Research Article

A Framework for Green Interior Design and Simulation Using Immersive VR Technology

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The green decoration indoor environment design method has become the main trend in recent years with the rising awareness of environmental protection. The green design strategy emphasizes the reduction of production materials, packaging materials, recycling of waste products, and material recycling. Generally, green interior design is a kind of cognition of friendly treatment to the environment. Considering the future use and development of space to adopt flexible strategies, the design process should incorporate the possibility of future changes. The flexible strategies can reduce the future part of the change and can redecorate waste. In the process of creativity and design, the design objectives should be clearly defined, and the frequency of modification should be reduced. This research introduces a framework for green interior design and simulation using immersive VR technology. The concept of regeneration is used to achieve maximum utilization and minimum damage. It improves the efficiency of using resources; on the other hand, it reduces the impact of interior design on human health and environment.

1. Introduction

The scarcity of the Earth’s environmental resources and the sharp increase in carbon emissions have caused global climate change and increased threats to human life and property. The issue of sustainable development has begun to attract global attention [1–3]. The green engineering environmental design method has become the main trend in recent years with the rising awareness of environmental protection. Saving the energy, reducing carbon emissions, and making good use of environmental resources to keep the environment sustainable and continuous have become a global common topic. As far as human living environment is concerned, “green” is an attitude of making good use of environmental resources. The so-called “green building” refers to the operation of buildings in the life cycle from base selection, design, construction, operation, management, and maintenance to demolition to save energy, making the most effective use of resources, and producing the least waste [3–5]. Build a safe, healthy, comfortable, efficient, environmentally friendly, and low environmental load living space and achieve the goal of people, building, and environment symbiosis and sustainable development. Design is an indispensable part of human history; in essence, it is a kind of human activity that is the art of people around, which is accompanied by the necessities of life and the development of the art. Modern design emphasizes the human-oriented design concept and emphasizes the ability of designers to analyze, judge, and solve problems in the process of design.

Design is a bridge between spiritual civilization and material civilization, which is hoped to improve the living environment of human beings. In the different historical periods of the development of human society, the design has different missions and directions [6, 7]. The goal of modern space design is to meet the needs of modern people’s material and spiritual life. Indoor space design for the daily work, entertainment, and other activities to provide facilities and services is one of the most basic human needs. Most people spend most of their time indoors; indoor environment directly affects people’s work and life, so it is necessary to highlight the “people-oriented” thinking in the design. Interior space design is a kind of artistic behaviour, an emotional phenomenon, and designers express their feelings.
not only through their own works but also through the design to meet the emotional needs of people [8–11].

People are beginning to reconsider the living environment and putting forward higher requirements with the improvement of the housing conditions and the improvement of the quality of life. Because the relationship between the indoor space and people is more direct and more appropriate, the design effect of the indoor space affects people’s material and cultural life. In the highly concise but thought-provoking intuitive interior space modelling, the form of the law is difficult to find. The form of law that is an important principle of all other indispensable activities is to give the interior space expressive design language, so that interior space has eternal life of art. In the field of art design, although the formal requirements of will are consistent, the formal rules of materialized expression of will are different [12]. If the space is too small or too low, people will feel constrained and depressed. Such a sense of scale will also affect the public space. The functional requirement of the public space generally has a larger area and height. It includes hotel space, bank business hall, and museum.

In the history of church building, its high indoor space scale is determined by the spirit of the requirements [13, 14]. Design is an activity of the human mind. In the mind of the creator, the abstract idea is to be expressed in the form of a particular medium, a writer’s pen, or a computer. Architectural design in the minds of designers, the only way to push the prototype to the market is to draw graphics through design tools as a medium. In the process of architectural design, the long-term dependence on a design tool will form a subconscious habit, which will interact with our thinking patterns constituting one of the most efficient modes of operation [15, 16]. In this context, this research introduces a framework for green interior design and simulation using immersive VR technology. The concept of regeneration is used to achieve maximum utilization and minimum damage. It improves the efficiency of using resources; on the other hand, it reduces the impact of interior design on human health and environment.

The rest of this paper is organized as follows. In Section 2, the computer vision techniques are discussed. In Section 3, the proposed interior space reconstruction paradigm is discussed. Finally, the paper is concluded in Section 4.

2. Computer Vision Techniques

Computer vision is an important branch of computer science and artificial intelligence. Computer vision research began in 1950. At that time, its sister disciplines computer vision, image processing, and pattern recognition were collectively referred to as computer image processing. All the research was about how to use computer image processing technology. With the deepening of research, these three disciplines have been in-depth development. Image processing focuses on improving image quality. Pattern recognition focuses on the classification of optical map, text, fingerprint, chromosome, and so on. Computer vision is to describe the scene of objects according to the situation of the image and to broaden and assist the visual function in a certain situation [17–19]. We can easily and consciously perceive the world around us through our eyes. When people watch a tea cup, we can accurately describe the color, texture, shape, size of the glass, and even the heat distribution and transparency of the tea cup from the reflected light, subtle texture changes, and shadow distribution. The interior space design pattern demonstration is shown in Figure 1.

2.1. Theoretical Framework of 3D Reconstruction. In 1870, Dr. Marr, an expert on artificial intelligence at the Massachusetts Institute of Technology, presented the first theoretical framework for computer vision. This theory regards the visual process as a process of information processing and establishes a set of relatively complete 3D reconstruction theory of vision based on 3D reconstruction [20–22]. The author puts forward that the research of visual information processing should be divided into three levels, that is, computing theory layer, presentation layer, and algorithm layer. The three answer the input and output of the information processing and the constraints between them. The input and output of the representation and the corresponding algorithm are utilized to achieve the physical representation and algorithm. Mar’s vision theory emphasizes the importance of computing not in theory, but in practice. The main task of visual process is to extract the shape and spatial position of one-dimensional, two-dimensional, and three-dimensional reconstructed images in the scene from quantitative image information. The three major stages are discussed in this section.

(1) The first stage of the visual process is to obtain the feature map from the input image including the location of the intensity changes in the image and geometric distribution and organizational structure. This stage of vision is also called early vision. The purpose of this stage is to express the important information in the original two-dimensional image more clearly.

(2) In the second stage, 2.5 dimensions are obtained from the original image and input graphics, namely view tilt coordinate system, visible surface, normal depth, and discontinuous contour. At the same time, because 2.5-D contains depth information, there is more information than 2D, rather than a real 3D representation [23, 24].

(3) In the third stage, it includes input images, 2.5-D graphics and other elements to represent 3D. The three-dimensional representation of the object is given in the object itself as the centre of the coordinate system. It is with the area of the element and the volume of the element of the hierarchical representation of the objects. In the framework of the Marr theory, the hierarchical generalized cone model is adopted. Accordingly, in Figures 2(a) and 2(b), we show the computer vision framework for reference.
The active vision theory framework is based on the initiative of biological vision. Human vision is not passive, and people will be based on the visual needs of the body or head to change the perspective, to help identify. At the same time, the human vision is not the same as the objects in the scene, but to choose one part of it. According to the existing analysis results and the current requirements of vision, the active vision system controls the motion of the camera by the active control of the camera parameters and coordinates the processing tasks and the external signal. At the same time, it can be used to guide the visual sense to solve the two senses of vision.

2.2. Green Interior Design. “Green interior design” can be said to be a concept. However, in the process of interior construction, it will impose a burden on the environment. Through the all-round environmental protection design concept, we emphasize the harmonious coexistence with nature and create a high-quality and healthy indoor living environment. Therefore, the so-called green interior design is a kind of friendly treatment to the environment. The green design of interior design must clarify the problems faced by the current situation of interior design. The green design of interior design must be discussed from the green design concept point of view, and then the green design strategy can be established. The foremost challenges in the green interior design contain structural secondary construction, excessive design operation and improper function design (design communication stage), building material misuse (decoration construction stage), energy waste (management and maintenance stage), and so forth.

Nevertheless, the process of interior design still includes the part of indoor demolition. Therefore, this research comprises decoration and construction stage, the design communication stage, indoor demolition stage, use and maintenance stage, and in-depth discussion of the green issues of interior design and corresponding green strategies according to the viewpoint of the whole life cycle of interior design. The problems faced by interior design at various stages are analyzed, including excessive design operation and improper function design (design communication), secondary construction of structure and incorrect selection of building materials (decoration construction stage), waste of energy and endangering indoor environment (use and maintenance stage), and excessive energy consumption. This study divides the interior design process into four stages based on the interior design life cycle. They detailed analysis of the green interior design faces is carried out, and it integrates the 3R strategy into each stage and finally proposes the “green creative strategy.”

In the design communication stage, we face the problems of excessive design operation and improper function design, resulting in waste of resources and use space. Therefore, the reduction plan, energy-saving design, and regeneration design strategy are put forward. In the decoration construction stage, we face the problems of secondary construction of the structure and wrong selection of building materials, resulting in excessive waste of resources and the waste of space. The proposed reduction construction is offered for the recycling and building material selection strategy in the use and maintenance phase. The existing models face energy waste and endanger the indoor environment that produces excessive environmental load. Therefore, the proposed model is put forward to reduce energy consumption. It further utilizes the low resource having low carbon living strategy. The indoor demolition phase faces the manufacturing waste. Waste and excessive energy consumption lead to waste of environmental resources. Therefore, waste classification, material separation, and recycling strategies are proposed.

3. Interior Space Reconstruction Paradigm

Vision, sound, smell, and touch are considered the main human physical perception. Every day, we rely on the eyes, ears, nose, tongue, and other organs to stimulate the environment. The humans experience the nature and soul of a place using various organs. These perceptions are considered the most basic form of human contact and perception of the world, which is also a prerequisite for the formation of a more comprehensive and complex experience. Therefore, the overall perception of the internal environment has been beyond the experience of a single sense of being one-sided, with a variety of internal depth of organ experience. In the interior design, it is necessary to consciously use this feature to enhance the awareness of the environment. The interior space reconstruction paradigms are shown in Figures 3(a)–3(e).

3.1. Spatial Behaviour of Environment. Human beings are living in the interior space and are often unconsciously affected by this space. Space is the protagonist of design. Space can accommodate, separate, construct, promote, and improve human behavior. A very important social collective space is living porch, coffee shop, square, and street. Their space settings have a catalytic effect on social interaction, not just for one person, so everyone should have a space consistent with their own goals and activities. The space with the behaviour environment can make the space identifiable, so that the user has a sense of identity and belonging. Therefore, behavior is an important principle for creating human internal space.
The interior space interface is the enclosed surface of the interior space, which consists of several parts of the top surface, the face, and the side. Spatial interface design can create a sense of depth, space, and scale, and also make the space functional, oriented, and artistic. According to the effect of design, interior space design can be divided into physical space design and psychological space design.

(i) The essence of physical environment design is called indoor physical space design, which mainly divides the indoor functional space into walls and partitions. TV background design and ceiling practice are also physical space design. The special light environment, thermal environment, object texture, and some textures in the indoor space are the general essence of the physical environment, which can be felt through vision, touch and hearing.

(ii) Psychological space design pays more attention to people's spiritual world and psychological feelings. Psychological space design needs to have its material carrier, often by means of physical space design to reflect.
3.2. The Diversity of Human Cultural Consciousness. The aesthetic level of modern interior design has changed from the past decoration and embellishment or general atmosphere to the present artistic style, cultural aesthetics, and artistic conception. Humanism advocates that every human being is valuable, and the respect for human dignity is the root of all other values and the root causes of human rights. The mechanism of interaction between many people and the environment is cultural. Focus on the design of human nature should also be reflected in the details of the design. The space and the corresponding interface are specific when every time the behaviour of people is concrete. Therefore, the specific design of the space and its interface is beneficial to the human behaviour and psychology. It is the true embodiment of humanization design, so in every detail of the design, it should consider the needs of the people. After more than ten years of ups and downs, the design community finally calmed down to reflect on the simple design and, found that the simple design has a strong unparalleled vitality, as shown in Figure 4.

(i) The vitality of minimalist design lies in its innovation. In terms of interior design, whether it is western Rococo style, European style, Chinese antique style, Hong Kong style, or Taiwan decorative style, it is “simple” to “imitate” the simple design of the existing style, but there is no fixed model. Bauhaus’ slogan “from nothing to something” emphasizes innovation. Mies van der Rohe’s “simplicity is richness” is also a simple inverse proposition. It is a pile of simple materials without cultural and artistic connotation.

(ii) Simple design is the vitality of innovation and also lies in the simple design style, which conforms to the mainstream of contemporary aesthetics. In the current era, the modern societies require fast development change. With the constant change of life style and the accelerating pace of life, people began to pay attention to the simple decorative style. In the face of a society with diverse information, people find that this decorative style also has the taste of modern culture in a sense. The desire for simplicity is hidden in the hearts of modern people, who demand a quiet and peaceful local environment. Therefore, the pursuit of simple beauty in room design seems to be the consensus of many people.

(iii) Simple design is the essence of design, emphasizing the concept of functionalism. Simple design is not only a style in the modern design concept, but also relatively cumbersome and complex. In the design, it especially emphasizes convenience and practicality, and realizes an elegant, lively, harmonious, and comfortable life experience in this pursuit.

People need a healthy, comfortable, pleasant, and cultural indoor environment. The symbols and performance effects of indoor space reflect the height of human cultural development, and indoor space modeling is an important form of interior design performance.

3.3. Design Pattern Simulation. Indoor space is perceived by its shape. The height and size of indoor space affect people’s spatial feeling. The internal space is triangular with the

Figure 3: Interior space reconstruction paradigms.
virtual points, lines, faces, and volumes. The shape of interior space defined by lines has linear characteristics, representing masculinity. From the sense of direction, if the space is narrow and high, so the vertical direction is relatively strong, it will make people feel upward, stimulate excitement, and raise their emotions. The long and narrow space is more intense in the vertical direction, which makes people have a deep feeling and will create a more profound artistic conception. The shape of the horizontal space gives people a relaxed, quiet, ordinary, and kind feeling. The shape of the inclined space will cause rise, criticism, liveliness, and various feelings due to different inclined spaces.

According to the demand, we can design the space of other functions, and show richer and more thought-provoking characteristics. For example, the shape of the dome space and the low space shape on both sides of the middle can produce the psychological effects of centripetal, cohesion, and convergence. Grasp the appropriate proportion of indoor space size, right and wrong, open and close, give a complete, stable and unstable visual experience, and meet the solemn requirements. The combination of indoor space and space is generally continuous and repeated. If you enter another space from one space, you will feel dull and slim if you connect directly. Then, a space full of changes will have a sense of rhythm on the premise that it meets the requirements of connection function. If the space grows from large to small, from small to large, from high to low, from low to high, from light to dark, from dark to light, the musical beat will be generated, as shown in Figure 5.

4. Conclusion

Computer vision technology is an emerging discipline but has a very broad application in some special industries such as health care, criminal investigation, and security, and the technical efficiency, ease of use, real-time and stable performance, and so on have higher requirements; therefore, the technology is facing unknown opportunities and challenges. According to the research achievements in recent years, the essence is the core and hot issues, discuss the nature of computer vision technology and its theoretical framework, the development process of computer vision is reviewed and forecasted the development trend in the future, hope can help some scholars interested in the sort of ideas in this field, and get inspiration from new research in. In this paper, we use computer vision technology to simulate the
interior space design. The interior design in the design should be based on the needs of the people, from the realistic, comprehensive and thoughtful consideration of the needs of people and as much as possible to meet the creation of humane architectural space, improve the quality of the space environment, as far as possible to bring convenience, safety, comfort and enjoyment to people, improve people’s quality of life.

Data Availability

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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