Research on Interior Design Paths from The Perspective of AI

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Abstract

This study explores the in-depth application of generative AI in interior design. It reviews the evolution of generative AI and analyzes its significant advantages and specific use cases across different stages of contemporary interior design. The research explains the underlying principles and project framework for optimizing design methods with generative AI. Through residential case studies, it examines the practical challenges of implementation and offers insights into future developments. The study aims to introduce an innovative working approach to the interior design industry, enhancing both efficiency and quality, while promoting intelligent and personalized design advancement.

Keywords

Residential Design; AIGC; Design Path.

1. Introduction

The paradigm shift in artificial intelligence (AIGC) technology is reshaping the development landscape across multiple industries. Focusing specifically on interior design, the emergence of AIGC technology has lintroduced new technological variables to the interior design workflow. Traditional interior design workflows typically require significant time and effort in stages like conception and rendering production. AIGC technology's powerful ability to rapidly generate various design solutions and renderings has significantly improved the speed and iteration efficiency of design generation, particularly during the initial concept drawing stage. Some designers are also exploring ways to combine AIGC with traditional design methods to create more innovative and competitive designs. Empirical research shows that cutting-edge design firms are pushing the boundaries of innovation within traditional approaches through technology integration. While maintaining the dominance of design thinking, AIGC demonstrates potential for improving efficiency and effectiveness across multiple design stages[1]. This study aims to explore the application of AIGC technology in optimizing traditional interior design workflows and, through innovative practice using an algorithm-driven model, propose a feasible solution for achieving iterative process upgrades.

2. The History of AIGC and Its Adaptability to The Design Field

2.1. AIGC Development Context

Artificial intelligence has been widely applied in areas such as visual content generation and spatial recognition. These capabilities are highly compatible with image generation and structural assessment in interior design, and have the potential to be transformed into design tools. In the field of painting, AIGC uses deep learning algorithms to generate highly realistic paintings. Artists use these tools to quickly gain inspiration and actively explore new creative styles. In the field of Go, AlphaGo has performed exceptionally well in complex strategy games. Its powerful computing and decision-making capabilities have deepened people's understanding of the enormous potential of artificial intelligence. Autonomous driving technology is gradually transforming transportation, significantly improving safety and

efficiency. The emergence of machine translation has facilitated communication between different languages, successfully breaking down language barriers. Intelligent customer service can quickly respond to requests and provide businesses with efficient customer service. Intelligent robots play a vital role in industrial production and service industries, effectively improving production efficiency and quality. Medical image processing provides strong support for doctors to accurately diagnose diseases, providing better medical services to patients. Image search functions allow users to quickly find the images they need, greatly improving the efficiency of information retrieval. These innovative practices demonstrate that AI is continuously pushing the boundaries of human capabilities through the trifecta of "data-driven, algorithmic iteration, and scenario-specific adaptation."[2]. From artistic inspiration to industrial manufacturing, from life sciences to daily services, AIGC is not only reshaping technological paradigms in various fields but also shaping a new form of civilization characterized by human-machine collaboration.

2.2. AIGC's enabling advantages in interior design

Traditional interior design projects face numerous pain points. From the initial concept stage to mid-term space plan adjustments, designers spend a significant amount of time manually sketching or creating preliminary models. This process is often limited by individual thinking, making it difficult to quickly identify the optimal design direction. Companies also face high time and labor costs. The heavy workload placed on designers in traditional design processes leads to long project cycles and increased costs, while the heavy reliance on manual labor keeps labor costs high. Industry-wide, there are also issues such as insufficient innovation, limited personalized services, and a low level of intelligent design. Traditional design methods struggle to meet consumers' growing demand for personalized services, and intelligent development lags behind. The emergence of AIGC offers hope for resolving these challenges, bringing new approaches and developments to the industry. Designers can input keywords (e.g., Nordic minimalism) and parameters (e.g., two bedrooms, one living room, 70 square meters) to have AIGC quickly generate multiple design options and identify the appropriate design direction[3]. AIGC can generate multiple matching plan sketches within seconds to minutes to assist in the early conception stage. The use of AI can help companies reduce costs. AIGC technology can quickly generate design plans and renderings, reducing designer workload, improving production efficiency, reducing labor costs, and increasing economic benefits.

3. AIGC-enabled Interior Design Path

3.1. Concept design stage

This phase focuses on establishing a design style. Using AI-powered cultural image technology, we input style keywords such as "modern minimalist," "classical European," "new Chinese," and "industrial" to generate a variety of design ideas in batches. The system covers over ten mainstream styles, including American and Wabi-Sabi, providing designers with creative inspiration and visual references. After the client selects a style based on the design ideas, the designer further refines the design concept and simultaneously analyzes the client's aesthetic preferences and functional requirements, laying the foundation for subsequent design.

3.2. Preliminary design stage

This phase encompasses two modules: spatial layout and 3D detailing, following the technical path of "floor layout - spatial rough model - graphic design adjustments - partial redrawing". First, based on the original framework drawing, CAD drafting is used to define the spatial dimensions and functional zoning. AI is then used to optimize furniture layout and wall demolition and modification plans. Lighting efficiency, ventilation paths, and traffic flow are comprehensively evaluated to determine the project's floor plan, providing data support for 3D

modeling. Using the 3D modeling software SketchUP, the 2D plan is converted into a block model, and a 3D spatial base model is constructed. The ceiling shape, wall form, and floor height differences are determined. AI graphic design is used to identify rough model elements such as walls and furniture. Using prompts (such as "glossy leather sofa" and "warm diffused light"), material texture, texture details, and spatial tones are defined. Dynamic lighting effects are then superimposed to generate preliminary renderings. While AIGC-generated content can improve overall expressiveness through parameter optimization, detailed issues such as furniture disproportion may still occur. Designers can further use the local redraw function to make targeted corrections, such as reshaping furniture, replacing decorative materials, and calibrating color saturation. This allows for quick corrections to shapes, materials, and other elements, ultimately resulting in high-precision renderings. This significantly reduces the time and cost of repetitive renderings in traditional modeling, shortening the modeling and rendering cycle.

3.3. Solution presentation stage

The final product of this proposal presentation phase is centered around systematic visual representation. AI not only generates dynamic color floor plans with millimeter-level accuracy but also leverages user historical behavior data and collaborative filtering algorithms to provide personalized, intelligent recommendations for spatial layouts. When outputting auxiliary diagrams such as flow analysis diagrams, functional zoning diagrams, and element decomposition diagrams, the system simultaneously integrates the user preference database to perform multi-objective optimization recommendations for factors such as material selection and color matching. This allows customers to intuitively perceive the design results and provides a precise reference for further construction drawings. Recent industry practice demonstrates that platforms and software such as Coolhome, IKEA, and Homestyler have already launched AI-powered renovation plan generation. These companies, through collaborations with technology companies or independent research and development, have launched a range of AI-powered home design and service products. For example, the Coolhome online design platform leverages AI algorithms to quickly generate personalized renovation plans and renderings, allowing users to adjust and modify them in real time until they are satisfied.

4. Technical Challenges and Solutions

4.1. Correction strategies for spatial scale bias

During AI-assisted design, there may be inaccurate understanding of the actual space dimensions. During the conceptual design and floor plan generation stages, AIGC's line drawing recognition may show discrepancies, resulting in furniture sizes not matching the actual space, or inconsistent proportions of wall and ceiling shapes[4]. This not only affects the aesthetics of the design but can also create difficulties during subsequent construction. To address this, designers can make adjustments to the space, layout, color, material, style, and perspective. For example, by adjusting the space layout, selecting appropriate furniture sizes, and adjusting color palettes, designers can optimize the space dimensions, improve its usability and comfort, and ensure that the final design meets actual requirements.

4.2. Compensation mechanism for missing image details

While AI can quickly generate numerous design proposals and renderings, in some cases these images may lack sufficient detail. This can manifest itself in inadequate texture reproduction, blurred light and shadow gradations, and other key elements lacking clarity, failing to truly convey the design's quality. This can make it difficult for clients to fully appreciate the design's quality when previewing it, and can also hinder designers from accurately referencing when

redrawing or adjusting details. To address this issue of image quality and content, designers or companies can establish a standardized parameter library to adjust parameters such as resolution, seed, iteration step, sampling method, and description relevance. Furthermore, they can improve the clarity, detail, and keyword relevance of imported images, ensuring the generated images meet their requirements[5]. The specific parameter settings are as follows: The resolution range is uniform; larger values result in clearer images; the seed generates a random image style; the number of iterations is suitable for 30-40 steps; the value affects the image's refinement; the sampling method affects the image's style; the description relevance range is suitable for 8-20; the value affects the similarity between the image and the keyword.

4.3. Reconciling Paths for Material Style Conflicts

During the detailed design phase of a space, the wood material in the AI-generated renderings may not match the design style, or the color choice may not harmonize with the overall atmosphere of the space. This requires designers to spend more time and effort on subsequent adjustments. Designers can use the partial repaint function to adjust the details of the space. By painting over selected areas, changing the shape, adjusting colors, changing the material, or adding decorative elements, the designers can better integrate the furniture or material style into the space and ensure a harmonious and unified design.

5. Conclusion and Industry Outlook

This study explores the application of AIGC technology in interior design, reviewing the development of AI and demonstrating its cross-disciplinary potential, particularly its multiple advantages within interior design. AIGC effectively addresses traditional industry pain points, freeing designers from repetitive tasks, helping them break through stereotypes, quickly identify optimal solutions, and significantly improving work efficiency. For businesses, this technology reduces reliance on labor costs, significantly improves economic efficiency through process optimization, and promotes systematic innovation in design methodology.

In project implementation, AIGC has demonstrated considerable practical value: it generates multiple sets of conceptual diagrams to visualize ideas, constructs spatial frameworks through floor plan generation and digital modeling, and refines design details through a combination of "image-to-image" and detailed redrawing. Despite technical bottlenecks such as spatial scale deviation and material distortion, these issues have been effectively addressed through parameter optimization and algorithm iteration, providing reliable support for creating functional and aesthetically pleasing living spaces.

Looking forward, the deep integration of AI and interior design will reshape the industry ecosystem. For designers, AIGC serves as both an inspirational think tank and an intelligent assistant, assisting with space planning and material selection, fostering breakthrough designs. For businesses, AI, through technologies like virtual reality, builds immersive experience systems, driving service upgrades and business model innovation. The penetration of AI will trigger structural changes, prompting businesses to accelerate technology R&D and talent development, build core competitiveness, and promote cross-disciplinary integration to create new value growth points. This transformation requires the industry to develop collaborative mechanisms across multiple dimensions, including technology application, service innovation, and talent development, to achieve sustainable development from efficiency improvements to business model innovation.

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