

Application of Artificial Intelligence Technology in Digital Design of Building Interior

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Abstract: This paper focuses on the application of artificial intelligence technology in building interior digital design. Firstly, it discusses the significance of the application of artificial intelligence technology in building interior digital design, such as helping to improve the efficiency of interior design and promoting the iteration of architectural industry design ecology upgrade. Then, several application measures are put forward, including indoor space intelligent analysis and preliminary survey application, AI intelligent scheme generation and space optimization design application, and intelligent modeling and virtual simulation design application. Artificial intelligence technology allows designers to provide more innovative ideas, promote the transformation of interior design from empirical creation to data-driven, precise, and intelligent creation, provide practical references for the intelligent upgrade of architectural interior digital design, and help the architectural interior design industry achieve high-quality, sustainable, and digital innovation development.

Keywords: Artificial intelligence technology; Digital design of building interior; App; Application

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1. Introduction

With the deep integration of the digital economy and the construction industry, the field of architectural design has officially entered the key stage of digital and intelligent transformation. Traditional architectural interior design has long relied on designers' manual drawing, experience, conception, and repeated revision, which has some problems, such as a long design cycle, poor man-machine adaptability, and large landing error, and it is difficult to better meet the diversified and personalized interior design needs of modern buildings. Against the background of rapid iteration of big data, artificial intelligence, digital modeling, and other technologies, artificial intelligence technology, with its advantages of efficient operation, intelligent deduction, and data optimization, has become the core driving force to promote the digital and intelligent upgrade of architectural interior design, providing an important path for the innovative development of the architectural interior design industry. With the application of artificial intelligence technology in building interior

digital design, intelligent analysis, scheme generation, parameter optimization, and risk prediction can be carried out based on massive design data, which can shorten the design cycle, reduce the design cost, and create an interior design scheme that meets the needs of users, space conditions, and modern aesthetic standards.

2. The significance of the application of artificial intelligence technology in building interior digital design

2.1. It is beneficial to improve the efficiency of interior design

The traditional interior design of buildings mainly depends on the manual operation of designers, from site survey, hand-drawn conception, modeling and drawing to rendering optimization and drawing proofreading. The whole process is complicated and time-consuming, and the design of complex apartment and commercial spaces takes several months; repeated revisions will lengthen the project schedule. However, in the digital design of building interior, the application of artificial intelligence technology can realize the automation and intelligent upgrade of design process, and rely on the functions of three-dimensional intelligent surveying and mapping, automatic scheme generation, one-click modeling and rendering, intelligent drawing checking, etc., which can compress the work that originally took several days to be completed by manpower to several hours and shorten the design cycle. At the same time, AI can iterate the scheme, replace the style, and optimize the layout in real time according to the needs of users, solve the problems of repeated revision of traditional designs, improve the speed of project design and delivery efficiency, and help the design industry adapt to the fast-paced and high-quality construction needs of modern architectural projects.

2.2. It is conducive to promoting the iteration of ecological upgrading in the design of the construction industry

There have been some problems in building interior design for a long time, such as shallow digitalization, disjointed data across all links, disjointed design and construction, and information faults across all links of design, modeling, construction, and operation and maintenance, which are likely to lead to construction rework. However, the application of artificial intelligence technology in building interior digital design can not only break through the data barrier of the whole chain of interior design, but also realize the data exchange and linkage update of space survey, scheme design, modeling and simulation, drawing output, construction check, and later operation and maintenance, and establish a full-life digital design system. At the same time, the standardized design output mode of AI unifies the standards of design results, avoids the arbitrariness of manual design, promotes the transformation of the interior design industry, helps the overall digital upgrade of the construction industry, and optimizes the development ecology of the industry.

3. The concrete application of artificial intelligence technology in digital design of building interior

3.1. The intelligent analysis of indoor space and the application of preliminary survey

The preliminary indoor survey and spatial analysis are an important foundation of the design work, which determines the rationality and feasibility of the follow-up scheme. The full application of artificial intelligence technology realizes the digitalization and intelligent upgrade of indoor space survey and analysis, and improves the accuracy and comprehensiveness of the preliminary design work.

The first is to realize three-dimensional intelligent mapping and data reconstruction of indoor space. Combined with AI vision recognition, laser scanning, and 3D reconstruction technology, the indoor blank space and existing reconstruction space can be fully automatically surveyed and modeled. Compared with the traditional manual measurement mode of tape measure and level, AI intelligent surveying and mapping equipment can quickly collect all-round spatial data such as indoor apartment size, wall structure, beam-column position, door and window openings, pipeline arrangement, etc., automatically avoid the blind area of manual measurement and accurately capture the subtle structural deviation of space ^[1]. At the same time, relying on the artificial intelligence three-dimensional reconstruction algorithm, the collected discrete data can be automatically integrated to generate a high-precision, one-to-one restored indoor digital space model. Because this model can directly connect with the subsequent design software, it does not require the designer's secondary modeling, which solves the tedious problem of traditional survey data and provides an accurate database for the subsequent digital design.

The second is to complete indoor ambient intelligence detection and parameter analysis. Modern interior design not only pays attention to the spatial form, but also pays attention to the living environment indicators such as lighting, ventilation, sound insulation, temperature and humidity, air quality, and so on. Traditional environmental analysis mainly relies on manual calculation and empirical prediction, with low data accuracy and a single analysis dimension. However, using artificial intelligence technology and various intelligent sensing devices, environmental data such as natural lighting duration, illumination uniformity, air circulation rate, noise decibels, space temperature, and humidity can be collected around the clock, and the environmental data can be intelligently analyzed and judged using deep learning algorithms ^[2]. Aiming at the problems of insufficient lighting, poor ventilation, and noise interference, an AI system can automatically mark the problem areas and quantify the environmental defect parameters, which provides important data support for designers to optimize the window opening position, partition layout, and wall material, and ensures the comfort of interior design.

The third is to realize the analysis of spatial function and intelligent deduction of people flow. According to different indoor scenes such as office space, commercial space, and residential space, artificial intelligence can combine the characteristics of space area, apartment structure, and users to carry out intelligent crowd simulation and functional adaptation analysis. By importing a large number of similar space design cases and usage data, AI algorithms can deduce the trend of people flow and space congestion areas under different layout modes, and accurately identify the problem of space waste ^[3]. Based on the analysis results, the optimization direction of space function, such as the optimization of counter layout in commercial space and the adjustment of station layout in office space, is automatically output, so that early space design can get rid of pure aesthetic conception and realize the adaptation of function, people flow, and space.

3.2. AI intelligent scheme generation and spatial optimization design application

Scheme design is the core link of digital interior design. Traditional scheme design mainly depends on the designer's personal experience, which has the problems of a long creative cycle and a single optimization dimension. However, the application of artificial intelligence technology, relying on massive design databases and deep learning algorithms, can realize intelligent generation, automatic iteration, and precise optimization of interior design schemes and improve the efficiency of scheme design, which is the core application of intelligent interior design at present.

The first is to realize the intelligent generation of multi-style and personalized schemes. By learning a large number of excellent domestic interior design cases, the artificial intelligence system covers a variety of design styles and accumulates a perfect database of color matching, material combination, soft decoration layout, and modeling design ^[4]. In the specific design process, designers only need to input the indoor space model, apartment parameters, owners' needs, style preferences, budget standards, functional requirements, and other parameters into the AI system, and the system can automatically generate multiple sets of differentiated indoor design schemes in a short time. The scheme covers a number of complete design contents, such as the overall spatial layout, the top surface modeling of the wall, the floor paving, the matching of soft cloths, the color system, etc., which changes the traditional mode of repeated modification of a single scheme. At the same time, AI can adapt accurately according to the individual needs of the owners and automatically match humanized design details for special scenes such as old people's rooms, children's rooms, and office spaces to meet the personalized design needs of different people and different scenes.

The second is to complete the parametric intelligent optimization of indoor space. Using artificial intelligence parametric design technology, multi-dimensional collaborative optimization is realized. By building an intelligent algorithm model, space size, daylighting standard, pedestrian flow law, energy consumption index, and aesthetic norms are set as constraint parameters, and the initial scheme is automatically iteratively optimized ^[5]. In terms of space utilization optimization, AI can fine-tune wall partitions, furniture sizes, and layout positions through algorithms, reduce idle areas of space, and improve the use efficiency of small-sized and irregular spaces; In terms of aesthetic optimization, AI relies on visual aesthetic algorithms to automatically adjust the spatial proportion, color contrast, and modeling symmetry to avoid visual imbalance. In terms of energy-saving optimization, the layout of doors, windows, and partitions is optimized by combining natural lighting and ventilation data, so as to reduce the energy consumption of artificial lighting and air conditioning and realize the green energy-saving design of indoor space. Compared with manual optimization, AI parametric optimization can take design indexes into account at the same time, with higher optimization accuracy and more comprehensive dimensions.

3.3. The application of intelligent modeling and virtual simulation design

Digital modeling and effect simulation are important links in indoor digital design. The integration and application of artificial intelligence technology, digital modeling, and virtual simulation technology have realized indoor modeling automation, multi-dimensional simulation, accurate effect prediction, and improved the landing of digital design.

The first is to realize intelligent rapid modeling and lightweight processing of indoor models. Using artificial intelligence modeling technology to realize automatic model generation, relying on the spatial data of previous three-dimensional surveys, the AI system can automatically identify structural components such as walls, beams and columns, doors and windows, ground and top surfaces, and build high-precision indoor foundation models. According to the design scheme, model materials such as furniture, lamps, soft clothes, and decorative components can be automatically imported, and the proportion adaptation, position alignment, and detail splicing of components can be automatically completed ^[6]. Aiming at complex special-shaped space and surface modeling design, AI algorithms can automatically optimize the model structure, solve the problems of artificial modeling surface distortion, and improve the modeling accuracy. In addition, for high-precision models, AI can carry out intelligent lightweight processing, compress model data on the basis of retaining core design details, ensure the smooth operation of the model, and adapt to subsequent rendering, simulation, and display requirements.

The second is to carry out intelligent simulation of indoor light and color. The artificial intelligence simulation technology is used to realize all-weather dynamic light and shadow simulation. According to the building orientation, floor height, window position, sunshade structure and other parameters, the indoor light intensity and light and shadow projection range at different time periods in the morning, noon, evening and night are automatically simulated, and the problems such as insufficient lighting, dead angle of light and shadow, glare and glare are accurately predicted, and the layout of lamps, window size, shading material and indoor light and shadow experience are automatically optimized ^[7]. Through an AI color simulation system, the color presentation effects of walls, floors, and soft clothes under different lighting color temperatures and natural light environments can be simulated, and problems such as color matching conflicts can be predicted, and color matching can be adjusted intelligently to ensure the harmony and unity of the indoor color system.

3.4. Application of intelligent rendering and digital achievement optimization

The rendering of design results is the final link of indoor digital design, and high-quality renderings and animations are the core carriers of scheme display and floor disclosure. Using artificial intelligence rendering technology, the rendering mode of interior design is innovated, and digital output with high efficiency, high definition, and intelligence is realized.

The first is to realize one-click intelligent HD rendering. AI rendering system has built-in massive rendering parameter templates, which are suitable for all kinds of interior design styles and scenes. Designers do not need to manually debug complex parameters such as light, shadow, and materials. As long as a three-dimensional model is built, high-definition renderings, panoramic views, and indoor roaming animations can be generated with one click through the AI system. Compared with traditional rendering, AI intelligent rendering can complete high-definition drawing in a short time and improve rendering efficiency ^[8]. AI algorithms can intelligently optimize the details of the picture, automatically correct problems such as fuzzy material texture, light and shadow faults, and ensure high-definition, true, and unified rendering quality. The second is to complete the intelligent adaptation and optimization of material texture. Artificial intelligence can accurately identify the physical characteristics of all kinds of building materials and soft-packed materials through image recognition technology, automatically match the corresponding rendering parameters, and truly restore the texture and appearance of materials. AI can intelligently fine-tune the light and shade and reflective intensity of materials according to the spatial light and shadow environment, so that the materials can adapt to the overall spatial atmosphere and improve the authenticity of the renderings ^[9]. The third is to realize intelligent standardization and optimization of design results. AI system can optimize the composition, color brightness, and picture proportion of renderings according to industry design standards and display specifications, and unify the style and texture of the whole set of design results. Automatically generate supporting design instructions, dimensioning, material list, and process instructions, and carry out data linkage among three-dimensional models, renderings, and construction drawings to ensure the high uniformity of drawings, effects, and parameters, and provide high-quality digital results for scheme reporting and construction disclosure ^[10].

4. Conclusion

To sum up, the application of artificial intelligence technology in building interior digital design can not only realize the automation and standardization of the design process, but also reduce labor cost and material loss, and combine the requirements of human settlement environment, ergonomics, and green energy saving to carry out multi-dimensional optimization design to improve the comfort of indoor space. Using artificial intelligence technology, designers can pay more attention to creative expression, humanistic shaping, and

personalized needs, and enhance the artistic value of design works. In the future, with the continuous maturity of algorithm models and iteration of digital technology, the application scenarios of artificial intelligence technology in building interior digital design will be more abundant, which will continue to promote the development of the building interior design industry in the direction of digitalization and intelligence.

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