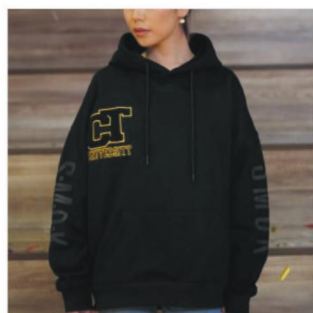


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СИТИ Их сургуулийн бусдаас ялгагдах өвөрмөц байдал, нэр хүндийг гадагш илэрхийлэх гол зүйл бол Сити брэнд бүтээгдэхүүнүүд билээ.

Бид Алсын хараа болон стратеги төлөвлөгөөндөө өөрсдийн брэнд бүтээгдэхүүнийг хөгжүүлэх ажлыг онцгойлон тусгасаны эхлэл болгож дурсгалын зүйлс болон хувцасны коллекцыг бүтээн хөгжүүлж эхлээд байна. Цаашид уг ажил улам өргөжин нэр төрлөө нэмэн Сити брэндийн эко системийн салшгүй нэг хэсэг болох юм.

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EXPLORATION OF THE APPLICATION OF ARTIFICIAL INTELLIGENCE GENERATED CONTENT (AIGC) IN URBAN FURNITURE DESIGN

Keyword: Artificial intelligence, AIGC, Urban furniture, Intervention methods, Effect comparison

ABSTRACT

In the era of artificial intelligence, the wide application and rapid iteration of AIGC promote the paradigm transformation of traditional design process. Exploring the intervention mode and partial application effect of AIGC in urban furniture design is of great significance for clarifying the current technical situation and promoting the development of technology integration. Firstly, the development process and application characteristics of AIGC were summarized. Secondly, the 9 intervention methods of AIGC in urban furniture design were expounded. Finally, based on the determination of evaluation indicators, Delphi method and SPSS were used to compare and evaluate the "basic design effect, improved design effect and differentiated design effect" of 7 AIGC tools in urban furniture design. In the comparison of 7 AIGC tools, Midjourney had the highest comprehensive evaluation in the above three aspects. AIGC has great potential in the field of urban furniture design, and the cross-modal fusion application of integrated design professional software may become an important inflection point in the transformation of AIGC from a popular tool to a professional tool.

INTRODUCTION

Since the second half of the 20th century, with the continuous development of computer science and technology, "computer tools and network platform" plays a more and more important role in all aspects of design. From AutoCAD, Photoshop to 3DMax, BIM, from AR, VR to MR, XR, from virtual simulation technology to digital twin technology, metauniverse scene, how to better use computer tools and other scientific and technological means to improve the efficiency of design, reduce the cost of design, strengthen the performance of design, and ensure that the design goal can be achieved. It has become a frontier topic in the field of design and computer science. In November 2022, the release of ChatGPT marked the breakthrough of AI-generated Content (AIGC) technology, and the era of symbiosis with artificial intelligence suddenly arrived in a way that caught people off guard 1. New tools, new content, and new production methods once again impacted everyone in design research and design practice.

1. The development course of AIGC

In accordance with the process of the development of artificial intelligence, AIGC since the 1950s, 60 years of infancy, 10 years of technical accumulation stage, and in recent years, with the rapid development phase. The first computer was born in 1946 2; In 1957, L.Hiller and L.Isaacson created string quartet "The Illiac Suite" by using automatic computer 3; In 1966, J.Weizenbaum of MIT Artificial Intelligence Laboratory developed Eliza 4, the first chatbot in history. In the embryonic stage,

due to the long development cycle, high cost and lack of maturity, AIGC did not make a major breakthrough. From 2007, the world's first completely by artificial intelligence creation novel "1 The Road ", in 2014 to the Los Angeles times reported robot Quakebot wrote an earthquake 5, and then to 2018 nvidia released can be automatically generated StyleGAN model of pictures, The iteration and update of deep learning algorithm and generative adversarial network lay a technical accumulation for the vigorous development of AIGC in the future. In 2021, OpenAI launched DALL-E; In 2022, OpenAI released ChatGPT, a model for generating fluent natural language text. In 2023, Meta Alpaca, GPT - 4, PaLM - E, wen xin a word, Office Copilot, Midjourney V5 successively, such as the rapid development of AIGC stage formally.

At present, there is no unified and standardized definition of AIGC in the world, and various researchers and institutions try to describe it from different emphasis. In research focused on technology, China Academy of Information and Communications Technology and JD Research Institute jointly issued the "AIGC white paper" will be defined as "by artificial intelligence algorithms to make production, manipulation, and changes to your data or the media generally referred to as the", and that is a collection of production content and technology, it is important to note that the concept of recognition is higher, more scholars to the reference in related research. From the perspective of generative AI and artificial intelligence synthetic media concept, Zhan Xini 6 proposed that AIGC's independent innovation includes "local generation based on key strategy clues, low-level understanding and fusion generation based on multi-modal content, and feature generation based on comprehensive or segmented scenes". In the research focusing on technical ethics, Chen Changfeng 7 emphasized that AIGC "is the content created with the help of artificial intelligence algorithm", and Wang Youmei 8 proposed AIGC as "the content creation subject by artificial intelligence, using deep learning algorithm and scene decision model and other technologies to generate results".

2. Application characteristics of AIGC

In terms of technical research, Li Baiyang 9 summarized the technical characteristics of AIGC into four aspects: "huge quantification of data, creativity of content, cross-modal integration and cognitive interaction". At the level of user experience, the characteristics of AIGC are reflected in the autonomy of the generated content, the large scale of meeting different needs, the customizability of personalized generation according to user needs, and the high efficiency of short time generation. At the same time, there may be errors and inaccuracies in the generated content results.

AIGC can be divided into several tool types accord-

ing to different usage scenarios. "Text tools" can generate text content such as articles, abstracts, titles, dialogues, stories, poems, lyrics, etc., often using natural Language Processing (NLP) techniques such as neural networks, language models, text analytics, etc. "Image tools" to generate image content such as photos, ICONS, illustrations, comics, artwork, etc., typically using Computer Vision (CV) techniques such as convolutional neural networks (CNNS), Generative adversarial networks (GAN), image style transfer, etc. "Audio/Video tools" can generate video content such as music, sound effects, speech, voice acting, animation, movies, presentations, tutorials, etc., often using signal processing (SP) techniques such as recurrent neural networks (RNN), Variational autoencoders (VAE), waveform synthesis, multimedia (MM) techniques such as video coding, video editing, video synthesis, etc. "Code generation tool" can generate program code, web code, database code and other code content, usually using programming language theory (PLT) techniques, such as Abstract syntax tree (AST), Parser, code optimization, etc.

With the continuous breakthrough of the underlying technology and basic model, the digital intelligent fusion environment has endowed AIGC with more powerful intelligent computing capabilities, a wider range of data corpus resources, a more general task training model and a more flexible information participation mode 10. Its influence is obvious. On the one hand, the cooperation of different types of AIGC tools can map user demands more accurately. On the other hand, the iteration, expansion and multi-field application of AIGC may overturn the existing way of life and production. Therefore, it is essential for the design discipline to actively explore new ways of using tools and compare the effects of different tools.

3. Application method and process of AIGC in urban furniture design

3.1 Research status of urban furniture design

The concept of "urban furniture" originated in Europe. However, due to the differences in historical process of urban construction, infrastructure, urban culture, development strategy and other aspects, different countries have different understandings of urban furniture and construction policies. In recent years, China has made outstanding achievements in infrastructure construction, and some relevant studies are representative. Bao Shidu¹¹ the earlier proposed the urban furniture such as systematic theory and urban furniture can be divided into six systems and 45 categories, and several design practice in zhejiang province and Shanghai; CAI Yuchao¹² summarized the concept of urban furniture from five perspectives, and proposed the triple dimensions of "human design, rational design and perceptual design" in urban furniture design. Gao Tanhao¹³ used urban furniture as the carrier of art healing and put forward

the intervention strategy of art healing. In addition, some scholars have studied urban furniture design strategies and design practices from the perspective of chinese regional culture and urban culture^{14, 15}, or from the perspective of contemporary urban lifestyle^{16, 17}.

3.2 Aigc intervention in urban furniture design

(1) Intervention in data collection and analysis. Aigc tools can collect various data of the city, including geographic information, socio-economic data, traffic data, meteorological data, etc., And analyze and model these data through data mining and machine learning technologies to reveal the potential problems and needs of the city. For example, data mining and machine learning techniques are used to analyze data, such as cluster analysis, association rule mining, classifiers, etc.

(2) Intervention in spatial analysis. Aigc tools can help decision-makers understand the physical structure and spatial organization of cities, as well as the spatial relationships and interactions between different areas through spatial analysis, including techniques such as three-dimensional modeling and spatial planning. Such as arcgis, qgis, etc., To analyze the spatial characteristics and relationships of cities.

(3) Social analysis intervention. Through social network analysis, emotion analysis and other technologies, help decision makers to understand the behavior habits of urban residents, cultural characteristics, social needs and other aspects of information, to provide more in-depth and comprehensive insight for urban furniture design. Such as vader, textblob, etc., Analyze the emotional tendency and attitude of urban residents to different topics.

(4) Intervention in environmental analysis. Environmental sensing technology, remote sensing technology and other means to help decision-makers understand various factors of the urban environment, including climate, soil, water, air quality and other aspects of the data, as well as the characteristics of the urban ecosystem and natural landscape.

(5) Intervention in image recognition and analysis. The aigc tool can analyze the elements such as buildings, roads and signs in the city through automatic perception technologies such as image recognition and classification, speech recognition and natural language understanding, and obtain the color and image characteristics of each urban area through algorithm processing, so as to understand the overall image and style of the city. For example, ibm watson studio can process image, voice, text and other data to realize the analysis and recognition of color and image in the city, and provide corresponding data and design ideas.

(6) Intervention in urban element extraction. Aigc tools can use deep learning, computer vision, natural language processing and other technologies to extract the basic elements (such as buildings, roads, green space, water, etc.) And characteristic attributes (such as form, function, style, atmosphere, etc.) Of a city from various

data sources (such as satellite images, geographic information systems, social media, literature, etc.). And it is presented to users in a visual or textualized way to facilitate users to analyze and evaluate the urban space.

(7) Intervention in urban element redesign. Aigc tools can edit, transform or create urban elements according to user input (such as modifying parameters, adding conditions, proposing goals, etc.), Use generative adduction network (gan), variational autoencoder (vae), neural style transfer (nst) and other technologies to generate new urban space schemes, and display them to users in the form of images or videos. For the user's reference and choice.

(8) Involvement in strategic writing. Aigc tools can automatically generate or assist in the generation of urban furniture classification standards and rules by analyzing a large number of urban furniture data, as well as corresponding classification examples and instructions. For example, gpt-4 can help designers generate classification standards, rules, examples, descriptions and other text content of furniture in a city or a specific area of the city.

(9) Intervention in the design and management of intention images. On the one hand, aigc tools can simulate the performance of urban furniture in the real environment through keyword translation, automatically generate or assist the generation of renderings, animations, videos and other multimedia content, and with text analysis tools for corresponding evaluation. Such as dall-e2, midjourney v5, dreamstudio, wenxin yige can help designers generate urban furniture design drawings, parameters, renderings and other image content. On the other hand, aigc tools can help managers and maintenance personnel through the internet of things (iot) or blockchain technology, real-time monitoring and recording of urban furniture use, damage, maintenance and other data, analysis and optimization, improve management efficiency and quality.

4. Comparison of application effects of different aigc tools in urban furniture intention image design

4.1 Comparison process

In order to explore the current use of mainstream aigc tools in urban furniture design practice and compare the application effects of different aigc tools in urban furniture design, this study focuses on the "intention image design" link in the "classification design" stage of the design process. The type of urban furniture should be limited to "urban public seating", and input conditions, different variables, and comparison contents should be worked out in three ways (table 1). The results of design intention maps generated by aigc tools such as midjourney, disco diffusion, dreamstudio, wenxin yige, draft, 6pen art and inception developed on different platforms at home and abroad (table 2) are quantitatively compared and analyzed. At the same time, the framework content of comparison index is

set up by Delphi method, and the results generated by AIGC tool are compared and analyzed respectively from the aspects of design effect, design improvement effect and differential design effect. The purpose is to explore how to use artificial intelligence technology to assist the design of urban furniture, and improve the innovation and efficiency of the field, and the comparison results will reflect the technical application effects of different AIGC tools in the current

	Same condition	variables	Content of comparison
Method 1	Same keyword	Different AIGC tools	Compare the design effects of different AIGC tools
Method 2	Same AIGC tool Same keyword category	Different number of keywords	Compare the design improvement effect of different AIGC tools
Method 3	Same keyword group	Different city Settings (Beijing, Hangzhou)	Compare the differentiated design effect of different AIGC tools

Tab.1 Three methods of controlling variables

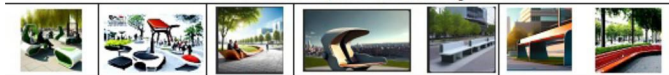
In order to explore the use of the current mainstream AIGC tools in urban furniture design practice and compare the application effects of different AIGC tools in urban furniture design, this paper will focus on the "intentional image design" in the "classification design" stage of the design process. Will be the type of urban furniture limited to "urban public seating", Limit the type of urban furniture to "urban public seating", set three methods of controlling variables (Table 1), and use AIGC tools (Midjourney Disco Diffusion DreamStudio Wenxin Yige Draft 6Pen Art Printidea) developed on different platforms to produce a design image (Table 2). Finally, Delphi method was used to compare and analyze the results generated by different AIGC tools from the aspects of design effect, design improvement effect and differentiated design effect. The comparison results would reflect the technical application effect of different AIGC tools at the current stage.



CONTENT OF DESCRIPTION

(Design scope+scene description)

Urban furniture; renewable city design; smart cities; public seats; multi-function seats; street views; future parks



CONTENT OF DESCRIPTION

(Design scope + scene + detail description)

Urban furniture; Urban renewable design; Smart city; Public seats; Multi-functional seat; Streetscape; Future Park; Finely curved; Curved but smooth; Full of motion; Metallic; Luminous; Unconventional; Personalized; Very futuristic



CONTENT OF DESCRIPTION

(Based on the same keywords, limited by different urban backgrounds)

City furniture, seating, Beijing, Hangzhou



Tab.2 Production results of different AIGC tools under different conditions

4.2 Frame and method for developing comparative indicators

Based on the "Research on the Standardization of Chinese Urban Furniture" as the logical framework and the design principles of urban furniture as the starting point, through the basis of literature research^{18, 19} and design practice experience, the common indicators that can reflect the design characteristics of urban furniture are selected to formulate the construction of "comparison indicators". The results of the comparison index construction are: "Design effect", "design improvement effect" and "differentiated design effect" are the first-level indicators. "The accuracy of keywords, the expressiveness of materials, the beauty of shapes, the innovation of designs, the matching degree of environments, the safety of forms, the accuracy of proportions and sizes, the rationality of color generation, the accuracy of background environment, sustainability, and the economy of costs" are the secondary indicators (Table 3).

Primary index	Secondary index
Design effect (A)	The accuracy of keywords (a1)
	Expressive force of material (a2)
	The beauty of the shape (a3)
	Innovation of design (a4)
Design improvement effect (B)	The match of the environment (b1)
	Security of form (b2)
	Accuracy of scale dimensions (b3)
	The rationality of color generation (b4)
Differential design effect (C)	Accuracy of the background environment (c1)
	sustainability (c2)
	Economics of cost (c3)

Tab.3 Proposed comparative indicators

4.3 Select Consultation Experts

According to the principles of representativeness and authority, 20 experts from this study are from 8 universities or scientific research from Tsinghua University, Tongji University, Harbin University of Technology, Zhejiang University, Southeast University, Yanshan University, Guangzhou University, and Guangdong University of Technology. The hospital involves three disciplines in three disciplines including design, art, drama, and film and television science, of which 78.3% of the experts are engaged in design disciplines. Experts aged 40-49 have 9 people (45%), the lowest working life is 10 years, with a maximum of 31 years. 45% of experts have a doctorate degree (Table 4).

Subject name	First level discipline	Percent
Design science	Environmental design	30.4%
	Visual communication design	4.4%
	Product design	26.1%
	New media art	17.4%
Fine arts	Photography	13.0%
Drama and film	Film production	8.7%

Tab. 4 Composition of experts

4.4 Establishment of comparative indicators

The survey was divided into two times. For the first time, experts were asked to answer structured questionnaires. In order to improve efficiency, 20 experts were interviewed online and offline. The importance of indicators was required to evaluate 3 primary indicators and 11 secondary indicators on a Likert scale of 9 sub-scales. For example, the X indicator is extremely important relative to the Y indicator, at this time, score 9; Index X is extremely unimportant relative to index Y, so the score is 1/9. The importance of indicator X is the same as that of indicator Y, which is 1 point. The scores of 20 experts were calculated, and the change in the appropriateness ratio of the first and second opinions of the experts was analyzed and the data was obtained (Table 5).

Primary index	Secondary index	CVR	AVG	StdDev	Mean	G.A.
A	The accuracy of keywords (a1)	1.00	6.69	0.75	7.00	5.90
	Expressive force of material (a2)	1.00	5.94	0.60	6.00	
	The beauty of the shape (a3)	0.75	5.81	1.02	6.00	
	Innovation of design (a4)	0.62	5.19	0.80	6.00	
B	The match of the environment (b1)	1.00	5.32	1.19	6.00	5.58
	Security of form (b2)	0.87	5.81	0.75	7.00	
	Accuracy of scale dimensions (b3)	1.00	5.19	0.80	7.00	
	The rationality of color generation (b4)	0.87	6.00	0.60	6.00	
C	Accuracy of the background environment (c1)	0.62	5.19	0.60	6.00	5.04
	sustainability (c2)	0.75	5.31	1.06	5.00	
	Economics of cost (c3)	0.37	4.63	1.45	4.00	

Tab.5 Delphi Method First Expert Survey Results (N=20)

According to the results of the first Delphi survey, one secondary index with a minimum CVR value below 0.42, namely "Economics of cost (c3)", was removed. Through two Delphi Method screening, the optimal application index of artificial intelligent-generated content (AIGC) in urban furniture design in this study is proposed. The CVR values of 10 secondary indicators are all above 0.42, which meets the requirements. The standard difference and other relevant scores meet the requirements, and finally determine 3 first-level indicators and 10 second-level indicators (Table 6).

Primary index	Secondary index	CVR	AVG	StdDev	Mean	G.A.
A	The accuracy of keywords (a1)	1.00	6.56	0.72	7.00	6.17
	Expressive force of material (a2)	1.00	6.37	0.61	6.00	
	The beauty of the shape (a3)	0.87	6.19	0.98	6.50	
	Innovation of design (a4)	0.75	5.56	1.15	6.00	
B	The match of the environment (b1)	0.75	5.69	1.30	6.00	5.70
	Security of form (b2)	0.87	5.00	1.01	5.50	
	Accuracy of scale dimensions (b3)	1.00	6.13	0.75	6.50	
	The rationality of color generation (b4)	0.87	6.00	0.60	6.50	
C	Accuracy of the background environment (c1)	0.75	5.19	1.02	6.00	5.16
	sustainability (c2)	0.75	5.13	1.27	5.50	

Tab.6 Delphi Method Second Expert Survey Results (N=20)

4.5 Analysis of the results of comparison between different AIGC tools in urban furniture intention image design

Based on the above content, a questionnaire survey was conducted to evaluate the optimal application indicators of AIGC generation tools developed on different platforms. The survey was conducted over a 25-day period from May 1 to May 25, 2023. A total of 300 questionnaires were conducted for practitioners and students related to design, fine arts, drama and film. 43 invalid questionnaires were excluded and 257 valid questionnaires were obtained, and the evaluation results were applied to the research analysis. Before the questionnaire survey, the researchers introduced the overall research content and terminology to the respondents, and provided relevant materials, so that they have an understanding of the definition of artificial intelligence-generated content, urban furniture design and other related terms. After that, the respondents were introduced to the evaluation indicators and evaluation methods. The main content of quantitative questionnaire survey is to investigate the applicability of 3 primary indicators and 10 secondary indicators in the questionnaire survey, and score their applicability and application degree on the Likert scale of 5 points (1 point is very dissatisfied, 2 points is slightly dissatisfied, 3 points is average, 4 points is slightly satisfied, 5 is very satisfied) to measure respondents' subjective judgment of the results of the images generated by AIGC. The questionnaire survey results were quantitatively analyzed by Microsoft Excel and SPSS11.5 statistical software, and the results were as follows (Table 7).

Index AIGC	Mid journey	Disco Diffusion	Dream Studio	Wenxin Yige	Draft	6Pen Art	Printidea	
A	a1	4.79	4.25	3.99	3.93	3.84	4.05	3.97
	a2	4.21	3.81	3.60	4.22	4.14	3.70	3.73
	a3	4.00	3.24	3.17	3.94	3.32	3.66	3.43
	a4	3.84	3.73	3.41	3.59	3.10	3.68	3.61
B	b1	3.47	3.54	3.56	3.26	3.47	2.96	3.64
	b2	3.41	3.26	3.62	3.47	3.36	3.30	3.42
	b3	3.65	3.15	3.72	3.24	3.19	3.47	3.26
	b4	3.69	3.86	3.10	3.12	3.61	3.21	3.91
C	c1	3.52	2.93	3.41	3.04	2.92	3.45	3.40
	c2	3.00	2.67	3.47	3.45	3.12	3.12	2.98
G.A.	3.76	3.44	3.50	3.52	3.40	3.46	3.53	
Sequence	1	6	4	3	7	5	2	

Tab. 7 Survey results of different AIGC generation results

Based on 3 first-level indicators and 10 second-level indicators, it can be seen that Midjourney has the highest comprehensive score among the above AIGC tools, and has a certain learning foundation for the word "urban furniture". It can not only understand user needs through simple keywords, but also draw it more accurately based on different descriptors. The following reviews were in order: Printidea, Wenxin Yige, Dream Studio, 6Pen Art, Printidea, Disco Diffusion, Draft.

In the evaluation of design effect, when the same simple keywords are used, Midjourney is the most accurate and innovative, and has the highest aesthetics. Wenxin Yige is the most prominent material. But Wenxin Yige and Draft and Printidea made obvious errors in identifying keywords, resulting in lower scores. In the initial identification of the keyword "urban furniture", most of the tools performed poorly, and Midjourney has a clear advantage in it. In the evaluation of the design improvement effect, when the keywords are added at the same time, Dream Studiot improves the environment matching degree and safety degree significantly, Printidea performs particularly well in the color improvement processing, while Disco Diffusion and 6Pen Art perform poorly in the scale scale. In terms of adding keywords to observe the improvement effect of design, Printidea and Midjourney have better improvement effect. In the comparison of the effect of differentiated design, when the main body of the keyword group is unchanged and only part of the keywords are changed, Midjourney, Dream Studio and Printidea all perform well in the background accuracy, while Disco Diffusion can hardly effectively identify the changed keywords.

In general, AIGC tools can play a good auxiliary role in the "intention image design" of urban furniture design, but the gap between different tools is obvious, and the tool that is relatively stable in all aspects is Midjourney.

Conclusion

Through the practical operation experience of multi-platform and multi-type AIGC tools, it can be concluded that as a new generation of computer science and technology tools, AIGC can assist designers to automatically generate data conclusions, text, images, videos and other parts of the work, and then play a role in speeding up the design process and broadening the creative vision to a certain extent. At the same time, at the technical level, cross-modal fusion applications and embedded applications will become the next inflection point of AIGC application scenarios.

It is undeniable that the period of rapid development of AIGC has arrived. In the process of writing this paper, new platforms and new tools are constantly refreshing the public's cognition of the boundaries of artificial intelligence work, which has also caused many scholars and institutions to worry about, doubt, and even opposition to AIGC, which is mainly manifested in content copyright, technical ethics, privacy and security. For example, in December 2022, thousands of artists launched a huge protest against AI works on the world-famous painting sharing platforms such as Artstation and Deviantart 20. Li Mingde, director of the Intellectual Property Center of the Chinese Academy of Social Sciences, said that the Copyright Law only protects human works. Ai-generated content is not a work and has no copyright.

In this context, a series of issues such as how to apply AIGC reasonably and in compliance, and how to adapt China's AIGC industry to national conditions still need to be further explored.

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