AI-Enhanced Architectural Animation: Exploring the Intersection of Technology and Aesthetic Narratives in Spatial Design

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Abstract: In the context of the development and progress of human civilization, AI technology (Artificial Intelligence) continues to develop and gradually combines with all walks of life in the market, which has attracted people's attention. Compared with traditional planar drawing and three-dimensional animation, architectural animation and space design based on AI technology can integrate technology and aesthetic narrative to strengthen the efficiency and effect of space design. With the interweaving of technology and aesthetics, AI technology realizes the innovation of architectural space design and brings a new experience for space design. This paper starts with the development of AI technology in space design, defines the design of intelligent building control system based on AI, puts forward the application strategy of AI technology in building space design, and finally explores the development trend of AI-enhanced architectural animation.
Keywords: AI; Architectural Animation; Aesthetic Narrative; Space Design

1. INTRODUCTION

AI technology belongs to an emerging technology, mainly used in simulation, development and other aspects, which extends the related theories and methods of human intelligence. It belongs to the branch of computer science. Through the analysis of the nature of intelligence, it has developed a technology that can simulate human intelligence. Since the application of AI technology in the market, related theories and technologies have gradually matured, and the application scope has also been expanded. Building animation based on AI technology can structure its new space environment through images, graphics, audio, etc., and strengthen the experience of space design. The application of AI

technology in the design of building space can not only meet the design needs of buildings, but also meet the spiritual needs of residents, and strengthen the safety of buildings while ensuring the efficiency of design and construction.

2. THE DEVELOPMENT OF AI TECHNOLOGY IN SPACE DESIGN

In recent years, the application of Generative Artificial Intelligence (GAI) technology in the market has become more and more extensive. This technology has made a great breakthrough in related underlying technologies, and human technology development level is facing new changes (Cao, 2023). AI is gradually coming into people's life, and everyone is familiar with AI. Especially in the background of hardware development, training models based on AI technology have strong capabilities. Among them, the computing power shows an exponential growth, which promotes diffusion models, dialogue models, multimodal models and other models to become reality. It can be seen that the development and application of AI technology has had a subversive effect on many industries, such as painting industry, language industry, visual industry, etc., which can simulate the work scene. AI research and development companies and AI technology companies have sprung up in the market to explore the application of AI technology in the creative field, and these emerging technologies have gradually entered the practice stage (Zhong & Luo, 2023). From the perspective of marketing, there are already large language models in the current market, such as Chat GPT, which can directly generate articles, copywriting and so on according to the needs of users. It can also be applied to the field of computer programming, which does not require programmers to operate and can generate coding structures according to needs (Yuge Guo, 2023). In addition, it also has strong application in the field of art, which can use drawing tools to directly generate pictures according to text description or code. Based on this, the application of artificial intelligence is very wide, and it can realize the replacement of traditional artificial in many fields (Chen & Ibrahim, 2023). With the development of technology, AI technology is developing to higher dimensional data format. Such as video simulation, geometric model simulation and so on (Yu, 2021). At present, there is also the application of AI technology in the field of architectural animation. The combination of architectural technology and AI technology can improve the efficiency

of architectural space design while ensuring the rationality of the design, and can also judge and warn the complex construction content (As et al., 2022). From the perspective of the development trend of the construction industry, society is progressing and technology is developing continuously, which brings new direction and power to the reform of emerging industries. With the changes of the market and the impact of new elements brought by emerging industries, the staff in traditional industries will be greatly affected in the process of daily work, resulting in many unpredictable factors. Virtually increased the architectural design risk. According to the current market development situation, the direction of the construction industry is green, intelligent and industrial (Cui et al., 2020). Automation and modularization are the key to the combination of automation technology and the construction industry, and also the basis to promote the construction industry to achieve a high level of industrialization. The fundamental goal of the construction industry is to achieve a product-driven manufacturing model. Only a high level of automation can promote the goal to reality. Green mainly refers to low carbon environment, our country put forward the strategy of ecological protection, energy saving and emission reduction, under the background of actively responding to the call of the state, the construction should also strive towards the green direction (Sciannamè & Spallazzo, 2021). Not only in the construction level, but also in the operation and maintenance level, through the use of green building materials, to achieve the effect of energy saving and emission reduction. Intelligence is mainly related to artificial intelligence technology, which contains two levels of significance. One is digitalization, which makes full use of information resources. Based on information technology, it realizes the interaction between building business and technology, and strengthens information acquisition and information management functions. The second is the acquisition of knowledge in the aspect of construction engineering and the input of information into the machinery and equipment, so that the machinery and equipment can produce the ability of perception, thinking and other aspects, and can respond to and execute the instructions put forward by people in time. In "Industry 4.0", the concept of "intelligent manufacturing" is proposed. In the process of building space design and development, the traditional method mainly starts from the perspective of industry, designers and construction enterprise managers pay great attention to this, but under the background of AI technology, it subverts people's cognition, and emerging technologies are gradually recognized by people. It has created a lot of benefits for human beings and industries. In

comparison, the benefits created by human individuals or organizations are much lower than technological benefits. Therefore, in many fields, artificial is on the decline, and the application of AI technology will also accelerate the process of intelligent development (Chen, 2020).

3. DESIGN OF INTELLIGENT BUILDING SPACE SYSTEM BASED ON AI

In the AI-based intelligent building space system, the first is the system framework design. The framework architecture is the basis of the system design, but also the basis of the design of other parts. The classical system contains the data input module. Data processing module, data output module, data management module and human-computer interaction module, each module exists independently, but can influence each other. Through unified data and specific instructions, the system framework can be improved (Wang et al., 2023). In the data acquisition module, it is the first step in the design of building space system, and its main function is to acquire, collect and process all kinds of information. In this part, the source of data is considered to lay the foundation for the accuracy of data. Then, through the pre-processing mode, the primary processing of data is carried out to screen out effective data and eliminate invalid data. In the process of design practice, there are many ways to collect general data, such as importing data, web crawler and API interface acquisition (Wang et al., 2024). In the data control module, it belongs to the key of building space system design, the main function is to process and analyze the data, and finally belongs to the data result. In this module, the focus of consideration lies in the processing and analysis of the data, combining different needs, selecting appropriate design scheme and construction technology, so as to ensure the space design work can be carried out orderly. And it has high stability. In the process of actual design work, the control module needs to dock with various programming languages and programming tools of AI technology, such as Python, Java, C++, etc. In addition, it can also directly apply data processing and analysis libraries to process data. Common data processing and analysis libraries include Num Py, Pandas, Scikit-learn, and so on. In the optimization module, it is one of the core links of the architectural space design system, which can realize the optimization of the system, strengthen the performance of the system, and improve the efficiency of the application of AI technology. The development of optimization module design mainly depends on the design system

performance, design scheme evaluation and other aspects. System tuning, algorithm optimization, structure optimization and other tools are one of the commonly used tools of this module. Through the development of optimization work, the stability of AI building space design system can be guaranteed. In the process of practical application, the optimization of the design system can promote the role of technology and tools (Steane, 2023). In terms of human-computer interaction module, this module is one of the more practical modules. Its main function is to receive data on the needs of users, and output programs for users to realize the interaction between users and designers. In terms of interpersonal interaction, user data security and user information privacy, etc., need the best protection and protection work. Human-computer interaction module can be implemented based on front-end technology, common technologies include HTML, CSS, Java Script, UI/UX, etc. In addition, back-end framework can also be improved, such as Flask, Django, etc.

4. APPLICATION OF AI TECHNOLOGY IN ARCHITECTURAL SPACE DESIGN

4.1 Simulating Real Three-Dimensional Space Design

In the current society, the requirements of architectural space design are relatively high and rigorous, mainly because the architectural design will have a direct impact on the aesthetic appearance of the building, the rationality of the internal structure and the safety of users. For architectural space design, the safety factor is the key, all the design needs to be carried out on the basis of safety, to ensure the effective development of the follow-up links. AI technology can simulate the real three-dimensional space of architectural projects and lay the foundation for the specific development of design work. Based on AI technology, designers can fully reflect their own design thinking, or design separately according to modules, and integrate the design in the end to feel the effect of architectural space design from an overall perspective, intuitively excavating the advantages and disadvantages of space design, so as to improve the feasibility of the design scheme. In addition, designers can also adjust the design scheme in real time based on the function of AI visualization, so that the architectural space can be beautiful and comfortable (Stephens, 2023). In the application process of AI technology, the architectural space design scheme can be displayed from multiple dimensions such as plane, elevation and section, so that users can see a

more realistic design scheme, improve the user's sense of substitution in the scheme, and make it easier to understand the relationship between the space design and the surrounding reference objects. On this basis, the environment and color can be integrated, so that the visual effect of the design can be optimized. The architectural space design needs a three-dimensional design effect. In order to reflect the three-dimensional effect in the building, it can be realized by the light model. Based on the light related principle, the designer simulates the reality to show the effect of light in the space design (Oumaima et al., 2023).

4.2 Comparison and Selection of Optimal Design Schemes

In the traditional architectural space design, the interaction between designers, users, design schemes and construction personnel is insufficient, and the design lacks authenticity. After the design is completed, there are great difficulties in the comparison and selection of schemes, and more professional comparison is needed to make a choice. However, building space design based on AI technology has strong interactivity. Designers can use computers to realize the interaction with the scheme. Different users have different needs, and designers can design a variety of qualified schemes according to the environment of building construction, cost requirements and user needs. Then combined with the user needs to screen and modify the scheme, and finally design the best scheme. Through AI technology, a variety of schemes can be designed, and different types of schemes have different advantages. Under AI technology, each scheme can be shown in the form of three-dimensional models, and users can intuitively see the advantages and disadvantages of each scheme, which is convenient for the selection of schemes. Especially in the process of analyzing the scheme, the scheme can be switched at will. When studying the details, the details in the model can be enlarged and processed, so as to provide professional guarantee for the architectural space design through rigorous analysis.

4.3 Comprehensively Reflect the Overall Information of the Building

The traditional architectural space design work also uses computer technology to assist, such as CAD, but has not yet been able to perfect the display of each location information of the building project. Contemporary designers pay more attention to innovation, which is also the main requirement of users, but there is a disadvantage here, designers are used to amplify their own innovative elements and design advantages, etc. There

is a certain neglect of user needs, that is, while satisfying part of the user's needs, there are also some unmet needs. The use of AI technology can effectively solve this problem (Touretzky et al., 2023). AI technology can comprehensively display the contents of the building space, including every detail. Based on the tangible display, users can also have a deep understanding of the whole situation of the building project and each location information, etc., after understanding the overall framework, and then show the details, such as the interior space design of the building, the external parameters of the building, etc., through the real experience of the visit, to provide users with opinions. Based on AI technology, designers can also communicate with users more conveniently, understand their needs, and provide designers with highly feasible design schemes and ideas (Xu, 2018).

4.4 To Monitor the Late Construction of Architectural Design

From the perspective of the whole process of construction project, space design is in the early stage, so that the important part of the construction project, the level of design will directly affect the effect of the future use of the project. With the improvement of people's quality of life, the requirements for architecture are gradually increasing. Therefore, architectural projects should not only ensure practicality and safety, but also take into account the sensory experience of the audience, that is, the visual needs, etc., so the architectural space design needs to comprehensively consider many factors. In the process of actual design work, the first work is to study the feasibility and difficulty of the construction project. Based on AI technology, the overall information of the construction project is controlled, and then specific to the local information of the building, AI technology can carry out simulation work from the perspective of physics, simulate and demonstrate the actual situation of building construction, and realize the identification of possible risks in building construction. Then, based on the risk factors and difficulty coefficient, the design scheme is adjusted to lay the foundation for the orderly development of design and construction. Secondly, in the application of AI technology in space design, it has the function of remote control. In the actual construction process, the construction party and the designer can realize real-time communication. When problems are encountered, they can also be solved in time based on AI technology, which shows that AI technology strengthens the authenticity and practical function of architectural design.

5. DEVELOPMENT TREND OF AI-ENHANCED ARCHITECTURAL ANIMATION

The development of AI technology originated in the 1990s, when Columbia University set up a special course for this technology to explore the combination of AI technology and architectural space design. Subsequently, the School of Architecture Alliance, the Massachusetts Institute of Technology and the Melbourne Institute of Management also carried out AI design courses one after another, and AI architectural design gradually spread around the world. After years of development, the combination of AI technology and architectural design has explored a new way for the development of architectural space design industry. With the development and application of computer technology, computer technology reveals powerful functions, such as rich functions, fast speed, large storage and so on. Relying on computer technology, the integration of AI technology and architectural space design provides new ideas for architectural space design work. At the end of the last century, the function of graphics software was gradually strengthened (Yanqi Guo, 2023). Programmers could provide program interfaces through the script program of image software or Visual, C++ and other environments to realize the secondary development of graphics software and provide auxiliary functions for the development of architectural space design. Modern architectural space design is characterized by complexity, and AI technology can fully display its complexity, so that the architectural surface design can be continuous and high-level, which is more logical than traditional architectural design. From the perspective of the current situation of the development of the domestic construction industry, AI technology has also begun to integrate into the architectural space design, but it is not deep enough and still stays in the outer level of space, skin and so on. Nowadays, the global construction industry is combined with science and technology, and AI technology is gradually popular. The construction industry in our country needs to strengthen the design and management ability to gain a firm foothold in the international market and stand out. There are many factors that can affect the competitiveness of the architectural design industry, among which digital technology and computer technology are one of the more prominent factors. Only by making full use of technology can we improve ourselves in the modern market environment. If we cannot make full use of technology, then the architectural design enterprises in our country will gradually become "manufacturers" in the world. It is at the bottom of the international

architectural design industry chain. If we simply buy foreign software and design, it is difficult to improve the level and ability of domestic architectural space design. Therefore, it is necessary to learn from foreign technology, study the relationship between AI technology and architectural space design, clarify design concepts and design patterns, and innovate new ways of space design with the help of the "east wind" of technology.

6. CONCLUSION

In summary, this paper starts with the analysis of AI technology principles, introduces the development of AI technology in architectural space design, summarizes the specific interactive design of AI technology in space design, explores the application strategy of AI technology in architectural space design, and finally prospects the development trend of AI-enhanced architectural animation. In today's society, the development of science and technology is changing with each passing day. As an emerging technology, AI technology can enhance architectural animation and improve the portability and effect of space design. With the development of The Times and technology, AI technology will gradually enter people's lives, integrate into the architectural space design industry, boost the development of architectural space design, and realize the intersection of technology and aesthetic narrative in space design.

References

As, I., Basu, P., & Talwar, P. (2022). *Artificial intelligence in urban planning and design: technologies, implementation, and impacts*. Elsevier.

Cao, W. (2023). "Analysis of the Application of Symbolic Aesthetics in the Design of Urban Public Spaces" *Beauty and Era (Urban Edition)*(9), 71-73.

Chen, X., & Ibrahim, Z. (2023). A Comprehensive Study of Emotional Responses in AI-Enhanced Interactive Installation Art. *Sustainability*, *15*(22), 15830.

Chen, Y. (2020). "Research on Immersive Experience and Atmosphere Creation in Space Design Scene Animation". *Architecture and Culture*(9), 215-216.

Cui, Z., Guo, Y., & Shi, M. (2020). "Research on AI-Assisted Nursing Home Architectural Design Based on cGANs". *Residential Technology*, *40*(11), 31-34.

Guo, Y. (2023). "Analysis of Public Space Design Strategies Based on Eastern Aesthetics". *Beauty and Era (Urban Edition)*(7), 96-98.

Guo, Y. (2023). Examining the Impact of Assistive Technology on Psychological Health, Family Education, and Curriculum Research in Japan: Insights from Artificial Intelligence. *Journal of autism and developmental disorders*, 1-14.

Oumaima, D., Mohamed, L., Hamid, H., & Mohamed, H. (2023). Application of Artificial Intelligence in Virtual Reality. In *International Conference on Trends in Sustainable Computing and Machine Intelligence* (pp. 67-85). Springer.

Sciannamè, M., & Spallazzo, D. (2021). Reframing the domestic smartness. Artificial intelligence between utopia and dystopia. In *Digitally Enhanced Design. Breakthrough tools, processes, and expressive potentials* (pp. 119-139). Franco Angeli.

Steane, J. (2023). *The principles and processes of interactive design*. Bloomsbury Publishing.

Stephens, R. (2023). Green Cities Artificial Intelligence.

Touretzky, D., Gardner-McCune, C., & Seehorn, D. (2023). Machine learning and the five big ideas in AI. *International Journal of Artificial Intelligence in Education*, *33*(2), 233-266.

Wang, A., Dong, J., Lee, L.-H., Shen, J., & Hui, P. (2023). Towards AI-Architecture Liberty: A Comprehensive Survey on Designing and Collaborating Virtual Architecture by Deep Learning in the Metaverse. *arXiv preprint arXiv:2305.00510*.

Wang, Y., Wang, L., & Siau, K. L. (2024). Human-Centered Interaction in Virtual Worlds: A New Era of Generative Artificial Intelligence and Metaverse. *International Journal of Human–Computer Interaction*, 1-43.

Xu, Y. (2018). "Renewal Design of Industrial Heritage in the AI Era—Taking Interactive Experiential Planting Space as an Example". *Art and Technology*, *31*(5), 208-209.

Yu, B. (2021). "Three-Dimensional Animation Stereoscopic Space Design Based on Virtual Reality". *Modern Electronic Technology*, *44*(8), 49-52.

Zhong, Y., & Luo, Q. (2023). "Research on Micro-Space Design in Cities Based on Urban Aesthetic Theory". *Urban Architecture Space*, *30*(9), 60-62.