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Computer-Aided Design AND APPLICATIONS

Human-Computer Interaction in Interior Design Process Based on Reinforcement Learning

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Abstract. As an important component of social construction, the field of interior design has become closely related to people's production and living environment. This article also uses computer-aided CAD technology and reinforcement learning algorithms to study the construction of interactive environments in the interior design process, as well as the application and design of human-computer interaction. Firstly, the advantages of CAD technology in architectural interior design were analyzed, and the problems in the current intelligent interior design process were briefly described. Create a good CAD development platform that enables a friendly human-computer interaction mode in the interior design process and improves traditional spatial layout according to the actual needs of interior decoration. Using CAD technology to adjust layout design images, optimize design effects, and create a virtual interactive experience space and platform for users. Finally, with the help of a CAD interior design system, a reinforcement learning algorithm is added to enhance the human-computer interaction function of interior design software by utilizing the basic principles of reinforcement learning algorithm and Markov decision formula. In the interior design effect, intelligent navigation and positioning systems are added to provide users with more intelligent services. The research results indicate that the human-computer interaction function in the interior design process, with the help of CAD and reinforcement learning algorithms, is more suitable for the needs of different groups of people. Not only does it improve the efficiency and quality of the interior design process, but it also provides the public with a more intelligent indoor living experience.

Keywords: Interior Design; CAD System; Human-Computer Interaction; Reinforcement Learning Algorithm; Intelligentization
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1 INTRODUCTION

Under the conditions of diversified social development, people's aesthetic and intelligence needs have become more diverse, and everyone's aesthetic standards are different. Their views on the needs of interior design are also not consistent [1]. Some traditional interior designs are becoming increasingly unpopular and unrecognized by people, leading to the emergence of many new designs. Technological progress has brought us into a new era of informatization and digitization, where computer technology and artificial intelligence are widely applied in various aspects of production and life [2]. As an emerging industry, modern interior design has made more attempts in terms of design methods, design processes, and expression methods. The modern interior design process introduces a large number of technological elements, which conflicts significantly with traditional residential design methods in the past. Therefore, how to adapt to the needs of the times and grasp the modern and intelligent performance of interior design is an important direction of research in this field. The traditional interior design process is complex and the expression techniques are single, which creates aesthetic and spatial conflicts between designers' and clients' needs and concepts. For non-professional clients, the inability to intuitively express their preferences for design requirements is a key obstacle, which also makes it difficult for the overall interior design scheme to achieve the desired effect [3]. With the improvement of network technology and computer processing software capabilities, the integration of design and computer networks has been promoted, and computer-aided software CAD technology has emerged. CAD computer-aided functions can achieve a perfect combination of art design and technology, not only meeting the adjustment needs of designers for 3D space models but also enabling designers and users to communicate more easily through interactive methods [4]. Different from the traditional manual drawing method in interior design, CAD computer-aided design software includes various functions such as 2D drawing, 3D drawing, and image processing. Designers can incorporate their innovative design concepts when using software to complete indoor space layout planning and indoor effect rendering. Enhance abstract design style through drawing software, combined with 3D modelling scene rendering and other methods, to form a complete interior design work. At the same time, the traditional interior design process is very time-consuming and labour-intensive, and now using computer-aided drawing software can greatly enhance the practicality and flexibility of the design process. Allowing designers to express their design concepts more intuitively, clearly, and in a three-dimensional manner, showcasing their design works, while also providing designers with more imagination and operational space [5].

In the early stages of interior design, CAD tools were widely used to create 3D models of buildings, simulating spatial layout, lighting, ventilation, and other conditions. Some scholars use CAD models as the physical basis for reinforcement learning environments, simulating indoor environmental changes under different HVAC settings, including temperature distribution, air flow, etc., to provide rich training data for reinforcement learning algorithms. By integrating CAD with reinforcement learning techniques, we can build a more intelligent design environment that allows designers to consider energy efficiency and thermal comfort requirements for future building operations during the design process. Embedding reinforcement learning modules in the CAD design interface allows designers to provide real-time feedback on the expected thermal comfort and energy consumption under the design scheme when adjusting it [6]. For example, the deep comfort framework can be further extended to automatically adjust the operating parameters of the HVAC system based on the thermal preferences and daily activity patterns of different residents, achieving a more personalized comfort experience. However, traditional CAD systems often focus on static design and lack real-time response capabilities to dynamic environmental changes (such as temperature and humidity changes) and resident behaviour patterns. By combining the behaviour patterns and preference data of residents, personalized thermal comfort control strategies are learned through reinforcement learning algorithms [7]. With the accumulation of actual operational data in construction, the integrated system of CAD and reinforcement learning can continuously learn and optimize control strategies. This real-time feedback mechanism helps designers identify and optimize potential issues in the early stages of design, reducing the cost of later adjustments. In this way, the algorithm can learn how to adjust the HVAC system to achieve the optimal balance of thermal comfort and energy efficiency under different building layouts and climate conditions. Through continuous iterative training, the system can gradually adapt to changes in the building environment and changes in the needs of residents, maintaining long-term energy efficiency and thermal comfort optimization effects [8].

Based on the 3D model constructed using CAD software and combined with DHM, designers can conduct ergonomic testing in a virtual environment. Based on this real-time feedback, designers can quickly identify and address potential design issues such as space congestion, obstructed vision, and inconvenient passage. In the CAD design interface, designers can provide customized design suggestions to users based on these predicted results [9]. By integrating CAD with reinforcement learning systems, designers can instantly obtain quantitative evaluation results on ergonomic comfort during the design process. Reinforcement learning algorithms can automatically adjust testing parameters, such as furniture layout, light distribution, temperature settings, etc., based on user behaviour patterns and comfort feedback to simulate user experiences in different scenarios. These results not only include static spatial size analysis but also involve dynamic human motion simulation and comfort prediction [10]. By combining user preference data and reinforcement learning algorithms, the system can learn and predict the personalized needs of different users for indoor environments. Adjusting colour matching, material selection, lighting schemes, etc. to enhance overall user satisfaction and comfort. The proposed framework constructs a closed-loop feedback loop that tightly connects CAD models, DHM evaluation, reinforcement learning optimization, and user feedback. In this loop, each design adjustment triggers a new round of evaluation and optimization processes until the optimal design solution that meets user satisfaction and ergonomic requirements is achieved [11].

Due to the pursuit of intelligence and interactive functionality in the interior design process, in addition to utilizing CAD computer-aided technology, powerful machine-learning techniques are also needed to meet the needs of modern design processes. Reinforcement learning algorithms, which have good exploration and autonomous learning capabilities, have been applied in many fields, such as machine control, urban transportation, game confrontation, etc., based on deep learning. This general artificial intelligence can build simulated real environments, allowing interior design systems to perceive data from the simulated environment. Relying on the behaviours generated by users in different environments, a relatively simple reinforcement learning training is constructed to meet the intelligence and generalization requirements in different complex spaces. Applying reinforcement learning algorithms to human-computer interaction design in intelligent design processes can not only achieve navigation and tracking of spatial layout but also provide users with an intelligent interactive experience. Therefore, this article focuses on using CAD and reinforcement learning algorithms to explore the application of human-computer interaction functions in the interior design process.

2 DEVELOPMENT STATUS

In the 1950s, the interior design industry abroad started earlier and flourished. Interior design has also become a highly influential independent industry. In 1991, China summarized years of design experience through a practical reference book, filling the theoretical gap in the Chinese interior design market. Subsequently, Liu et al. [12] conducted extensive research on the development history, schools, and future trends of interior design. Nowadays, with the gradual maturity of architectural design concepts, interior design thinking and genres are becoming increasingly stable. In modern life, people's attention to the practicality of interior design has shifted towards functionality and intelligence, and they are beginning to turn towards personalized interior space needs. Meanwhile, due to the dynamic development of society and the concept of sustainable development, the interior design direction of different residential buildings is also shifting towards more systematic, convenient, and efficient aspects. In this situation, the process of human-computer interaction in interior design is increasingly demanded by designers and the market. Máder et al. [13] used CAD software as the main tool for design expression in their experiments to construct three-dimensional models of indoor spaces and allow users to make intuitive modifications and customizations. A comprehensive data-driven framework has been introduced, which is not limited to traditional data analysis and visualization but closely integrates the precise modelling capability of CAD with the intelligent optimization mechanism of reinforcement learning. Through this framework, Nicoletti et al. [14] designed and implemented an interactive evolutionary computation (IEC) design experiment that focused on simplified interior design tasks, and successfully recruited 230 participants for testing. We conducted in-depth data analysis and visualization using the data collected during the experiment. The system can capture users' implicit preferences, such as style, colour, materials, etc., and provide personalized suggestions in the subsequent design process. K-means clustering and other methods help us identify different categories and patterns in the design process, providing strong support for understanding the complexity and diversity of the design process. In addition, a content-based recommendation system was trained using experimental data. This feature not only enhances the intelligence level of the IEC system but also makes the design process more efficient and user-friendly. Meanwhile, reinforcement learning algorithms are integrated into the design process, automatically learning user preferences and design habits by analyzing user interaction data with CAD interfaces (such as clicks, drag and drop, selections, etc.). By analyzing the overall colour range, users' colour preferences and trends during the design process can be revealed. This experiment not only collected a large amount of data on user behaviour, design choices, and final design results but also provided us with a valuable platform for validating and optimizing design theories. This integration mechanism enables the system to adjust design parameters in real-time and propose design solutions that better meet user expectations, thereby achieving a transition from "user-guided design" to "user-adapted design."

The global construction industry is a major contributor to energy consumption and carbon emissions, accounting for 30% of the total, posing serious challenges to global energy security and environmental sustainability. In the process of addressing these challenges, the rapid development of Internet of Things (IoT) technology, artificial intelligence (AI), and computing power has brought new opportunities for SBEM. DRL can not only effectively handle uncertain and dynamically changing environments but also find the optimal balance between exploration and utilization, achieving long-term energy optimization. Wolf et al. [16] developed efficient and intelligent Building Energy Management (SBEM) technology. Promoting the development of energy-efficient and green buildings has become an urgent and important task. However, achieving this goal faces multiple challenges, including complex and variable thermodynamic model construction, uncertain system parameters, operational constraints of spatiotemporal coupling, difficulties in handling large solution spaces, and low generality of traditional methods. The integration of reinforcement learning and CAD has opened up new avenues for achieving a more intelligent and personalized design experience. It is worth noting that as we shift our attention to the interior design process, the importance of human-computer interaction becomes increasingly prominent. Especially deep reinforcement learning (DRL), as a powerful artificial intelligence technology, has shown great potential in solving SBEM problems, with complex decision-making and adaptive optimization capabilities. CAD (Computer Aided Design), as the core tool of interior design, provides a precise and intuitive design platform. Specifically, DRL can be based on user behaviour habits, preference data, and environmental parameters. Yang [17] integrated DRL into CAD systems, allowing the design process not only to be created unilaterally by designers but also to become an interactive process where designers and algorithms collaborate. Meanwhile, CAD systems can also provide rich visual and physical data for DRL, serving as the training and validation foundation for optimization algorithms. Real-time adjustment of design parameters in CAD models, such as layout, lighting, ventilation, etc., to optimize the comfort, energy efficiency, and aesthetics of indoor environments. This integration method not only improves the scientificity and accuracy of the design but also enhances user engagement and satisfaction.

The fields involved in human-computer interaction include artificial intelligence, natural language processing, and pattern recognition, as well as more research achievements in industrial design and computer engineering. It is no longer limited to simple input and output but appears in spatial layout in a more advanced and natural way of interaction. The movement of the human body, the vibration of sound waves in the air, changes in facial expressions, and the psychological fluctuations of users can all complete the information transmission between humans and computer systems. In this case, CAD, also known as computer-aided design, provides excellent interactive support for designers to carry out architectural design work through computer systems and image recognition models. This software combines two-dimensional and three-dimensional technologies to form new image-drawing functions, enabling data interaction between humans and computers. The United States developed and applied CAD computer-aided technology earlier, discovering that the powerful graphic editing capabilities of CAD technology can support interoperability between different hardware and devices. Complex architectural design systems can be displayed in three-dimensional space through computers, and drawings can be edited and modified in software, reducing drawing time and improving design efficiency. In addition, Germany has applied CAD technology to the automotive industry, utilizing CAD modelling capabilities to reconstruct the internal spatial planning of cars. Make the functional configuration of the car more in line with people's needs for smart cars, and increase the comfort experience with the support of technology. Due to the significant differences between the real environment and the design scheme in the interior design process, Yu et al. [18] used reinforcement learning algorithms to adjust data decisions, thereby improving the integration degree between environments and providing reliable technical support for real space and virtual interaction. The core of reinforcement learning algorithms is to study the interaction between intelligent agents and the environment, which also plays an important supporting role in achieving human-machine interaction functions in the interior design process. Reinforcement learning algorithms make corresponding decisions and receive rewards by continuously learning the optimal strategy. In the process of reinforcement learning, agents need to explore the relationships between different objects to obtain the optimal path, take random actions, and complete data training. After more than 60 years of development, reinforcement learning algorithms have become the most popular research and application direction in the field of machine learning. At the same time, the introduction of deep learning technology in 2006 led to the completion of the second update of machine learning. In the increasingly heated environment of academia and business, the numerous classifications of reinforcement learning algorithms have also achieved good application results in different fields.

3 RESEARCH ON INTERIOR DESIGN PROCESSES AND HUMAN-COMPUTER INTERACTION APPLICATION

3.1 Research on Interactive Application of Interior Design Process Based on CAD Computer-Aided Technology

In recent years, due to the intervention of computer technology and digital technology, the final presentation results of interior design have also tended towards diversification and intelligence. Computer-aided software, which is widely used in the field of interior design, currently includes 2D drawing software, 3D drawing software, image processing software, etc. When using various software functions, designers must integrate their interior design creativity, enhance design details through software, and complete scene construction. In the traditional interior design process, designers can only manually draw drawings, which can result in different colours and messy handwriting, leading to problems such as unclean and complex design drawings. At the same time, it is difficult to modify the drawings, which seriously affects the design efficiency and the quality of the finished product construction. The emergence of CAD computer-aided software can effectively simplify the design process, allowing designers to complete multi-dimensional spatial drawing of images using a mouse and keyboard, and also significantly improve the design cycle and quality.

In addition, CAD computer-aided software can also control the calculation accuracy at the centimeter level in the actual architectural design process. Both design speed and accuracy are superior to traditional interior design processes. CAD, as a computer-aided software, is the most widely promoted and applied drawing tool. It can complete various tasks such as image editing, 3D drawing, graphic insertion, interactive design, etc. In addition to being able to draw lines and shapes quickly, it can also locate, capture, and search images, helping designers quickly generate various complex multidimensional floor plans. In addition to CAD computer-aided software, there is also SU software for computer-aided tools. The feature of this software is that it is easy to use and operate, but it tends to focus more on rendering in terms of production effects and lacks in processing image data and adjusting parameters. 3DMAX is also a tool used in computer-aided software to complete animation rendering and scene construction. Compared to other design software, the operation of 3DMAX is more complex and requires designers to have certain professional abilities, which limits its promotion.

In the application of computer-aided software, CAD software has shown good applicability, with the highest number of applications. Next is 3DMAX software, which some designers with strong professional skills may choose to use. In our research, we focus on exploring the applicability of CAD technology in human-computer interaction in the interior design process. Firstly, it is necessary to establish a systematic framework for interior design data on a large scale, construct a visual interior 3D model library, and provide reliable parameters for the design process. The structure of the CAD database system is shown in Figure 1.

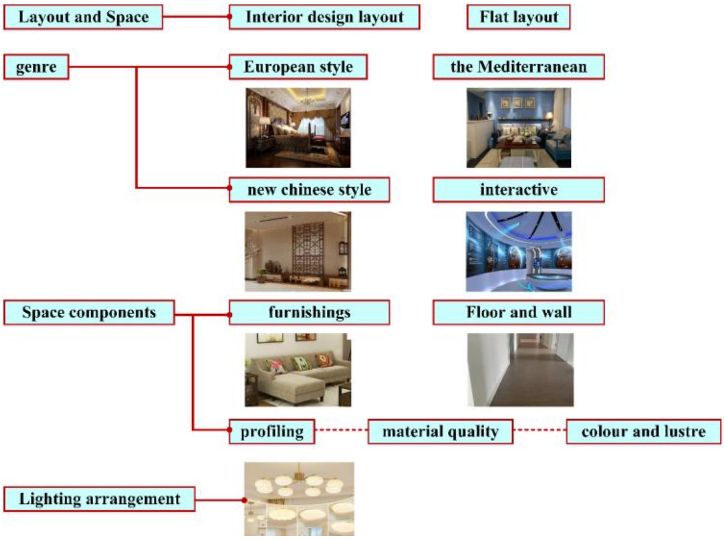

Figure 1: Structure of CAD database system.

As shown in Figure 1, after determining the interior design layout and floor plan, users' different needs are selected based on style and genre. Subsequently, materials and colours are selected for different shapes of furniture, flooring, and walls in the spatial components, and finally, the lighting layout is completed according to the indoor space shaping. The CAD database system effectively preserves the elements and parameters related to interior design in big data collection, providing reliable assistance for the interior design process. At the same time, in the human-computer interactive application of the interior design process, we use CAD technology to adjust the spatial layout images. Using perception algorithms to calculate the degree of image adaptation and reduce spatial distortion caused by size errors. Import 3D solid components and modules into CAD systems to display indoor materials. Simultaneously complete interactive operations and functional layout in indoor scenes, including viewpoint switching, scene roaming, input response, and various other aspects. Designers can customize, adjust information, and dynamically select interior design spaces for users based on database management and display functions. User experience users can further confirm the interior design structure and spatial layout based on the map navigation and location query functions provided by the CAD system.

3.2 Research on the Application of Human-Computer Interaction Function in Interior Design Based on CAD and Reinforcement Learning Algorithms

With the continuous improvement of living standards, people have put forward higher requirements for living environment and interior design. Modern interior design processes reflect the creativity and ideas of designers. Designers use computer simulation software and CAD-assisted modelling tools to build virtual scenes and transform this virtual environment into real space. As more and more designers pay attention to the human-computer interaction mode in the interior design process, this paper adopts a reinforcement learning algorithm to study the construction of human-computer interaction function in the interior design process and is committed to achieving the interaction needs between indoor space and experiences. Reinforcement learning algorithms are an important branch of machine learning, and a reinforcement learning task can be described using Markov decision processes.

With the continuous advancement of technology, China also experienced a rapid increase in the number of research results released around 2018. In reality, human-computer interaction in the interior design process requires the use of input devices as the data source for the system. At the same time, it is also necessary to locate the interior design space in addition to using a stereo vision system for various recognition of the human body, gestures, sound, and posture. A formula can represent the transformation relationship between actual three-dimensional spatial coordinates and human-computer interaction objects:

$$p^w = [p_x^w, p_y^w, p_z^w] \tag{1}$$

$$p = C_{IW}^i P^W + i_0 \tag{2}$$

In the formula, w represents the indoor spatial coordinates. Assuming that the target object coordinates are fixed, the human-computer interaction positioning can be transformed from perspective in the following way:

$$x = (f \,/\, P_z) P_x \tag{3}$$

$$y = (f \,/\, P_c) P_y \tag{4}$$

By incorporating reinforcement learning algorithms and utilizing agent strategies to complete the planning of transition functions based on the state of the interacting object and guiding machine devices to perform state transitions, the optimal strategy sought by the agent yields the following reward:

$$G = \sum_{K=0}^{i-1} r(s_t, a, s_{k+1}) \tag{5}$$

Usually, the expected factor is introduced into the training function and rewritten as:

$$G_1 = \sum_{K=0}^{i-1} r\Upsilon^k \mid s, a \tag{6}$$

In the formula, s there is a series of data feedback. Considering that the policy function is a conditional probability distribution, we redefine the state value function as:

$$u(s_t) = E_{r\sim\pi}[G] \tag{7}$$

$$u(\pi) = s_t + E \frac{\sum_{K=0}^{I} YR_{t+k}}{a} \tag{8}$$

We also use spatial simulation algorithms to default the motion constraint relationship of the target object, and the positioning formula between humans and machines is as follows:

$$\theta_{DIP}(Y) = \frac{2}{3}\theta_{RIP}(u) \tag{9}$$

The formula Y represents a certain part of the interactor, and the specific positioning motion model needs to be obtained through the inverse calculation of simulation algorithms. The changes in the state in space are as follows:

$$q = (\theta_1, \theta_2, \theta_3, \ldots r) \tag{10}$$

$$X = f(x)[z, y, \beta] \tag{11}$$

To make human-computer interaction more intelligent, we also need to find the best path for the agent. Using the strategy gradient approach of reinforcement learning for modelling, a fitting neural network is generally used to represent the strategy function:

$$J(\pi_\theta) = E[R(\tau)] \tag{12}$$

$$\theta^* = \theta + A(J)\pi_\theta \tag{13}$$

The solution to the maximization problem can be calculated using the gradient ascent algorithm, and the formula is as follows:

$$\Delta J(\pi_\theta) = \Delta E[R(\tau)] \tag{14}$$

The gradient adjustment of the final return function concerning the calculation result is the core of the entire strategy. By expanding the above formula, the following variation can be obtained:

$$J(\pi_\theta) = E_{\tau \sim \pi}[\sum_{t=0}^{T} \Delta\theta \log(a \mid s_t)] \tag{15}$$

Using reinforcement learning algorithms and CAD computer-aided drawing software to delineate human-computer interaction scenarios in interior design space layout. Construct an interactive system by incorporating sensing devices and visual posture information collection devices. Through the analysis of the interaction function requirements of the experience, we further planned the interior design process structure under human-computer interaction design.

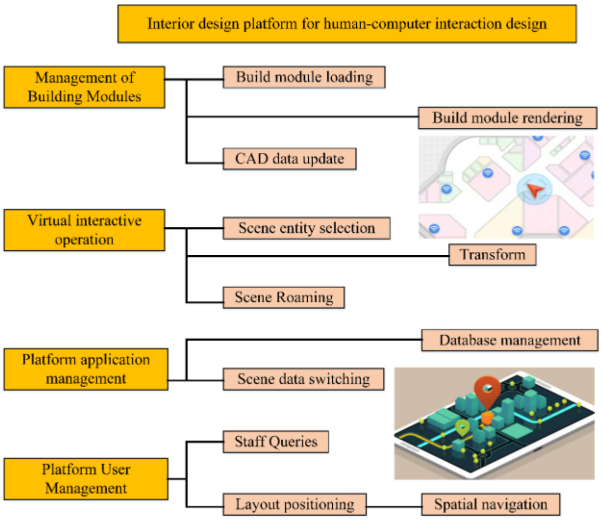

Figure 2: The process structure of interior design under human-computer interaction design.

As shown in Figure 2, it is necessary to adjust and update the data of the CAD system in the management of building modules, to complete the loading and rendering of spatial building modules. In the human-computer interaction module, designers select scene entity materials according to the needs of different users, complete data roaming through geometric transformations and scene construction, and ultimately provide users with spatial navigation, layout positioning, and other functions. Finally, in the platform management and user management modules, designers can customize scenarios, switch data transmission methods, and dynamically update and supervise the database based on the system's management functions. The user management module can choose map navigation and personnel query operations that suit their usage habits.

4 ANALYSIS OF RESEARCH RESULTS

4.1 Analysis of Research Results on Interactive Application of Interior Design Process Based on CAD Computer-Aided Technology

With the development of society, urban housing has gradually entered a new stage, and the interior design process has also opened up new directions for development. People's requirements for interior design and interior space layout are gradually increasing. In addition to reflecting modern aesthetics, they also need to experience the intelligence and high-tech feeling of human-computer interaction in indoor activities. Traditional indoor space layout and interior design processes cannot effectively integrate user needs into spatial spaces. This article uses CAD computer-aided technology to study and analyze the interactive application of interior design processes. Before creating interior design renderings, it is necessary to establish a comprehensive design concept and design spatial styles based on the interaction modes of different locations. Preliminary selection of renderers in CAD software, emphasizing the atmosphere of human-computer interaction and enhancing the overall effect from multiple perspectives. We compared the changes in human-machine interaction structure within the interior design process space before and after using CAD computer-aided design, as shown in Figure 3.

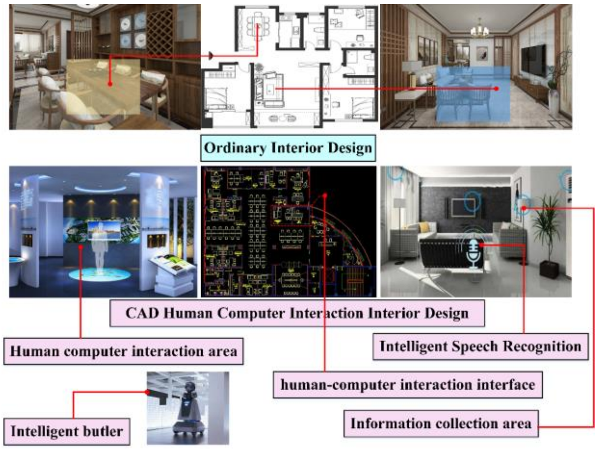

Figure 3: Changes in human-machine interaction structure within the interior design process space before and after using CAD computer-aided design.

From Figure 3, it can be seen that the left side is the spatial layout of the ordinary interior design process. From the perspective of spatial structure, furniture placement, furniture structure, and user experience in interior design are all traditional home styles without highlighting intelligent and digital interactive sensory modes. On the right is the change in spatial layout after CAD computer-aided design, including various functions such as intelligent speech recognition, human-machine interaction area, and intelligent robot butler. In the detailed functional introduction, the human-computer interaction interface and some areas related to recognition information collection in CAD software design are also marked. Subsequently, we randomly selected different test groups to conduct human-computer interaction feedback time statistics on the CAD design space, as shown in Table 1.

Test No	*Experimental testing time/s*
Test Group 1	1.21
Test Group 2	1.01
Test Group 3	0.89
Test Group 4	0.98
Test Group 5	0.87
Test Group 6	1.33
Test Group 7	1.20
Test Group 8	1.11

Table 1: CAD design space human-computer interaction feedback time.

According to Table 1, the number of different test groups can fully meet the authenticity requirements of the data. From the perspective of human-machine interaction feedback time in indoor space, the overall time is relatively short. This proves that the indoor process of computer-aided design has higher intelligence and interactivity.

4.2 Analysis of Research Results on the Application of Human-Computer Interaction Function in Interior Design Based on CAD and Reinforcement Learning Algorithms

This article uses CAD computer-aided drawing to complete the three-dimensional and simulation construction of design schemes. However, to transform the spatial layout from traditional flat expression to interactive virtual space display, we also added reinforcement learning algorithms to transform the flat functional structure into an experiential 3D design space. The experiencer can not only immerse themselves in the real scene in the virtual environment but also interact with the internal spatial objects of the house through the human-computer interaction system. In our research, we mainly focus on two directions. The first direction is the human-computer interaction between designers and design tools in the interior design process. Utilize reinforcement learning algorithms to adjust data parameters during the decision-making process dynamically. Designers can randomly adopt different needs of the masses, add demand characteristics to the spatial design model, and generate design results through training reinforcement. Although ordinary CAD software can dynamically adjust data parameters, it still has certain shortcomings in feature point capture. Comparing the quality of feature point capture before and after using reinforcement learning algorithm optimization, as shown in Figure 4.

As shown in Figure 4, the feature point capture quality is higher after optimization using a reinforcement learning algorithm. This also indicates that reinforcement learning algorithms have played a good role in data collection for human-computer interaction. The second direction for the subsequent spatial design process is about the efficiency of human-computer interaction feedback for the experience in the spatial layout. The changes in the efficiency of human-computer interaction feedback before and after reinforcement learning optimization are shown in Figure 5.

As shown in Figure 5, after optimizing the human-computer interaction design using a reinforcement learning algorithm, the efficiency of communication and feedback between the experiencer and the intelligent machines inside the space is significantly accelerated. Further explanation shows that reinforcement learning algorithms have a positive effect on improving human-computer interaction in the interior design process.

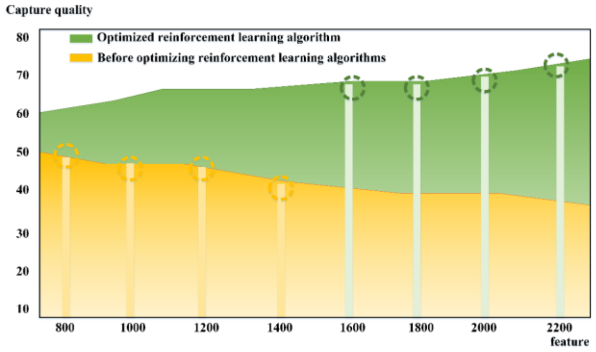

Figure 4: Changes in feature point capture quality before and after optimization using reinforcement learning algorithms.

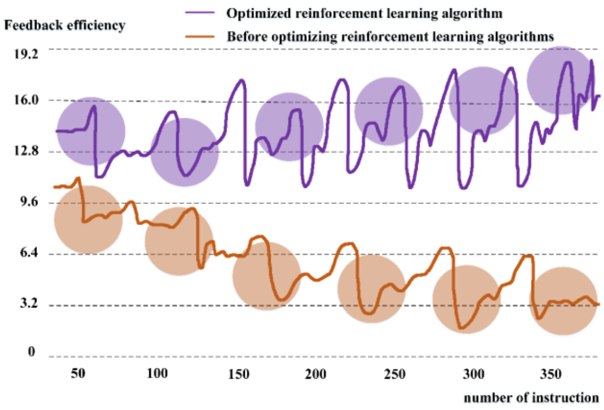

Figure 5: Changes in the efficiency of human-machine interaction feedback before and after optimizing using reinforcement learning algorithms.

5 CONCLUSIONS

With the rapid development of modern technology, the field of interior design should make intelligent and modern innovations in design expression, design methods, design processes, and other aspects. At present, the application of human-computer interaction and interactive experience systems has become the mainstream direction in the interior design process. On this basis, this article also explores the human-computer interaction function in the interior design process using CAD computer-aided technology and reinforcement learning algorithms. Firstly, the development status of CAD technology and reinforcement learning algorithms in recent years was analyzed. Regarding the CAD computer-aided software design and production process, detailed parameters that comply with human-computer interaction functions were inserted. In research, CAD design software can provide intelligent operational assistance according to the needs of designers, simplify the process of generating design drawings, and better meet the needs of the public in the final presentation of indoor space renderings. Finally, with the help of reinforcement learning algorithms, Markov decision computation was utilized to adjust the object relationship between the intelligent agent and human-computer interaction. Through reinforcement learning data collection and iterative training, the human-computer interaction effect in interior design space layout has been improved, enhancing the interactivity in the design process. The research results indicate that the classification design process using CAD technology and reinforcement learning algorithms can not only meet the human-computer interaction needs of designers but also provide intelligent residential services for users.

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