AN EXPLORATION OF RESIDENTIAL INTERIOR SUSTAINABLE DESIGN FROM AN ARTIFICIAL INTELLIGENCE-DRIVEN PERSPECTIVE

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Abstract

With the continuous progress and popularisation of AI technology, its application in the field of interior design is gradually becoming a reality. This article aims to explore how AI can contribute to the sustainability of interior design by analysing specific interior design principles, and summarising the development of AI today. This article explores the prospects for the application of AI in interior design and the methods for evaluating its effects, emphasising that interior design, as a discipline that serves people, should keep pace with technological development and actively embrace the wave of AI. Empowered by AI, interior design can not only achieve higher sustainability, but also better meet the needs of users and reach a new stage of development that is healthier, more comfortable and better.
Keywords: Artificial Intelligence, Interior Design

Introduction:

In today's era of dramatic technological revolution, artificial intelligence is quietly reshaping every corner of human life. From healthcare to education and research, from smart cities to cloud-based offices, AI is leading social progress with its unstoppable momentum. In the field of residential interior design, which is most closely related to everyone's life, how to participate in the wave of AI technology that is occurring and push residential design to a new stage of development has also become the topic and goal of the moment.

1.0 Overview of contemporary interior design

In the contemporary context, interior design refers to a specific creative activity carried out within an architectural space. Tracing its conceptual origins to the early 19th century, the term interior decoration first appeared in the book Home furnishings and interiors by the British designer Thomas Hope, and connoted such things as planning and coordinating colours and styles of furnishings within a room. In 1927, the American architect Bennett used the term Interior Design in his book Concrete building design. At that time, interior design was defined as the creative planning and decoration of a

building's interior space according to artistic and architectural guidelines. Today, interior design has evolved to take on a richer appearance. Interior design not only focuses on the visual presentation of the space, but also emphasises the enhancement of the quality of life of the occupants, as well as the creation and sublimation of the interior of the building.

The most basic space that human beings innately need - the residence - is the most abundant and rich space type in the development of interior design. After the reform and opening up, China's real estate industry experienced a period of explosive growth, and the number of residential buildings increased rapidly. Nowadays, in this period when environmental and climate problems are highlighted and commercial housing has entered the inventory stage, the public's demand for quality, comfort and higher-level connotations of living has become an objective fact. The concept of harmonious development of nature and society is deeply rooted in people's minds, and sustainable design has become a recognised necessity.

Sustainable design in interior design has different levels of meaning. At the level of the use of construction and decoration materials, sustainability often lies in the use of environmentally friendly, renewable and low-energy materials, such as bamboo and clay, which are low-cost and have little negative impact on the environment. And the recycling of materials is emphasised to reduce waste generation and save resources. At the same time people choose durable and easy-to-maintain materials to extend the life of products and reduce resource consumption and environmental impact in the long term. Overall, sustainability at the material level is basically characterised by environmental friendliness, durability and economy.

At the spatial planning level, sustainability is reflected in the creation of multi-functional and flexible interior environments that can adapt to the changing needs of occupants, thereby reducing future demolition and renovation. Through clever and rational spatial layouts and modular design to improve the efficient use of space and allow for variability, interiors can be easily adapted over time to meet new functional needs. This not only extends the service life of the residential design, but also reduces the waste of resources caused by demolition and reconstruction or under-utilisation of space.

The importance of the psychological and emotional needs of the occupants in interior design is becoming more and more apparent today. At this level, sustainability in design is equally important. Through the use of colour, lighting and spatial arrangement, interior design can greatly influence the mood and behaviour of the occupants, creating an environment that is both aesthetically pleasing and psychologically healthy. At the same time, through the implantation of different cultural or memory contexts, it can establish a deep emotional connection between the occupants and the space, and enhance the occupants' sense of belonging and satisfaction. At the same time, the principles of environmental psychology can be used to guide and strengthen the expected behaviours of the occupants through the design details. For example, to promote social interaction or improve work efficiency, to build a healthy and sustainable space psychological characteristics.

Overall, the sustainability of interior design lies in the creation of aesthetically pleasing

and functional spaces while at the same time giving in-depth consideration to their long-term impact on the environment, society and the psyche of the occupants, and promoting a healthier, more efficient and environmentally friendly living environment through scientific and informed design decisions.

2.0 Overview of current artificial intelligence and development trends

The concept of Artificial Intelligence (AI) can be traced back to the early 20th century, when British mathematician Alan Mathison Turing proposed the "Turing machine" model, which laid the foundation for computer science and AI. in the 1940s, the introduction of electronic computers provided hardware support for AI research. The introduction of electronic computers in the 1940s provided hardware support for AI research. Subsequently, researchers began to explore how to make computers have the functions of human intelligence. The real concept of "artificial intelligence" was proposed by American computer scientist John McCarthy in 1956. He first introduced the term "artificial intelligence" at the Dartmouth conference, marking the birth of the discipline of AI. Since then, the field of artificial intelligence has gone through many stages of development, including logical reasoning, expert systems, machine learning and so on.

Artificial Intelligence (AI) is in a rapid stage of development and has a wide range of influences, radiating from the field of technology to daily life. Machine learning and deep learning, as the core technologies of AI, have made remarkable progress, especially in the fields of image recognition, speech recognition and natural language processing. With the continuous optimisation of algorithms and increased computing power, these technologies are becoming more accurate and efficient. Reinforcement learning, a branch of machine learning that trains machines by interacting with their environment, has shown great potential in areas such as gaming, robot control and self-driving cars. Advances in Natural Language Processing (NLP) technology have enabled machines to better understand and generate human language, providing more possibilities for language modelling. AI is also showing its potential in applications in the creative industries, such as art, music and design, which together are pushing AI technology, and society as a whole, into a new era with a trend towards interdisciplinary collaboration. Knowledge and methods from a wide range of disciplines, from computer science to cognitive science, psychology to economics, will work together to build the foundations for the future.

Over the past few years, the focus on AI has peaked with the release of ChatGPT[1] 3.5 by the end of 2022. However, ChatGPT is only in the text domain. We also have corresponding tools in the image domain, such as Midjourney and DALL-E. These tools have been used in the field of AI-generated art and images.DALL-E,Midjourney and other similar tools can generate images based on the input text [42]. Such tools, by increasing the efficiency of the design process, help human designers and artists to

[1] ChatGPT is one of the generative GAI tools. Generative Artificial Intelligence (GAI) is an unsupervised or partially supervised machine learning framework. Its basic principle is to generate artefacts through the use of statistics, probability, etc.].ChatGPT, Chat Generative Pre-trainingTransformer, is a text generation tool created by OpenAI.

create develop more innovative designs. In addition, since designers usually operate these tools on AI-enabled platforms, this helps AI tools to provide designers with personalised design suggestions that meet specific requirements and needs.AI tools (e.g. Midjourney and Dall-e) also have a positive impact on residential interior design education.

3.0 Exploration of Artificial Intelligence to Enable Sustainable Residential Interior Design

An interdisciplinary perspective that explores the ways in which the integration of AI and interior design can have long-lasting significance for both.

Residential interior design is inextricably linked to architectural design. From an architectural point of view, architectural design is a solution to architectural problems that combines both internalised knowledge, refined methods, abstract concepts and practical design implementation.AI has been used in architectural design to play an important role in automating the problems of space planning and allocation. Computational methods such as Half Plan, Shape Grammar, Blocking and Graph Theory can be used in this process. AI research is now moving towards automating routine tasks and conceptual design.

The logic used by AI in residential modelling differs from traditional design methods. AI prefers to generate images through inductive and deductive reasoning, which is very different from the intuitive logic of traditional design. Therefore, AI requires collaboration between designers and AI experts to improve the design process. In a design process involving AI, an infinite number of design images can be generated by a trained design model. Different solutions can be derived from different problem inputs, and the final product can be refined and optimised through user feedback and iterative experimentation. In the end, we can get an intelligent design system that can cope with complex problems and adapt to evolving user needs.

How artificial intelligence can be integrated with architectural or interior design involves three aspects: the design process, design education, and intelligent environments.

Starting with the first aspect, in the general design process, design development, construction document preparation, bidding and tendering, construction support, programming, schematics and construction support are all included in the complex process of architectural design. In the original phase, the architect needs to determine the client's needs and create a preliminary design on the schematic. After this stage, the selected design is further refined during the design development phase and detailed drawings and specifications are provided to the contractor through construction documents. From the "Schematic" or "Conceptual" stage, the architect must look at the preliminary shape and layout of the building while analysing the location. At this stage, complex inputs need to be synthesised into solutions, a process that involves divergence studies. In divergent studies, the most important thing is visualisation and conceptual interpretation. To visualise and explain their concepts, architects use techniques such as CDs, physical models and sketches. From the beginning of the design to the end of

the process, architects try to improve the chosen plan, taking into account the influence of different factors of building codes, materials and structural systems. They work closely with consultants and engineers to try to ensure that the design is feasible and balanced against all criteria. Taken together, practical and aesthetically pleasing buildings must combine creativity, technical knowledge and teamwork.

It is easy to see that architectural and interior design is a rather complex process that usually involves conflicting goals. How to strike a balance between the many goals is a fundamental part of multi-objective problems (MOPs). In this regard, AI algorithms may be able to help solve these problems.

In general, AI can be used as a drafting tool, a modelling tool and a design methodology in the design process. From a specific point of view, AI can currently perform most of the work in the "schematic" or "conceptual" phase. The main task in this phase is open exploration, aiming to have a variety of design directions in order to explore the best solution. AIs in this phase can quickly draft several basic renderings using a text-image approach. Among the basic cueing techniques are the explicit use of descriptive language, such as definitions about required elements such as colours, textures or themes, adjectives that distill the characteristics of the image, etc. And, there is also a need to keep adjusting the cueing words during the iterations to observe how slight textual changes affect the final visual effect. At this stage, the technical advantage of AI is that multiple unexpected creative results can be generated quickly by simply requiring architects to replace different cue phrases and adjust parameters. And by refining the desired image with the most desirable cue word combinations during the iterative process, the AI-generated conceptual drawings can be made to align with the envisioned outcome to a greater extent.

If we go to a more specific technical level, the design of homes is a very complex field and it is difficult to solve the problem with a generic AI design tool. In response to this problem. Architecture industry personnel have developed their own tools, which can be broadly categorised into three groups: traditional architectural design software, open-source architectural design software, and architectural design software within AI design software, such as GrimshawArchitects, Foster Partners, UN Studio, and Zaha Hadid Architects.In the past. designers had to employ complex tools in the face of the scripting language of programmes such as AutoCAD, Autodesk Maya, Rhino and MicroStation. However, plug-ins for CAD/CAM programmes have made the use of ML tools in architecture commonplace, such as Rhino, Dynamo. and Marionette. The Optimisation Solver, developed in 2010 by the Galapagosi division of Grasshopper, is the best ML tool for finding a specific objective using algorithms. And now there is a specialised Artificial Intelligence for Architecture (AAI) based on general AI, which operates on a process that generates designs based on input architectural problems and building specifications, and develops criteria for evaluating how good or bad the design is. It uses machine algorithms and machine learning techniques to analyse large amounts of data and identify corresponding patterns, leading to more efficient building designs. By integrating user feedback and continuously improving its database, AAI will undoubtedly create a wave of change in the architectural field towards faster, more accurate and highly customised design methods.

In terms of technology-specific application processes, generative AI models in architectural design use algorithms and machine learning to generate design solutions based on predefined parameters and constraints. In this process, the most basic intellectual logic of architecture is reinterpreted through the help of architects, thus allowing AI to achieve a complete reconfiguration of architectural design. GANs, for example, have been used to alleviate the slow adoption of architectural design due to insufficient data.GANs can generate thousands of architectural floor plans with small datasets, colour matching schemes and semantic maps.Cai11u's research and the Berkeley Artificial Intelligence Research Laboratory's Cai11u's research and Berkeley Artificial Intelligence Research Laboratory's Pix2pix application have successfully converted simple sketches into realistic images, such as building elevations.The use of AI tools has streamlined the design process, which has allowed architects to quickly generate multiple design solutions and evaluate their feasibility. In addition, by automating the analysis and integration of designs through AI tools, it frees up the architect's time and energy, allowing the architect to focus on more creative aspects of the design.

The high-pressure ecology of the architectural design industry that has prevailed since 1990, with a shortage of senior architects and constrained growth in design outcomes in a globalised environment where the scale of construction has doubled, has impeded the further sustainable development of the globalised architectural industry. However, AI has dramatically reduced the workload of individual architects, enabling one architect to realise the benefits of greater outcomes compared to before, which is significant for the sustainability of the architectural and interior design industry.

At this stage, AI is not only gradually penetrating into the original architecture and interior design industry, but also into the content of design education, showing a complementary trend. The former focuses on the practical implementation of AI-assisted residential design projects, emphasising efficiency and practicality, while the latter focuses on exploring the diversity and innovativeness of AI applications in residential design, with a view to cultivating sustainable architectural talents for the construction industry.

In specific design education, AI applications are combined with traditional architectural design methods. Students use AI applications to generate a set of models, develop these generated models, and apply their own design skills to create architectural floor plans for these generated models, rather than using AI directly. In the courses at the Department of Architecture and Interior Design at Horus University and the Department of Architecture at the Arab Academy for Science,Technology,and Maritime Transport in Egypt, students aim to understand the mechanics of using the Midjourney application. The required parameters include: style, use of buildings, floor area layers, and rendering style. In addition to this, students use AAI parameter settings to generate building floor plans: e.g. land area, required footprint, orientation, climate. They applied this AI intervention in residential design to a practical case study of designing a home for the homeless, in this comprehensive case study, the AAST architecture students chose Aswan as the design unit, generated the original schematic from Mid journey, then analyzed and filtered the results and used them as a preferred initial schematic, before

creating a building plan to transform the concept into a complete design outcome. into a complete design outcome. At the University of Belim, Antalya Interior Architecture and Environmental Design Department they assigned a coursework for less experienced interior design students in which they had to create a design for a character in the TV series "Heart of Europe" using artificial intelligence design tools. Heart of Europe" in which students had to use an AI design tool to create different concepts of office interiors for characters from the TV series. The instructor introduced the students to the use of two different types of AI design tools, Mid journey and DALL-E, and demonstrated how to create an appropriate combination of cue words to help the AI tool generate images. This was all to enable students to explore different ways of incorporating AI tools into the design process and to improve their ability to use AI tools.

In our previous paper, we discussed AI as a production tool empowering the sustainability of residential design in terms of design process and design education, respectively. However, AI itself can be involved in sustainable residential design as part of the residential design product.

3.1 Smart Environments and Sustainable Development:

In recent years, the integration of advanced technology and artificial intelligence has dramatically changed the residential living environment, and in response to this change, scholars have proposed the concept of smart environments, which has received widespread attention. In this era of digital transformation, how should residential design be sustainable? The principle of human-centred and user-centred design remains the bottom line that we must adhere to in the midst of rapid technological advancement.

User-centred smart environments have the ability to sense, adapt and respond to human needs. Within these smart environments are a wide range of intelligent usage patterns, from smart home automation systems controlling lighting, heating and security to smart cities optimising traffic flow and energy consumption, all of which can be subsumed within the concept of smart environments. Within this concept, the focus on personalised residential interiors is an area worth exploring, where AI holds great design potential.

Artificial intelligence's capabilities in data analytics, pattern recognition and machine learning offer transformative solutions for personalised residential interior design. With AI, designers and users can generate interior design solutions that match individual tastes based on large data sets of popular design trends, colour palettes, furniture styles and user preferences. And, machine learning models are able to adapt and improve recommendations over time, continually improving the alignment between design and user preferences.

However, there is currently a large gap in this area. This has been researched by an academic who found that the key principles for designing and developing smart environments lie in user engagement, personalisation, privacy, security, accessibility and affordability, and that user needs lie in the personalisation, ease of use, reliability, privacy, security and affordability of the finished design. However, there are challenges

in this area such as technical complexity, lack of standards and user acceptance. Despite this, user-centred smart environments in his study still showed a high level of interest and willingness to invest from the participants. This demonstrates the promise of user-centred smart environments.

If we are to carry out an analysis of the sustainability of AI as a product in its own right in the field of residential design, we have to sort out the results related to the field of smart environments.

In the field of smart environments, the application of smart homes is relatively more popular. Intelligent housing can be said to be a subdivided component of intelligent buildings, which appeared in order to enable the occupants to obtain a more relaxed and comfortable living condition in the residential space. There are many definitions of intelligent housing, the overall summary is the use of products of science and technology, based on integrated wiring, a variety of highly centralised information command integrated configuration of various functional subsystems in the living space. The information conduction processing into a kind of service to the human interaction mode, so that can create a safer, more comfortable, convenient living space for the occupants. It meets the user's various functional needs for different environments through intelligent data processing mode and changes the traditional lifestyle.

In the project represented by the American Xanadn House, the basic concept of whether a computer can be used to unify the management of all kinds of electrical appliances in the family has been put forward many times, but there is still a long way to go before it can be put into practice. In 1979, the Stanford Research Institute in the U.S. proposed the "Home Bus" and "Home Controller" intelligent house system. Intelligent system settings can be set to understand the daily habits of the residents, according to the preferences of the residents to actively complete some of the residents need daily home life behaviour. For example, according to the resident's commuting time can automatically turn on the water heater, the owner of the hot water ready to bathe, become the exclusive residential nanny. Intelligent residential system in the security protection function can be real-time active signal to remind the owner to avoid danger, improve the safety of living. The emergence of the true meaning of intelligent buildings should be the United States of America in 1984, United Technologies Corporation in Hartford, Connecticut, a project transformation results, they use the computer system to monitor all the facilities and equipment of the entire building, and for this transformation of the building to provide information technology services. Since then the concept of smart home was born and went to the residential interior design industry.

With the further development of science and technology, many developed countries have begun to take the lead in developing their own smart home systems and have completed the realisation of their functions in architecture through design. Some of the more important ones are: X-10, CEBUS, LONWORKS in the United States, HBS in Japan, E1B and EHS in Europe and other intelligent systems. The earliest intelligent residential community originated in the United States, the mid-1980s Japan also began to vigorously promote residential automation, Japan in the curtain goes up the establishment of an advanced intelligent community, the establishment of home bus research institutions HBS (HOME BUSSYSTEM). Japanese scientists are also

constantly researching the form of intelligent housing that can provide necessary information to users in a timely manner, the University of Tokyo's Satō Sen Research Laboratory and the Industrial Technology Research Institute's Digital Human Research Centre and other units, the trial production of a large number of sensors buried in the house. Using a sensor control system built into various indoor furnishings, it is possible to grasp various types of information about the activities of the occupants from the time they get up in the morning to the time they go about their home, and to display the relevant daily activities in a designated location.

Exploration and research in the field of intelligent building and intelligent residential composition mainly focus on "system integration technology", "intelligent building network system protocol", building sub-system services, including "HVAC system", "lighting system", "fire protection system", "elevator system", "security defence system HVAC system", "lighting system", "fire protection system", "lift system", "security and defence system", "communication system", "security system" and "fire protection system". ", "lighting system", "fire protection system", "elevator system", "security defence system", "communication system" and other advanced intelligent technologies. Through the application of information network technology, people can easily realise real-time sharing of all kinds of global information for office and leisure life, and can interact with all kinds of boards of business, as well as realise remote operation of the residence at home and out of the house. Intelligent home system is introduced into the indoor space, so that users can make use of the indoor space environment more convenient. Intelligent home can supply people with convenient ways of doing things in their daily activities, so that users can arrange things reasonably and efficiently and make full use of time and resources.

In general, smart home development is inseparable from the network, information and electronic integrated systems. All three work together as technological tools to guarantee the principle of human-centred residential design. More precisely, by centralising the electronic management of information in the home, we can create a less wasteful housing system, allowing us to move towards a recyclable, sustainable and green design path. Artificial Intelligence, on the other hand, can help us move forward on this path. A more accurate understanding is that since 2012, against the backdrop of advancing global informatisation, the rise of cloud computing and the Internet of Things (IoT), we have entered the era of big data, laying the data foundation for the emergence of AI. At this stage, we have intelligentised our household goods, and in the process of intelligentisation, we can get a huge amount of user information and data with personalisation. This information and data can not play its value until it is processed. Through artificial intelligence, we can let it digest this information, and through training models, we can get design solutions with decision-making value and continuous adaptive design.

Thinking in this direction, we can imagine specific application scenarios in all three directions:

3.1.1 Human-computer Interaction

Human-computer interaction is both an important channel for AI to obtain a training set, as well as and to try to apply the use of AI in a natural language interaction approach.

Nowadays, human-computer interaction methods are: manual, mobile phone, cross-screen, voice and gesture. Manual interaction mode is the most classic form of interaction, such as manual remote control to adjust the product and other ways. In order to avoid the instruction error, the intelligent home products on the market are supplying the intelligent interaction mode at the same time, but also save the classic manual mode. Mobile phone interaction mode is currently the most frequently seen, mobile phone APP and WeChat applet to achieve the remote control and on-time switch function, but also set the scenario mode, to achieve a key multi-control, very convenient. Cross-screen interaction can solve the problem of not having a mobile phone or not being able to take it out conveniently. The emergence of smart watches allows users to keep abreast of various conditions and prevents them from missing critical information. Voice interaction methods are divided into direct voice and indirect voice. Direct voice is to send voice commands directly to the device, and indirect voice is to interact with other products through intermediate smart products. Gesture interaction mode is that the device receives and realises the commands issued by the user through infrared sensing of the user's sense of body or camera recognition of gestures.

Human-computer interaction will evolve in three ways with the constant updating and upgrading of the Internet of Things and the development of artificial intelligence: user-centricity, personalised biometrics, and omni-directional perception.

The key to user-centred human-computer interaction lies in the ability of smart products to more effectively identify the subtle emotions expressed by users, and quickly understand and satisfy their potential needs. Intelligent products are able to perceive the essence of the source of user needs, analyse the motivation of user behaviour through the fusion of big data and artificial intelligence in the background, and then quickly make reasonable feedback.

Passwords will be used less and less frequently in the future, and will gradually be replaced by biometrics, the most important thing about biometrics is security. After the mutual integration of smart wearable devices and the human body, personalised biometric human-computer interaction will become the biggest prerequisite for creating a safe and intelligent life. Future smart products will more naturally synchronise with human biological reactions and processing processes, including thinking, feeling, hobbies, etc., and will be able to sense users' needs in an all-round way and provide ways to solve them, and even anticipate users' potential needs.

In terms of current human-computer interaction, touch control is only the primary stage of human-computer interaction, and body and voice recognition will be the further biometric identification methods in the future. It is believed that the future human-computer interaction will be more and more simple, and the future development trend will be inclined to the natural interaction mode, and the harmonious interaction between human-machine and environment will be in the state of natural integration. Virtual reality and augmented reality technology, which is characterised by interactivity, immersion and conception, has real-time three-dimensional spatial expressiveness, and natural human-computer interaction can bring users the feeling of being in the realm of

reality.

3.1.2 Auto-Sensing

Automatic sensing that is, sensors in the smart home system, has the function of intelligent switching and adjusting, sending commands through the sensor, thus liberating people's hands in a sense. Sensors can sense infrared touch, human movement, illumination, temperature and humidity, gas, smoke alarm lights, to provide people with a convenient and safe home environment. Human infrared sensors are mainly linked to the intelligent lighting system to achieve the automatic switching of lights function, people do not have to touch the dark to find the light switch, but also according to the time and area automatically adjust the situational mode. If you simply use infrared detectors are prone to false alarms, the human body, infrared sensing can reduce the error rate of the home system.

In terms of intelligent security, the human infrared sensors combined with AI technology intelligent security system plays a role in preventing illegal invasion, automatic alarm, and protecting people's safety. In the intelligent bathroom can solve the problem of water waste, users can pre-set customised modes according to personal bathing habits, provide the best self-cleaning effect of the equipment and a comfortable cleaning experience, power supply and regulate the temperature of a variety of security measures, intelligent bathroom to enhance the sense of experience in the home bathroom.

Temperature sensors are used in the opening and closing of air-conditioning and underfloor heating equipment, automatic thermostat according to the temperature changes in the room, energy saving and environmental protection, so that people can enjoy the most comfortable temperature at home, to avoid persistent low temperatures caused by the cold, the temperature is too high sweating conditions. The humidity sensor is used in intelligent window pusher with the function of automatic window opening and closing. When people sleep, go out during the sudden wind and rain automatically close the window, to provide convenience for people's lives. Smoke and gas sensors can detect problems early, so that people can quickly alarm and escape from the scene, to protect the safety of people's lives.

3.1.3 Light and Shadow Changes

In interior design, lamps not only play a role in lighting, lamps and lanterns also have a certain role in beautification, belongs to the category of visual art, play an important role in the atmosphere of the interior environment. Clever use of lighting can not only show the face and temperament of the space, but also add a sense of texture and layering of interior space. Intelligent lighting will be the trend of the entire lighting industry, people are no longer looking for switches in the dark, the use of distributed wireless remote control to control the intelligent system, lighting and other intelligent equipment linkage, through voice interaction commands, or APP control, you can adjust the lighting brightness, colour, colour temperature, and can be automatically adjusted according to

the sky changes in lighting brightness. The designer adjusts the function of lighting through the intelligent system to meet the needs of different scenes, providing people with more convenient and energy-saving lighting effects, so that the intelligent lighting achieves the ideal predetermined lighting effects and renders a lighting environment that matches the indoor scene.

The light and shadow effect of the sun can also accentuate the indoor atmosphere. Intelligent curtain equipment can use voice or mobile phone APP to control the opening and closing of curtains, precise opening and closing can regulate the brightness of indoor light and shadow, improve the role of indoor light and shadow layout, eliminating the need to walk around the trouble of pulling the curtains, so that people can enjoy a more convenient and comfortable intelligent life.

The lighting control system of smart home is generally divided into: wake up mode, night mode, leave home mode, home mode and anti-theft mode. Wake-up mode is when you wake up in the morning, the intelligent system will follow the pre-setting, all the lights in the house will be lit on time according to the user's work and rest time, and the curtains will be pulled open to let the sunshine into the room, so as to make the morning more relaxing. Night Mode enables the sensor light to turn on automatically when you get out of bed, providing a soft light that won't irritate your eyes that are used to darkness, and won't make you trip over foreign objects when you get up in the dark. Leaving home mode enables users to leave home without having to specifically check whether the lights are off before leaving home, and can use voice control to turn off the lights, and remote control on the mobile phone to control the lights on and off status.

Home mode enables the user to come home without having to turn on the lights in the dark, and the smart sensor light will follow the user to turn on the lights automatically. Intelligent light also has anti-theft function, if the user is out for a long time, the anti-theft mode will make the light turn on and off on time every day, to fake the scene of someone's life. Intelligent lighting control systems are smart home systems with a high degree of mass market acceptance and are ideal for families that care about the mood and quality of their lives. Most families equipped with lighting control will choose to also have an intelligent curtain control system or use it in combination with other functions to form a linkage, creating various scenarios and realising intelligent life.

Through the specific imagination of the above application scenarios, it is not difficult to see that through AI-assisted, we can residential interior design to achieve sustainability in the smart home.

4.0 Domestic and International Cases of Artificial Intelligence Applied to Residential Interior Design

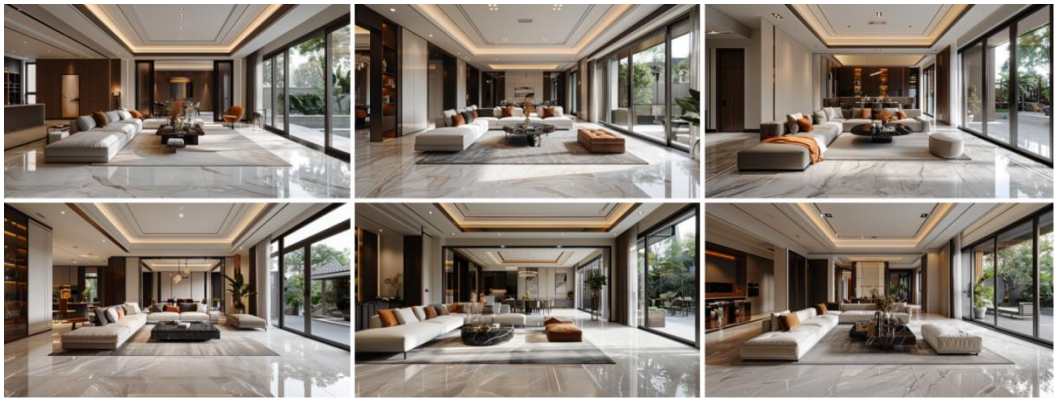
Progress has been made in the application of Artificial Intelligence (AI) technology in the field of contemporary interior design. The milestones of AI interior design are explored in terms of three key areas-automated generation of design drawings, intelligent selection of building materials, and precise analyses of clients' psychological preferences. In addition, this paper will provide insights into the practical application of AI in interior design with the help of some case studies.

4.1Automated generation of design drawings

With advances in computer vision and machine learning technologies, AI is now able to automatically generate design drawings based on customer needs and preferences. DECORILLA of the United States provides a variety of visualisation tools, including 3D models, CAD drawings, mood boards and floor plans, to meet the needs of different users. These tools can help users better understand and select design solutions, significantly improving design efficiency and unleashing the creative potential of designers.

4.1.1 First Generating diagrams from text prompts

Directly generate master style works, you can directly keywords for description, you can output images, such as: "Designer Leung Chi-Tin style guest dining room, the requirements of light colours.



Text descriptions to generate different designer styles for the living room

4.1.2 Second Diagram Generation

4.1.2.1 Intent to expand:

Though an existing intention to generate multiple perspectives of a similar style of intention to provide more inspiration possibilities.

original figure

Approximate style generation graphs

4.1.2. 2 Combined Graphics:

Two spatial graphs or an ambient graph are combined by AI to generate a new scene graph.

original figure

Above picture plus the picture in below

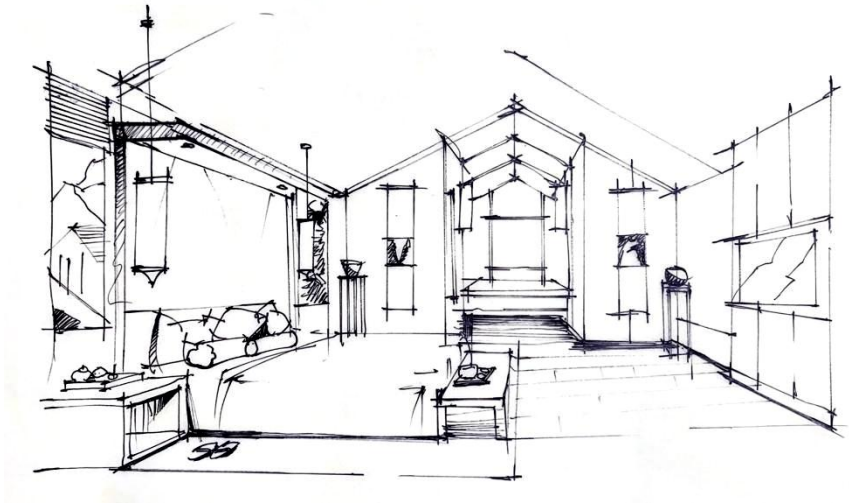
A series of generation charts

4.1.2.3 Third Generating Images from Line Drawings

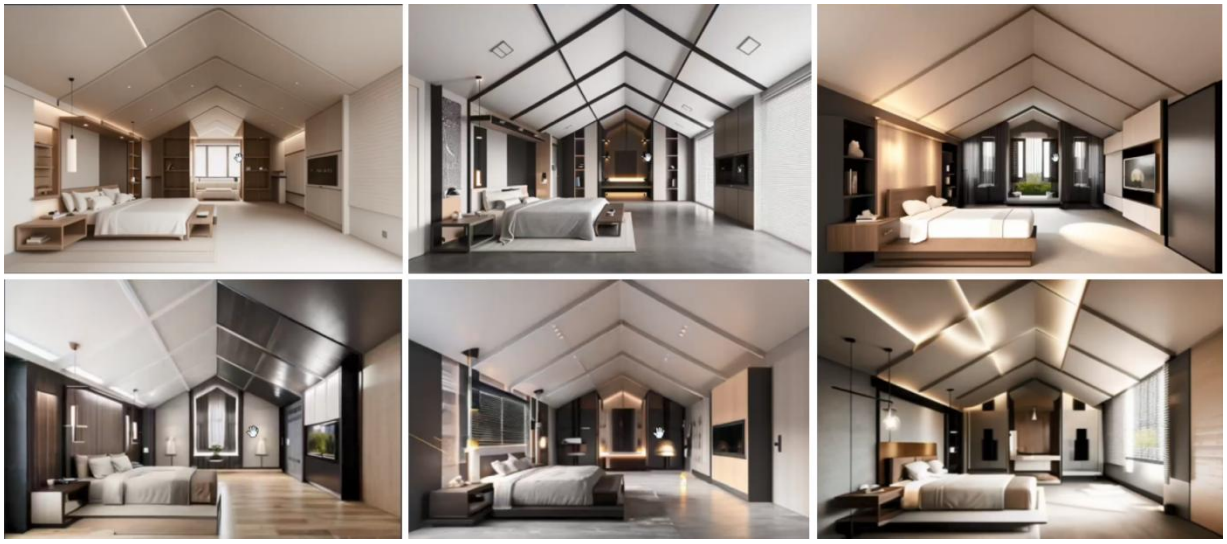
Spatial line Drawings

By hand-drawing a line drawing of the scheme, it is possible to generate the scheme via SD software, which also requires corresponding text descriptions and the selection of a large model.

Script



Images generated from line drawings



4.1.2.4 Floor Plans

In SD software it is possible to generate different styles of coloured floor plans from the floor plan line drawings using different large models to represent the functional spaces in a more vivid way.

Fifth Generated images can be modified in detail, e.g. modifying local furniture

White sofa and pillows Light curry pillows Light curry sofa

4.2 Artificial Intelligence in the construction process

With the rapid development of technologies such as AI, IoT and machine learning, it will be easier for the construction industry to realise the variable housing
the vision of variable dwellings. The proliferation of various smart devices and sensors provides the technological foundation for building space automation.
Sensing - Communication - Positioning - Decision Making:Firstly, AI can monitor and

analyse existing walls, roofs, floors and furnishings in real time through sensing technologies. They can scan the building structure, identify the type, size and condition of components, and even assess the structural stability and safety of the building, providing basic data for subsequent retrofitting.

The application of AI technology in the selection of building materials makes the selection of materials more scientific and economical. The American company HAVENLY launched a new service called "Havenly At Home", which analyses customers' style preferences and budgetary constraints through AI, and recommends the most suitable materials and furniture, which not only meets customers' personalized needs, but also achieves the optimization of cost-effectiveness.

4.3 Precise analysis of customers' psychological preferences

AI's ability to analyse data has empowered interior designers to gain more accurate insights into their clients' psychological preferences. The Dulux Colour Research Centre in the UK uses AI to analyse colour trends and provide psychologically based colour matching suggestions to create interior environments that meet customers' expectations. Two Japanese companies-LIXIL's Smart Toilet System and PANASONIC's RELAX ROOM-demonstrate the use of AI to enhance living comfort and personalised experience.LIXIL's system is able to customise bathroom facilities based on users' personalised information, while PANASONIC's RELAX ROOM uses AI to regulate the indoor environment and create a relaxing space for the user.

4.4 Other applications of AI into home life

4.4.1 AI Virtual Socialisation

Perhaps AI will change the form of socialising. At a conference table, dining room table or coffee table, a special type of glasses could be worn to realise multi-person meetings, family chats in a different location, or even virtual sharing of food. Unlike ordinary video calls, AI socialising will be a three-dimensional interaction in three dimensions, perhaps simulating the senses of touch, smell, and even taste, on top of the audiovisual effects.

Interactive Schematic

In the future, the interior design or the image of the person is captured through the camera and projected into the other person's environment through a projector. This full range of digital images must be presented in real time so that uninterrupted chats can be realised. Integration of holographic projection in interior design
The integration of holographic projection in interior design allows you to chat face-to-face with your friends thousands of kilometres away from each other.

4.4.2 AI Healthy Living

AI technology real-time monitoring of the indoor environment, such as air quality, lighting, etc., to provide health advice and optimisation; in addition, the use of AI technology to achieve family immersive fitness scenarios, to save time on the way to the gym, such as cycling, ball games, etc., can be online team, can also be together with family members, to help residents to create a healthier and more comfortable living environment, and to promote the physical and mental health of family members.

Interactive Schematic

Users can enter a virtual fitness environment from any space in their home via smartphone, tablet or headset. In this environment, users can not only see the hologram of a professional fitness trainer, but also receive real-time feedback and guidance, making the home fitness experience both personalised and interactive.
In this environment, users can not only see the holographic images of professional fitness trainers, but also receive real-time feedback and guidance, making the home fitness experience both personalised and interactive.

4.4.3 AI Butler Service

The future smart house can conduct more intuitive and personalised communication with residents through emotional computing technology and intelligent voice assistants, provide more intimate and demand-responsive intelligent housekeeping services, and enhance the emotional connection with the house. For example, kitchen and bathroom maintenance, housekeeping services, etc., can be achieved directly through dialogue for door-to-door maintenance; through continuous learning to predict the user's bathing time, the water heater can be turned on in advance.
Through continuous learning, users can predict the time to take a bath and turn on the water heater in advance; cook recipes with audio-visual performance; and assist in calling for takeaways and so on.

AI Intelligent Holographic Butler

With the continuous evolution and application of AI technology, the field of interior design and living residences will usher in more innovation and change.
Experience more convenient, comfortable and intelligent living experience in the intelligent and digital future life.

5.0.Community Practice Content for AI Residential Interior Design

From a healthy living perspective, AI technology's real-time monitoring of the indoor environment's air quality, light conditions, etc. provides the feasibility of providing health advice and optimisation solutions. In addition, the application of AI technology

can also save the time needed to travel to the gym through the realisation of home immersive fitness scenarios, such as cycling and ball sports. The design allows users to form teams online and participate with family members, helping to create a healthier and more comfortable living environment that promotes the physical and mental well-being of family members. Users can access a virtual fitness environment from any space in their home via smartphone, tablet or headset. In this environment, users are not only able to watch holograms of professional fitness trainers, but also receive real-time feedback and guidance, making the home fitness experience both personalised and interactive.

In terms of future intelligent residential design, the application of AI technology can adjust the layout and functional partition of indoor space according to the user's behavioural patterns and living habits, thus enhancing the living experience and quality of life. In addition, through the use of emotional computing technology and intelligent voice assistants, it can communicate with residents in a more intuitive and personalised way, provide more intimate and demand-compliant intelligent housekeeping services, and thus enhance the emotional connection with the residence. For example, kitchen and bathroom maintenance and housekeeping services can be achieved through dialogue for door-to-door maintenance; prediction of the user's bathing time through continuous learning to turn on the water heater in advance; audio-visual representation of cooking recipes; assistance in calling for takeaways, and so on.

Artificial Intelligence (AI) provides powerful support for interior design through intelligent material selection, energy efficiency optimisation and environmental benefit assessment, making it more sustainable. As AI technology continues to advance, future interior design will be able to better balance aesthetics, practicality and environmental protection, creating healthier and more sustainable living spaces for humans.

6.0reach a verdict

With the continuous progress and popularisation of artificial intelligence technology, its application in the field of interior design is gradually becoming a reality. As a discipline that serves people, interior design should follow the pace of technological development and actively embrace the wave of AI. Empowered by it, interior design can not only achieve higher sustainability, but also better meet the needs of users and reach a new stage of healthier, more comfortable and better development.

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