International Journal of Smart Home
Vol. 9, No. 9 (2015), pp. 119-128
http://dx.doi.org/10.14257/ijsh.2015.9.9.13

Application of Digital Simulation Technology in Environmental Design

Fei Wang

Xuchang University
530835181@qq.com

Abstract

The pursuit of technology and humanities, social, economic, ecological and other aspects of coordination, is the future development direction of environmental art design, based on the combination of both process or may appear to the main issues discussed, This paper takes the overview of digital simulation technology as a key point, discussing the influence of digital simulation technology on the Environment industry as well as its specific application, which can make the designers update designing concept during the process of Environmental design, so as to achieve the personalized requirement of the modernization, to achieve the combination of the environmental art ,the design art and digital technology, the environment art and digital technology can bring out the best in each other, the perfect combination, make the environment art design can be better and better.

Keywords: *Digital simulation technology, Environment industry, Modernization*

1. Introduction

Nowadays our society is changing with each passing day, new things appear endlessly every day，the emergence of digital technology application in art design is also an important manifestation of technological development, traditional design methods cannot meet people's growing aesthetic demands and the evolving aesthetic concepts[1][2]. With the emergence of multimedia and the development of computer-aided design, digital technology is integrated more and more into environmental designs，making a new life to Environmental designs，and abundant means of expression to art [3].Architecture, as well as other cultural factors, has the strong cohesion function to society. When we enter into a strange city, what we see and contact first is its architectural complex. We percept the history (architecture of old or new), geography (landscape terrain), climate (overhangs, orientation, sunshade, window size, wall thickness, etc.), economy (building standards, advertising logo, etc.), life style(building density, height, and housing closure and openness, collection and dispersion, etc.), culture and art (architectural style, decoration design) and other basic features of the city from the architectures .there is no any other artificiality that can transfer so much information fixedly, while people cultivate their own life style and cultural patterns in this architecture environment, and shape their architectures with the life style and cultural patterns conversely. “We form our own architecture, and then, they form us.” This is the social cohesion function of architecture, which is the cultural value of architecture. Architecture is a microcosm of the Times. Architecture of each historical period reflect its contemporary social politics, economy, culture, ideology, as well as life style and artistic taste of each class with its own characteristics, and convey information to contemporary and future generations of people in a particular language and symbols system (Table 1).

ISSN: 1975-4094 IJSH

Table 1. Significance of Western Architecture

Years	Country or Region	Cultural Heritage	Typical Architectures	Architectural Space Construction and Structural Characteristics	Time Significance of Architecture
14-15 century	Italy	Boccaccio "Decameron" (1313-1375 AD)	Florence Cathedral Dome (1417-1420 AD) - bruner laiszky (completed in 1436）	The Renaissance style (early) 1. Homogenization space concept (unlike the hierarchical structure of the Gothic) 2. The use of basic geometric shapes (highlighted with "round" shape) 3. The reuse of the human body and classical pillar type 4. The perspective and proportion	Universe Concept of Digital organization
20 century (before World War II)	The United States, Western Europe	Abstractionism, cubism and surrealism aesthetics confronted with the socialist realism	Van Doesburg's residential design	Functionalism: 1. The adoption of simple geometric shapes 2. Open plane and transparency 3. Spatial continuity 4. Opposition to decoration	Architecture became functional "container"
20 century (after World War II)	The United States, Western Europe	diversification of art	The Sydney Opera House (1959-1972)	Multiple times 1. Both organic and technical 2. Emphasis on local characteristics, requirements of the sense of place 3. The application of Gestalt psychology and System concept	The new integration of freedom and order
The late 20th century	The United States, Western Europe	The rise of personalized	Bilbao museum	Emphasizes on individuality, fade out "style"	The tertiary industry rose as the leading factor

The change of the development has also caused the designers of environmental design, interior design to respond positively [4]. To a designer, digital technology did cause them with might redoubled. Complex space form creation, various styles of the creative imagination and description, are available through the computer aided design system and virtual technology, digital technology performance. In view of this, the digital technology performance not only to the traditional design with innovation and change, but also can make traditional environment art design model performed by digital virtual technology to achieve more real freedom, highly interactive art effect. In addition, the designer can via the electronic network technology and digital presentation means for design, construction and project management for reasonable control, with customers realize a timely, effective communication, so as to improve work efficiency and design quality [5]. At the same time, digital technology has infiltrated into much large animation, film and television scene environment design, digital 3D virtual scene and field scene with a seamless heavenly robe, to create an impressive artistic effect, bring people to experience the shock of a

hitherto unknown. The environment art development to rely on modern science and technology, however, too much emphasis on technology, the pursuit of advanced technology, some by the outstanding Sherborn. And pay attention to technology and humanities, technology and economy. technology and society, technology and the ecological contradictions and relations, comprehensive analysis, suit one's measures to local conditions to establish science and technology in the environment of artistic creation in the position, explore it's to develop a tendency, positive, and effectively promote the development of technology, in order to achieve the maximum economic benefits, social benefits and environmental benefit. In the Environmental design field, digital simulation technology as a kind of unique technology can solve the problem between abstract thinking and its generated entities [6]. Since 1990's, digital simulation technology widely has been widely used in solid modeling, information management, art field and some other fields, which has also attracted some planners and architects; moreover, it has obtained the preliminary application in the field of Environmental and city planning [7].

2. An Overview of Digital Simulation Technology

Digital simulation technology, computer graphics software technology as well as virtual simulation system build up 3D simulation model, which also has built up testing technology through a series of experiments on three-dimensional model [8].

Three dimensional simulation technologies has the advantages of high efficiency, safety, which can be less affected by environmental conditions and constraints, according to the actual needs of the project, it has the advantages that can change time and ratio of model size. From the characteristics of computer's three-dimensional simulation technology, there are three features: the first feature is the interactivity of three dimensional software, followed by the feature of imagination, finally the feature of immersion, "Immersion refers to the degree that users are in the real virtual environment The ideal virtual environment can make it difficult for users to distinguish the degree between true and false (such as 3D visual scenes which are changed because of the changeable view), even beyond the reality, such as the realization may be more real than real lighting and sound effects and so on. "

"Interaction refers to the degree of an object model that can be operated but users within 3D virtual environment, as well as the degree of natural level that is getting feedback from the environment (including real-time). If users can directly control the objects in the virtual environment, users also can move freely through the virtual environment when users are encountered with trees or walls in virtual scene, users will be covered by an object and they have to stop the motion."

Imagination refers to users who are immersed in the multidimensional virtual space, they can rely on their own perception and cognitive abilities so as to increase spatial conception effect in a full range, which can play full role initiatively and form new concept.

2.1. Relationship between Environmental Design and Simulation Technology

Simulation technology has close relationship with Environmental when it has not entered into the digital era, as early as in the era of Da Vinci, the architects were willing to draw virtual space on the four walls of the construction, in the hope that people could feel more vast in the area of the construction. In 1930's, people tried to use four frame movie projectors to have wall projection at different Environmental corners within the interior space, which can make people feel and experience the changeable Environmental space in this room. After 1980's, with the development of computer technology, people simulated Environmental interior space and group Environment space in the CAVE system.

After entering the twenty-first century, simulation technology was usually used for the construction of the study group or restoration. Eindhoven University of Holland once used simulation technology to design and consult, they developed a software package that was composed of a set of functions of CAD, called CAAD software, which can create, modify and provide a toolkit for visualization of architecture. It can support the input and output of Auto CADDXF file; moreover, it also can increase the dynamic behavior animation for objects in the virtual environment. Taking a domestic example, in 2003 one VR for the Forbidden City called The Forbidden City, Emperor's Palace was an immersive theater, which could accommodate 54 staff, and the high resolution images projected were 50 feet wide, 14 feet high on the curved screen. Visitors could fly freely in the virtual Forbidden City by using the controller so that visitors could roam in the Forbidden City between Kangxi Dynasty and Qianlong Dynasty, who could have closest watch on the panorama of the Forbidden City.

2.2. The Main Effect of the Digital Simulation Technology in the Construction Industry

Computer's 3D simulation technology is mainly the integration of all kinds of technologies, in the computer simulation field, technology and research contents are mainly including: the first is the application of map baking technology; the second is the application of seamless editing biological modeling technology; the third is the application of Multi Gen real-time interactive technology; the forth is the application of particle system technology. 3D simulation technology has three characteristics, namely, interactive feature; feature of imagination and immersion, this kind of technology has the advantages of safety, high efficiency, less restricted by the environmental condition, which can change time and ratio of model size according to the actual needs of the project and so on.

In 3D scene simulation system, the real sense of simulating virtual reality needs a lot of elements; generally speaking, creating a virtual reality scene should be in accordance with the needs of the following operations step by step, which is shown in Figure 1.

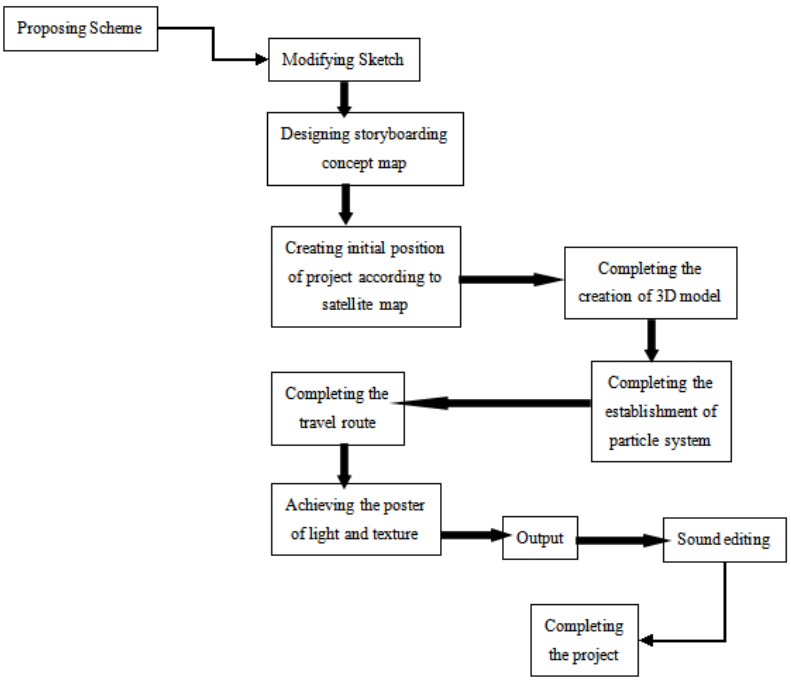

Figure 1. The Operation of Creating Virtual Reality Scene

Taking the construction of campus as an example, in the reformation of Environmental design, usually the designers will propose several designing plans, through different elevation design of campus appearance, 3D simulation system by using computer can realize real-time switch. During this process, we need to take the image thinking of computer simulation in three-dimensional space into account, which mainly use AutoCAD and 3DSMAX to complete the virtual campus scene in various facilities. After completing the creation of campus 3D scene with AutoCAD, importing it to 3DSMAX, creating a ground model, because of its strong modeling capabilities, the creation of campus three dimensional models will show the strong stereo effect of the simulation.

3. Effects of Digital Simulation Technology on the Construction of designing Concept

Virtual simulation has brought a new designing way of expression, it can change our understanding for the perception of space and construction program, and therefore, with the deep development of digital information revolution, it can also change our thinking habits during the process of Environmental designing.

3.1. Virtual Simulation can Aid Environmental Design

From different aspects, during the process of Environmental design, it is required rational thinking and emotional thinking, the effects of using virtual simulation can be expressed in two aspects: on one hand, it can reduce the restriction during the process of design, which can make designers have creative thinking and play its full role, not only by the tools, methods and so on, but also by the creative ideas for Environments so that designers can get the enlightenment and inspiration; on the other hand, the assisted rational thinking can help designers to analyze things comprehensively, more reasonably, which can allow the designers to obey the designing rules. That is to say, on one hand, the application of virtual simulation in the conception of Environmental design makes the conception of Environmental design have more freedom; on the other hand, it makes the design more rational. Virtual simulation with the aided Environmental design can reduce many restrictions during the process of design; therefore, designers have more freedom to play their imagination. Moreover, the Environmental design combined with virtual simulation and aided design can make architects get rid of the limitation of expression, the Environmental forms have got breakthrough, the accurate description can easily complete the complex 3D space.

Virtual reality technology is a series of the combination of new and high technology, these technologies include computer graphics, multimedia, artificial intelligence, artificial interface technology, the sensor technology of real-time computing technology, human behavior and a number of key technology research. It has broken through the pure digital mode interaction information between men, machine, which has created a man-machine harmonious information environment like being personally on the scene. Every time, the progress of science and technology can provide the possibility for architects to break the confines. The invention of virtual reality technology has brought lots of changes in the environment architecture designing field, which also can make the architects' wisdom and creativity being further liberated and developed. By means of creating and experiencing the virtual world like being personally on the scene, the realization of interactive visual simulation can make the architect's creative thinking unprecedentedly liberated.

Virtual environment (shorted for VE) is the performance space with application of virtual reality technology, (as shown in fig 2), which is a visualization platform combined with various technology integration together, people can perceive and interact in the virtual world through virtual environment. An ideal virtual environment should possess the characteristic such as three-dimension, advanced man-machine interactive means, good sense of being real and so on.

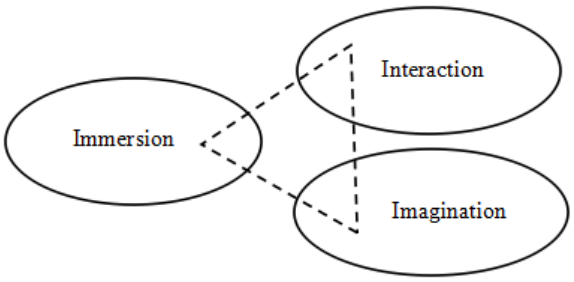

Figure 2. Features of VR System

3.2. The Combination of Environmental design of and Virtual Environment Simulation Technology

Design can be divided into two layers of meaning to understand namely, "idea" and "plan". Idea is the expected artistic effect that people want to achieve in an artistic practice; while plan is the adopted method and step which is to achieve the expected effect and artistic conception. Because of the virtual environment simulation technology is concerned with the environment, so, here it refers to the artistic design of environmental design. Environmental design is the design that takes human life space as the object, including city planning, landscape design, Environmental design, interior design, which is overall design with a comprehensive natural, social, cultural factors, at present, the combination of virtual environment simulation technology and design is not so close, there are two situations on the whole: one situation is after having design, virtual environment simulation technology is used passively to perform it, such as: interior design, estate planning engineering and other designing schemes. Designers or developers want to make users feel the real situation, and then they have to use virtual environment simulation technology. But the scheme has already been shown by designers in the drawings, thus, virtual environment simulation technology is just a mechanical reproduction on drawing scheme, which has not too much room to create; another situation is when the virtual environment simulation technology is applied, people did not consider or have less consideration of its art feature, which makes people feel stiff and cold, such as: the virtual scenes of some traffic tools, the virtual scenes of education and training and so on. These virtual scenes have no sense of art, which makes people find it difficult to accept and fell them boring; therefore, it affects its using result and effect in a certain extent. Why there is such a situation? This is caused by the irrational education system in our country. On one hand, those who learn art have poor knowledge in science and engineering, who have little idea in the computer and high-tech field and do not know what to do, which makes it unable to participate directly in the virtual technology and unable to bring art to a virtual environment simulation technology; on the other hand those who learn science and technology are poor in art, thus, they cannot have deep consideration in art. Eventually it resulted in the above results.

4. The Key Technology of Constructing Virtual Environment

Virtual reality technology involves parallel computer graphics, sensor technology, multimedia technology, network technology, computing technology and some other technologies, which is integration and higher penetration of these technologies. The construction of virtual environment cannot be without the support of virtual reality technology, which also needs the following key technologies:

4.1. Modeling Technology

Modeling is use the data to generate the corresponding virtual model through acquiring a variety of data of the real environment, then according to the need of application to use

it. Modeling of virtual environment includes the geometric modeling of the virtual object, physical modeling and motion modeling.

Geometric modeling can be a description of 3D modeling of the virtual objects (polygons, triangles and vertices) with its appearance (texture, surface reflection coefficient, color, etc.). Three dimensional modeling of the virtual objects can be accomplished by a variety of 3D modeling software; the common software includes 3DsMxa, Maya, Auto CAD, etc. Another method is with the help of special hardware or software to generate the model automatically, such as by using laser scanning techniques, 3D model can be obtained by the laser beam scanning objects in the object surface. The appearance scene can use digital camera or scanner to save the actual scene photos with the computer image format, which also can buy the texture database.

The motion modeling should consider the changes in virtual environment caused by its location, collision, zoom, surface deformation and dynamic generation, which is one of the most difficult problems in the virtual environment. For example, detecting problem of collision, when the relative positions of the two virtual objects Re changed, how to detect whether they are collided, so as to avoid the mutual penetration between the two objects and other real situations, physical modeling can describe physical characteristics of virtual objects, such as quality, weight, inertia, modes of deformation (elasticity or plasticity) etc.. In the real world, most objects are not rigid, when the user interacts with it, a variety of deformation can be occurred, the ideal virtual environment should show these deformations, however most of the deformations are very difficult to describe in mathematical method.

4.2. Realistic Graphics and Real-time Display Technology

Most of virtual environment take the scene generated by computer as the final visual output, therefore, the picture quality will directly affect the participants to Level the sense of reality in the virtual environment. The realistic graphics technology can use a variety of realistic graphics algorithms, including illumination model, ray tracing algorithm, texture mapping algorithm to render the scene, which can eventually generate the realistic scene on computers.

With the development of graphics algorithms and graphics hardware, 3D graphics generation technology is gradually mature, but the key problem is how to generate it in real-time. In order to achieve the purpose of real-time, at least, it must ensure that the graphics refresh rate is not less than 24 frames / sec. On the premise of not reducing the graphics quality, how to speed up the graphics rendering speed and improve the display frame rate is the research content of real-time display technology.

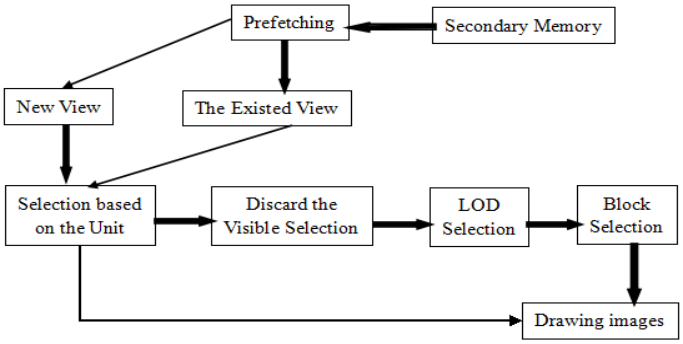

Figure 3. Real-time Drawing Program

5. The Application of Digital Technology in Environmental Design

5.1. The Stage of Creating Environmental Design

We usually use "two-dimensional" graphics to express three-dimensional objects, however, it is a simplification for two-dimensional information, and there is inevitably simplification and abstraction. The viewer cannot have normal perspective to experience the Environmental space, who cannot acquire the real person's true feelings in the future. However, by using virtual reality, it can make the space of Environments be fully reflected in the Environmental creation stage, so the Environmental design of the space experience is more interactive and flexible, at the same time, the spirit of the place can be shown and expressed as much as possible, thus, the authenticity is greatly strengthened. As shown in fig 4. In the virtual reality system, the actual feeling of be personally on the scene can show the proportion of the layout in architecture, which can be refined by adjusting the schemes of the designing elements. Immersed in the future construction, the designer thinking can be no longer interrupted and they cannot wait so long time, creativity and inspiration will be greatly stimulated, therefore, the traditional methods cannot compare with this method.

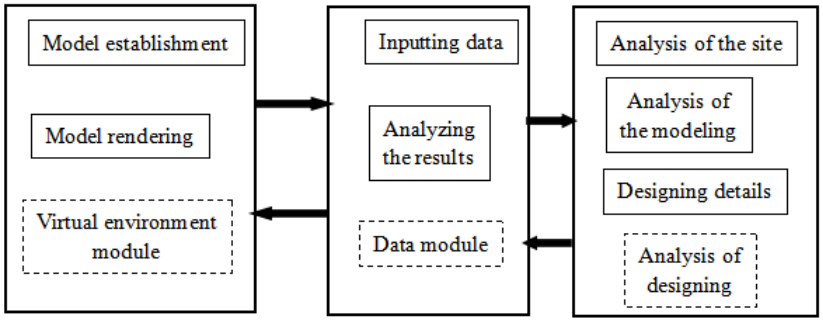

Figure 4. Steps of Aided Environmental Design for Virtual Reality

5.2. The Performance Stage of Environmental Design

Digital simulation technique can provide designers more opportunities to experience man-machine program with multi-angle, so as to experience free multi-dimension interaction. People can choose to observe the Environment with static state, or in a variety of forms of motions to experience Environmental space. At the same time, it also can have real-time comparison between different schemes, then after comparing, making judgment and choice. Moreover, the system can also simulate the sun light, as well as the related equipment’s and other facilities, which can make the overall expression of the Environment more comprehensive, real, scientific and convincing.

5.3. Interaction with other Designing Links

Using numerical simulation technology, it can be used to study and review the design of other links. Such as the simulation of wind environment of high-story Environment, so as to design the lower part and adjust the Environment's outer space, thus, the wind environment of high-story Environment's surrounding can be improved. In addition,it also can verify the safety of fire compartment, the control of smoke, evacuation routes and so on. In short, today, digital simulation technology can give support to the Environmental design from the aspects of the professional integration,which can consider comprehensively with different majors, so as to make the Environment to be designed more perfectly.

6. Conclusion

The application of digital simulation technology will have a very broad development in the construction industry, at the same time; it is also great extension for designing, in the virtual environment with construction roaming. Meanwhile the designing requirements for the environment has brought new challenges, how to create different construction types in the virtual environment, so as to make color delicate and make particle dynamic effect within 3D environment vividly, how to combine with the dynamic objective virtual model and create a more beautiful visual experience is a great challenge for all designers.

Acknowledgement

The paper is funded by the humanities and social science project in department of education in Henan province in 2014, 14Q079

References

[1] S. Meehae, "Muller-wittig Wolfgang C T K Y. Reconstructing Peranakan Identities through Digital Heritage", in Proceedings of VSMM. IEEE, **(2002)**.
[2] A. M. Bonacchi, V. Cappellini, M. Corsini, A. D. Rosa and A. B. M. Piva, "ArtShop, an artworks image processing tool", In Proceedings of VSMM. IEEE, **(2002)**.
[3] D. Watson, "Energy conservation through Environment design", New York, McGraw-Hill, **(1979)**.
[4] S. Jarmul, "The architect's guide to energy conservation, realistic energy planning for Environments", New York McGraw-Hi11, **(1980)**.
[5] M. Iansiti, "Technology Integration Making Critical Choices in a Dynamic World", Boston Harvard Business School Press, **(1998)**.
[6] N. C. Hale, "Abstraction in Art and Nature", New York. Watson-Guptil Publications, **(1981)**.
[7] F. Frascina and C. Harrison, "Modern Art and Modernism a Critical Anthology", New York, Harper and Row, Publishers in association with The Open University, **(1982)**.
[8] R. Arnheim, "Art and Visual Perception", California, the University of California Press, **(1974)**.

Author

Fei Wang, (1978) Xuchang University, research direction, digital architecture .E-mail: 530835181@qq.com