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Application of Aigc Image Generation Technology in Product Design

Chi Han

Kyonggi University

http.lgpmwv@foxmail.com

Abstract. Since the advent of artificial intelligence (AI), its technological developments have garnered cross-industry attention. With recent technological breakthroughs, AI has entered a rapid development phase, spawning multiple specialized fields. Generative AI (AIGC) technology is now being applied commercially, demonstrating growing potential to drive intelligent societal advancement. This study examines the implementation of AIGC image generation in product design, analyzing its transformative effects, technical advantages, and limitations. The research explores the synergistic relationship between human designers and AIGC technology, proposing strategies to enhance creative output and workflow efficiency through human-AI collaboration. Findings suggest that AIGC can augment designers' creative capabilities while requiring careful integration to preserve artistic uniqueness in design outcomes. creativity and work efficiency, and create novel and unique works.

Keywords: AIGC; AIGC application; Image generation; Product design; Innovation.

1. Overview and Development of AIGC Technology

1.1 Overview of AIGC Technology

Artificial Intelligence Generated Content (AIGC) refers to an emerging technological paradigm that leverages artificial intelligence (AI) to generate diverse forms of content through computational operations and data-driven learning and simulation, guided by user instructions. This field represents an intersection of computer graphics processing technology and AI. Computer graphics processing technology focuses on the creation, analysis, processing, and visual representation of graphical information, while AI technology emphasizes the development of computational intelligence and decision-making capabilities. By integrating the strengths of both disciplines, AIGC enables more precise learning and emulation of human cognition and behavior, thereby facilitating enhanced efficiency in serving diverse user needs.

The rapid advancement of internet technology has empowered AI systems to acquire extensive knowledge through web-based learning. Current developments indicate that AIGC is progressively transforming production methodologies across multiple domains. In the near future, AIGC is anticipated to exert significant influence on production relations, while also providing a catalyst for breakthroughs in societal productivity. Notably, AIGC underscores the role of data and information as pivotal resources in the digital era, thereby accelerating the societal transition toward digitization and informatization. This technology not only streamlines content creation processes but also fosters innovation in data utilization, laying the groundwork for sustainable technological and economic progress.

1.2 The Development of AIGC Image Generation Technology

The origins of AIGC technology can be traced back to the 1950s, when Alan Turing proposed the "Turing Test" in his seminal paper Computing Machinery and Intelligence. This test established a framework for evaluating whether a machine could exhibit human-like intelligence, particularly in its ability to learn human thought patterns and generate content reflective of such cognitive processes. Turing’s theoretical groundwork foreshadowed the creative potential and transformative

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trajectory of AIGC in content generation, laying a conceptual foundation for subsequent technological advancements in this field.

The development of AIGC-driven image generation technology can be divided into three distinct phases:

Exploratory Phase (1950s – 1970s): During this period, researchers began experimenting with computer programs to generate literary works, poetry, and other rudimentary content. However, due to technological limitations and the nascent state of computational capabilities, the outputs were simplistic and lacked consistency in quality.

Foundational Application Phase (1980s – Early 2000s): Advances in computer technology enabled AIGC systems to transition from experimental prototypes to practical tools. These systems could generate basic images or musical compositions based on predefined instructions. Despite this progress, the technology remained confined to academic or niche applications and had yet to achieve commercial viability.

Rapid Development Phase (2000s – Present): Iterative advancements in computer hardware, coupled with breakthroughs in machine learning architectures such as Generative Adversarial Networks (GANs) and Convolutional Neural Networks (CNNs), have propelled AIGC into a new era. Modern AIGC systems now possess the computational power to process vast datasets and generate highly sophisticated content tailored to user specifications. Today, AIGC technologies are widely deployed across industries such as design, gaming, and film production, offering efficient and scalable solutions that redefine traditional workflows.

2. The Aesthetic Value of AICG Image Generation Technology

The application of AIGC technology in design and creative fields inherently possesses innovative aesthetic value. By leveraging computer algorithms to learn from and simulate vast datasets, AIGC can generate visual imagery or effects that transcend the expressive capabilities of traditional artistic methods. This innovation offers designers novel creative paradigms, helping them overcome limitations imposed by their own thinking and experience, while facilitating further artistic experimentation and exploration that enriches artistic forms and modes of expression.

AIGC image generation technology exhibits diverse aesthetic characteristics. Through analyzing and learning the styles and compositional features of various artworks from online data, AIGC integrates and reimagines these elements to produce original and creative works. The diversity of AIGC-generated art is not only manifested in its visual impact but also in the emotional expression and artistic conception it conveys. This diversity provides the public with a broader range of visual experiences and stylistic choices, encouraging artists to utilize the technology for deeper artistic exploration and opening up new possibilities for artistic development.

The aesthetic limitations of AIGC lie in the fact that content generation follows predefined programs, which may result in monotony in terms of expression, emotional depth, and visual presentation, thereby restricting innovation and emotional resonance. Furthermore, regional differences in aesthetic preferences and cultural backgrounds must be considered when employing AIGC for creative purposes to ensure the design's acceptability to a broader audience.

3. Application of AICG Image Generation Technology in Product Design

3.1 Diversification of Design Concepts

In the conceptual design phase, designers engage in iterative comparisons, client communication, and multi-scheme development through sketches and ideation — a process demanding extensive research and market analysis to ensure quality and diversity. AIGC technology addresses these challenges by enabling batch generation of conceptual renderings via keyword inputs, with adjustable parameters (e.g., style, color, material) to produce diverse visual references. These

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outputs inspire designers to refine or expand ideas by synthesizing professional aesthetics and client requirements. Furthermore, AIGC ’ s deep learning algorithms assimilate design standards and preferences, generating compliant visuals for iterative optimization, thereby accelerating workflows.

By automating labor-intensive tasks like sketching and modeling, AIGC allows designers to focus on creative synthesis. For instance, it rapidly converts line sketches into 3D renderings, facilitating real-time adjustments and enhancing client engagement through intuitive visualization. Its intelligent algorithms also propose optimizations for color schemes, contextual backgrounds, and conceptual effects, reducing operational costs. AIGC thus fosters intelligent design paradigms, elevating output quality while broadening creative possibilities, ultimately empowering designers to deliver visually compelling, innovative solutions.

3.2 Provide Personalized Design Services

Enabled by deep learning and generative adversarial networks (GANs), AIGC technology extracts critical features from user inputs (textual or visual) to generate design solutions tailored to consumer preferences. For instance, users can specify requirements for product form, color schemes, or aesthetics via AIGC tools, which then produce visual prototypes that concretize abstract ideas. Designers utilize these outputs to iteratively refine styles, experiment with diverse elements, and derive multiple design variants, significantly expanding consumer options. Concurrently, AIGC analyzes user behavior and cognitive patterns to optimize solutions for alignment with individual habits and preferences, enhancing both personalization and design efficiency. This integration of AI-driven automation and human creativity streamlines ideation while maintaining innovation rigor.

4. The Advantages and Disadvantages of AICG Image Generation Technology and Its Relationship With Designers

4.1 The Advantages and Disadvantages of AIGC Image Generation Technology

The strengths of AIGC technology lie in its ability to learn from vast datasets, analyze user information, and rapidly generate design solutions that meet specifications, thereby enhancing work efficiency, reducing designers' workloads, and shortening the time and effort required to transform sketches into visualizations, ultimately improving the overall design process. Additionally, by analyzing and learning from artistic works of various styles and techniques, AIGC can generate unique and innovative images, providing creators with diverse references and inspiration. Furthermore, advancements in technology have made AIGC more accessible, lowering the barrier to entry and enabling broader public participation in creative endeavors, fostering imaginative and diverse artistic expressions.

However, AIGC technology has limitations. It relies on existing big data, which restricts its ability to generate truly original, autonomous creations from scratch. Being based on intelligent algorithms and pre-trained models, AIGC may produce templated images, leading to homogenization in design styles and appearances, high similarity to existing works, and potential copyright issues. Moreover, current AIGC technology struggles with image detail processing, resulting in blurred, fuzzy, or damaged areas, as well as unnatural or disjointed transitions, compromising realism. These deficiencies require designers to adjust and optimize the flawed portions.

AIGC technology also lacks human emotion. Exceptional design not only excels in form and function but also conveys designers' emotions and philosophies to consumers, evoking emotional resonance and enhancing design impact. Furthermore, AIGC currently struggles to comprehend statements with deep meanings, often performing literal analysis and image generation that falls short of user expectations, hindering later design stages. Designers must regulate AIGC throughout the process to ensure outcomes align with design intentions and final expectations.

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4.2 The Relationship Between AIGC Image Generation Technology and Designers

AIGC technology is gradually being applied across various industries, not only expanding the scope of creativity but also enhancing creative efficiency. Consequently, there is a societal view that AIGC technology may replace human designers. However, this perspective is incomplete. While AIGC technology possesses powerful generative capabilities, the ultimate service target of product design is humans, and the "people-oriented" concept remains the core of product design. From the proposal of design concepts, design research, market analysis, product sketching, feedback, refinement of plans to the completion of design projects, AIGC technology cannot fully cover the entire design process, with each stage requiring human oversight. Designers should integrate technology into design to enhance design efficiency rather than allowing technology to replace them. Therefore, the relationship between human designers and AIGC technology is not one of replacement but mutual complementarity, with each leveraging their strengths to create novel and culturally rich works that promote the integration of technology and art.

5. Conclusion

AIGC-based image generation holds untapped potential in product design, currently enhancing designer efficiency by rapidly translating concepts into visual prototypes and enabling customized consumer services. However, challenges persist, including deficient emotional expression, homogenization-induced copyright disputes, and insufficient humanistic considerations. AIGC will not replace human designers but establish a complementary relationship, jointly advancing intelligent evolution in the design industry.

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