different individuals in the entire population is calculated [23]:

$$f(i) = \frac{k}{f(U_i)}. \tag{18}$$

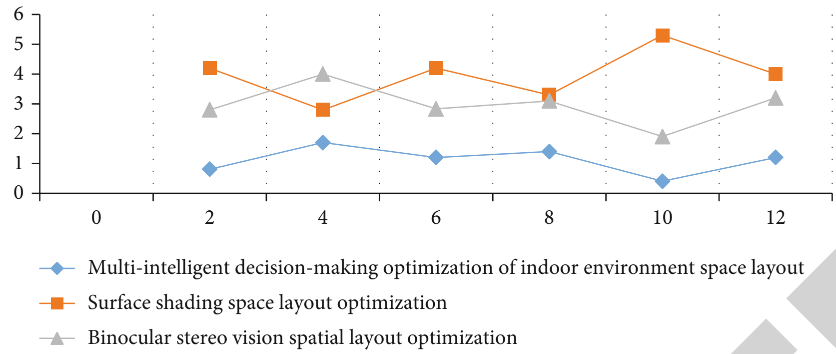


Figure 6: Test results of energy consumption coefficient.

The probability of an individual being selected in the population fitness [24]:

$$V_i = f(i)\sum_{i=1} f(i). \tag{19}$$

Cumulative probability of individuals in population fitness:

$$R_i = \sum_{j=1} V_i. \tag{20}$$

Crossover probability:

$$V_c = \frac{n}{2N} + \frac{f_i f}{2(f_{\max} f)}. \tag{21}$$

4. Simulation Experiments

4.1. Virtual Simulation. The experiment takes the optimization design of the indoor signage system of a commercial building in a shopping mall as an example and studies the design method of commercial building interaction. The purpose of the experiment is to find out the important factors that affect the user's choice of commercial space. The article conducts optimization research on commercial space signs, so as to improve the space awareness. The experiment summarizes and analyzes the indoor layout optimization of several well-known shopping malls in my country and draws on the logo design elements that are widely used and obtains the following plane models, as shown in Table 1.

After summarizing and analyzing the interior designs of the three shopping malls, two sets of different independent styles are obtained and models are established, denoted as set A and set B, and each set includes several signs of the same type. Logo set A is mainly gray in color, with 1 or 2 decorative colors, and the shape is dominated by a single rectangle; set B is mainly bright in color, with a variety of decorative colors and shapes. The above are mainly geometric or special shaped. In the experiment, two sets of sign sets were placed in the indoor space of the commercial street in the same distribution and arrangement, and the virtual space as shown in Figure 2 was obtained. Finally, the multi-intelligence decision-making technology is used, roaming in SA and SB with the same route and speed from the user's perspective, and the video data of the roaming field of view in different identification sets for subsequent analysis was obtained.

Table 7: Accuracy test results of indoor environment spatial layout optimization.

Testing frequency	Multi-intelligent decision-making optimization of indoor environment space layout	Surface shading space layout optimization	Binocular stereo vision spatial layout optimization
1	97.2	32.6	64.2
2	98.5	48.7	68.9
3	97.9	39.5	64.8
4	99.2	49.7	72.1
5	98.4	38.9	76.4
6	99.6	37.4	68.6
7	97.1	47.6	72.9
8	98.3	42.8	73.1
9	99.6	45.1	75.8
10	97.4	39.7	71.9

In terms of the significance of the logo, the confidence score is mainly used as the evaluation standard, which represents the confidence level of the detection model for the currently recognized logo, and corresponds to whether the user "sees clearly" the logo. When the marker is farther from the user, the confidence score is usually lower, and the opposite is true when the distance is closer. Therefore, the confidence score can express the distinctive feature of the logo, that is, whether the logo is easy to identify, easy to find, and so on. In terms of significance, the two sets of schemes have an average time of 0.68 s for all-category recognition of set A and an average of 0.46 s for all-category recognition of set B. It takes 0.11 s to correct the misidentification of all categories of set B. The average confidence level of different identification categories of each set of identification sets is shown in Figure 3.

According to the experimental results in Figure 3, we can conclude that the average of the confidence level and the

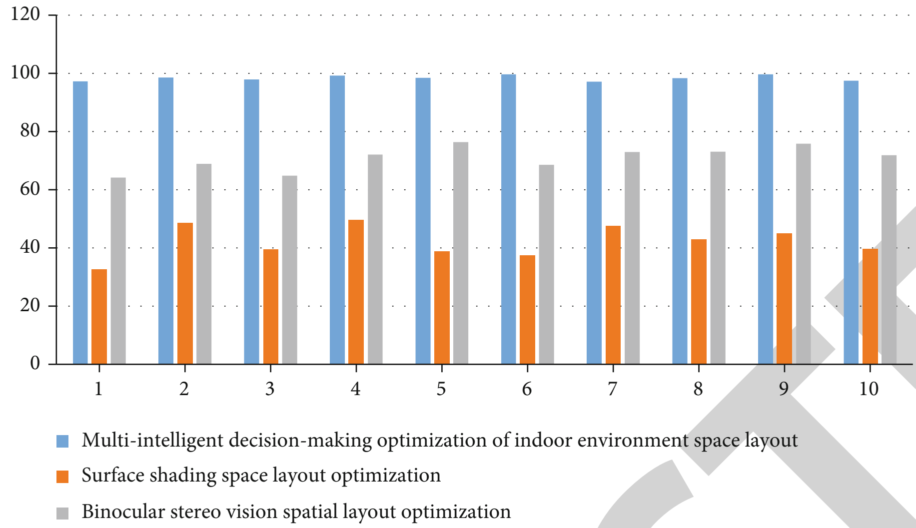


Figure 7: Indoor environment spatial layout optimization accuracy test.

average recognition time of logo set B are both smaller than those of logo set A, indicating that logo set B is easier to be recognized by users in the same commercial building environment. Relevant information can be transmitted more quickly; in terms of discrimination, the time used to correct the misrecognition of set B is shorter than that of set A, indicating that it is easier to distinguish between different types of identities in set B. The color, shape, and expression of the signboard have a great impact on the user's ease of identification and distinction. The B-type identification system in the commercial space is more likely to be noticed and accepted by users than the A-type identification system, indicating that the B-type identification system's morphological expression has higher visual perception. Therefore, the use of eye-catching colors and the use of various colors can effectively improve the ease of identification. The form design of the logo system should break the currently commonly used design methods of focusing on conventional shapes and a set of logos of a single form. The special-shaped combination can effectively improve the distinguishability, and the combination of pictures and text in the identification system is more effective than the simple text expression.

4.2. Analysis of Experimental Results. In the indoor space calibration experiment, the object is placed at any position in the space, the elements of the matrix are calculated, and the average value is obtained. The starting position data is shown in Table 2. According to the experimental data, we can conclude that the matrix elements have good stability.

The experiment selected three photos taken by a digital camera, in which the foreground of the small space was white and the background was black, and marked points were made on the space points. Manually picking the marked points in the space, because the positioning of the mouse picking space is not accurate enough, the solution of the photographic depth value is not accurate enough, and this method has a large error in the space design. The projection errors of the marked points are shown in Table 3 and Figure 4.

Using the article, the indoor space calibration method based on intelligent decision-making algorithm is proposed. Table 4 shows the X and Y coordinates of the actuator moving to different positions in space. The experimental results show that the spatial positioning algorithm proposed in this paper has good reliability and practicability and has high positioning accuracy. It is used for indoor spatial coordinate positioning error is small.

Using the projection error of the algorithm in the article as shown in Table 5 and Figure 5, according to the experimental results, we can conclude that the projection method of the method in this paper has a significantly lower error than the traditional method, and the maximum error is only 0.272, which makes the indoor space design more rational.

4.3. Test Analysis. In order to verify the performance of indoor environment spatial layout optimization based on multi-intelligence decision-making, the experiment introduces the energy consumption coefficient H of indoor environmental spatial layout optimization. The larger the value of energy consumption coefficient H, the higher the energy consumption of indoor environmental spatial layout optimization. The energy consumption coefficient H is used to test the indoor environment layout optimization system of the article and the optimization of the surface shading space layout and the optimization of the binocular stereo vision space layout. The test results are shown in Table 6.

It can be seen from the test results in Figure 6 that during the test process of the indoor environment spatial layout optimization system based on multi-intelligence decision-making, the energy consumption coefficient of indoor environmental spatial layout optimization is always less than 2 with the change of time, indicating that the system optimizes indoor environment The energy consumption of environmental space layout is low; while the space layout optimization system of curved shading shows that when the test time reaches 10 minutes, the energy consumption coefficient of indoor environmental space layout optimization is as high as 5.5, indicating that the energy consumption of indoor environmental space layout optimization is the highest at this time. The spatial layout optimization system of stereo vision shows that with the change of test time, the energy consumption coefficient of indoor environment spatial layout optimization fluctuates between 2 and 4, indicating that the energy consumption coefficient of the system is high. Comparing the energy consumption coefficients of the three space layout optimization systems, it can be seen that the indoor environment space layout optimization system based on multi-intelligence decision-making has the lowest energy consumption when optimizing the indoor environment space layout, because the system designed the indoor environment in the design process. The environmental space layout model effectively reduces the energy consumption of indoor environmental space layout optimization.

On the basis of testing the energy consumption coefficient of indoor environment space layout optimization, the indoor environment space layout optimization system based on multi-intelligence decision-making, the curved shading space layout optimization system, and the binocular stereo vision space layout optimization system are used to test three systems. The optimal precision of the indoor environment spatial layout. The experimental results are shown in Table 7.

From the test results in Table 7 and Figure 7, it can be seen that when the indoor environment space layout optimization system based on multi-intelligence decision-making is used to optimize the indoor environment space layout, the average optimization accuracy is 98.32%. The average accuracy of environmental space layout optimization is 42.2%, and when optimizing the layout of binocular stereo vision space, the average optimization accuracy is 70.87%. By comparing the optimization accuracy of the three indoor environment space layout optimization systems, it can be seen that the optimization accuracy of the indoor environment space layout optimization system based on multi-intelligence decision-making is the highest. The steps of layout optimization are simpler, which effectively improves the optimization accuracy of the indoor environment space layout.

5. Conclusion

In order to meet people's diverse living needs and aesthetic needs, it is necessary to rationalize the design of interior space and to propose an intelligent and funny interior space design algorithm [25]. The rational design method of indoor space based on multi-intelligence decision-making proposed in this paper is to calibrate the indoor space, estimate the 3D visual space based on the calibration results, and reconstruct the visual space through the calibration results and estimation results, so as to realize the 3D reconstruction of the space. The indoor environment space layout optimization system design proposed in this paper on the basis of multi-intelligence decision-making technology realizes the optimization of the indoor environment space layout through the hardware design and software design of the indoor environment space layout optimization system. The test results show that the system has high performance in terms of energy consumption and optimization accuracy. In the future research, it is necessary to further analyze the hierarchical structure of the indoor environment space layout to improve the rationality of the optimization of the indoor environment space layout.

Data Availability

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

Conflicts of Interest

The authors declared that they have no conflicts of interest regarding this work.

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