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Research Article

Environmental Landscape Modeling Design Based on Smart City Public Facilities

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At present, the development of cities faces many problems of integration and coordination of practical operation and management. Smart cities will change the existing urban management model to a new management level and will bring about changes in many aspects. With the acceleration of urbanization, people will pay more attention to improving the living environment and living standards. Landscape is an important part of people's living environment. The research of landscape modeling design is of great significance to improve people's living environment. The purpose of this study is to study the modeling design of the environmental landscape of public facilities in smart cities. It improves the quality of residents' living environment and the sense of belonging to the city by optimizing the landscape shape. This study firstly describes the point, line, surface, body, and color elements that constitute the landscape modeling and lists the corresponding vivid cases for design reference. Then, this study uses the virtual reality method and BIM technology to conduct a detailed analysis and research on the construction of landscape image and the dynamic visual characteristics of human eyes. Then, this study conducts a field investigation and research with the preference of the community vegetation as the investigation target and collects the residents' satisfaction with the vegetation design. Experimental data show that more than 80% of residents prefer carefully designed and tailored plant combinations with regular arrangements. Then, based on these experimental results, this study proposes a targeted improvement plan for the landscape modeling design of the community. Through the research on the environmental landscape modeling design of public facilities based on virtual technology and BIM technology, it can enhance the interactivity of landscape experience, reduce design costs, and optimize landscape modeling design. It makes the landscape environment truly serve to improve the quality of life of residents.

1. Introduction

With the leap and development of new urbanization construction, the environmental landscape industry has also encountered new development opportunities. At the same time, people's living standards are constantly improving, and people's concepts are also changing with the development of the times. Therefore, people pay more attention to improving the living environment and living conditions. In the development and construction of the city, the landscape art of the public facility environment is an important part of building a smart city. As the vitality and arteries of urban development, public facilities are one of the places where people interact more frequently in their daily lives. Through the rendering of the landscape environment, the viewer can establish an emotional resonance with the landscape and even the city. It makes the viewers feel a strong sense of belonging and identity and feel the warmth from the city. But at present, the urban landscape design is still far from meeting people's needs for improving the urban environment. People urgently need a public facility landscape environment that can enhance viewing pleasure and living happiness from all senses. Therefore, it is an inevitable popular development trend to create excellent landscape modeling based on smart cities.

Virtual reality is not only a presentation medium but also a design tool, which produces a human-friendly multidimensional information space in a visual form, which provides favorable support for people to create and experience virtual worlds. Due to the real-time three-dimensional space performance capability, human-computer interactive operating environment and the immersive feeling brought by virtual reality technology, it has played a pivotal role in the simulation and training in the aerospace field. The environmental landscape design exists to improve the living standard of the residents, and it provides the residents with a landscape of a comfortable living environment. An excellent urban environment landscape design can become a city's business card and logo. It can not only enhance the character and charm of the city but also promote the development of local tourism, thereby enhancing the city's influence and regional popularity. Through the design of the environmental landscape, a bridge of emotional communication between the city and the viewer can be constructed. While presenting strong local cultural characteristics, it can also arouse the audience's resonance and enhance the audience's pleasure and sense of belonging. The urban environmental landscape design is of great significance to the construction of a modern city, the inheritance of spiritual culture, the continuation of history, and the protection of the ecological environment. Therefore, the environmental landscape design of urban public facilities is crucial to the development of the city.

Once the real landscape is formed, the designer cannot easily change it, but the virtual landscape designer can change it at will. Therefore, before formulating a plan, designers can present the design plan through virtual reality technology and then improve the plan according to the information fed back by the virtual image. The innovations of this study are as follows: (1) this study uses virtual reality technology to optimize the landscape experience. It breaks the limitation of traditional landscape experience and makes landscape design more interesting. (2) This study uses BIM technology for cost analysis and dynamic visual analysis. Its multiangle research is to study the multiangle of its landscape modeling design. (3) This study takes the constituent elements of the landscape as the starting point of the research and designs the landscape modeling design scheme suitable for the target area through the analysis of the elements.

2. Related Work

Many scholars have paid attention to the research on the environmental landscape modeling design of urban public facilities. Shan discussed and researched how to construct a three-dimensional urban landscape. He introduced the role, significance, and development prospects of the three-dimensional urban landscape dynamic simulation technology, combined with the application possibility and development direction of GIS. He gave an application example of dynamic simulation of three-dimensional urban landscape [1]. Liu combined salt culture with landscape design for sports and leisure tourism. He analyzed the elements of salt culture in the modern sports and leisure tourism landscape and listed the application examples of salt culture in landscape design. He clarified how to spread salt culture through the sports and leisure tourism landscape [2]. Young and Vosloo identified the role of landscape design in communicating multiculturalism and significance in places of remembrance. Using the case study of memorial site Isivivane, he surveyed and measured visitors' experiences and perceptions of Isivivane. Based on the results of the quantitative questionnaire, he analyzed it with the theory of phenomenological explanation and landscape narrative [3]. Kurtaslan et al. investigated the water requirements of plants used in the Selcuk campus, irrigation methods of green spaces, mulching, and plant species used and made recommendations for ecologically sustainable landscapes [4]. Dnmez used correlation analysis to determine the relationship between landscape design work and brand image in the preferences of tourists in the accommodation industry. The results show that as the role of individual regional regulations in tourists' purchasing preferences increases, so do brand awareness, brand image, quality perception, and brand trust [5]. However, most of these studies lack sufficient data to support, and the individual differences in the investigation are large, which can easily lead to the bias of the research results.

Virtual reality and BIM technology can be used in the design of landscape modeling. Diao et al. analyzed the application of virtual reality and simulation technology in 3D urban landscape environment design. He also studied in detail the contribution of virtual reality technology to major landscape activities such as landscape experience, project site selection, and landscape composition [6]. Li and Hou use virtual reality technology to build a virtual roaming system of rural landscape. He aimed to provide a rural landscape experience with strong authenticity, good user experience, and vivid image [7]. Dong and Gao discussed the application of BIM technology in landscape design to help the future development of BIM technology application. He used BIM technology to analyze landscape site selection, landscape construction costs, landscape layout paths, etc. [8]. Borkowski and Wyszomirski introduced the application of BIM in landscape architecture construction engineering, pointed out the problems existing in landscape architecture engineering design, and optimized the design of landscape shape through landscape modeling technology [9]. These methods provide technical and data support for the optimization of landscape design, but their complexity is relatively high, and they are more troublesome to operate.

3. Ways to Improve Landscape Modeling

3.1. Elements of Landscape Modeling Design. Point, line, surface, body, and color are the design elements of landscape modeling. In these design elements, the point represents the collection of landscape in space and the line represents the aggregation of the movement of multiple points with the characteristics of length and orientation. A surface represents a two-dimensional surface formed by the aggregation of multiple lines with length, width, and orientation characteristics. A body represents a three-dimensional cube composed of multiple faces with length, width, depth, orientation, form, and spatial characteristics. The schematic diagram of the elements is shown in Figure 1.

3.1.1. O'clock. The point is the most concise and basic shape in the modeling design elements. Points have the characteristics of concentrating sight lines and representing the spatial location of the landscape [10]. In urban public facility environments, fragmented landscapes are often grouped together and presented as attractions. Its specific manifestations are vegetation and flowers, rockery lakes, amusement facilities, pavilions, and towers.

(1) Create a Landscape Mood. When designing landscape modeling, it is necessary to clarify the role of "points" in the design, and make full use of the highly aggregated characteristics of points [11]. The shape and orientation of the points appearing in the space are easy to attract people's attention and become the focus of attention. Therefore, the characteristics of "points" can be flexibly used in the design, so that they can play a better role in the overall landscape layout. The following three aspects can be mainly considered: (1) it emphasizes the use of "point" elements at the endpoints of the overall landscape, emphasizing the focus of the overall layout. It focuses the eye on the focal point of the landscape. (2) It uses the change of topography to configure the landscape elements of "points" on the highest or lowest terrain. (3) It arranges the landscape elements in the center of the site, making it the center of sight.

(2) Highlight Rhythm and Rhythm. The way the points are scattered and gathered can form a line or plane, and when two points are in different positions, it will give people a different psychological feeling [12]. As a visual appreciation, it also has a clear sense of rhythm, which effectively increases the interest of viewing, as shown in Figure 2. A variety of different layouts and combinations have formed a regular and orderly form, showing a different charm and specific artistic conception.

3.1.2. Line. In general, lines can be divided into straight lines and curves. Straight lines have obvious directionality and are the most basic techniques in landscape modeling design, which are suitable for use in various scenes. The curve has a strong sense of flow, and it can be used as a supplement to the design of scenic spots to produce very good visual effects, as shown in Figure 3.

(1) Straight Line Framing. Straight line is the most commonly used expression method in landscape modeling design. Straight lines give people a sense of stability and solemnity, which are usually applied to the pavement of pavement, the construction of water features, the outline of monuments, and the design of guardrails. Using straight lines to frame the landscape creates a clear sense of boundaries, allowing each landscape to be isolated. It makes the picture appear orderly, neat, and harmonious.

(2) Curve Composition. Curves are usually used in landscape design in supplementary form. The basic look and feel of curves are soft, flexible, and vivid. It is not as rigid as a straight line, and it can often show a lively, flowing, and vital

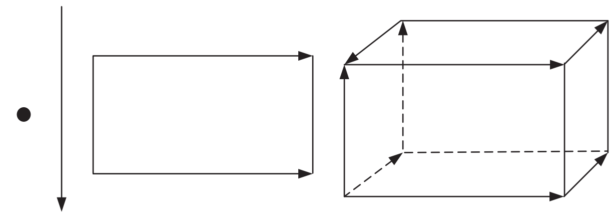

Figure 1: Design elements: points, lines, surfaces, and volumes.

atmosphere [13]. Therefore, it often appears in the design of classical gardens. Curves can imitate the rolling feeling of mountains and rivers. It is often used in the modeling design of arch bridges, rockeries, and flower beds. Moreover, the curve can soften the texture of the picture, making the picture more relaxed, free, and impactful.

3.1.3. Surface and Body. Surfaces and volumes are forms composed of points and lines. In the design of landscape modeling, the trimming of plants, the layout of flowers, the appearance design of fountains, sculptures, buildings, etc., all have face and body techniques. Symmetrical and irregular composition techniques can also be used in the design, which can make the overall picture appear neat and bold, giving people a harmonious and orderly viewing effect.

3.1.4. Color. Color can bring fresh life to a landscape. It is the most infectious design factor [14]. Landscapes with different tones can arouse different emotions in viewers, and bright colors can make people feel happy and refreshed. Dark tones can make people feel depressed and solemn. The use and collocation of colors should be in line with the theme of the design venue, and the leisure and entertainment venues can enrich the collocation of colors. It allows the viewer to relax. For some solemn occasions such as memorial sites, the performance of colors should be weakened and a quiet and solemn atmosphere should be created. At the same time, the use of color can also be designed according to the preferences of the target group. The children's playground can be decorated with warm and bright colors. The elderly activity center can use more calm, low-saturation colors to meet the psychological needs of the elderly.

3.2. Landscape Modeling Design Method Based on Virtual Reality Technology. In contemporary society, various fields have a certain degree of dabbling in virtual reality technology, such as virtual scene construction in the film and television industry, virtual scene experience in the game animation industry, and mechanical virtual manufacturing in the industrial field. Thanks to the development of digitization and computers, human beings have made the most of aesthetic art using modern science and technology [15]. Vision is the most intuitive way for the brain to receive external information. It applies virtual reality technology to urban landscape design. It can transform the audience from passive recipients to interactive participants, making the landscape just like a dazzling array of commodities for the audience to choose from.

Figure 2: The vergence of points.

Figure 3: Landscape design of straight lines and curves.

The development of science and technology has promoted the development of society and economy. As the basic driving force of development, science and technology have promoted the progress of productivity, and people's living standards have gradually improved. Subsequently, it will pay more attention to the promotion of social culture and economic prosperity, and people's way of life has also been changed [16, 17]. As science and technology become more and more common in people's production and life, people's thinking and concepts have gradually changed. People begin to pursue new things and pursue spiritual satisfaction. Improving the quality of life has become the focus of attention. Therefore, under the promotion of many parties, the design and creation of urban environmental landscape can be generated and developed. Figure 4 shows a deduction diagram of technological development and landscape creation.

3.2.1. Spatial Thinking of Environmental Landscape Design. Landscape design often starts with space creation [18]. Taking matter, time, and space as the three basic elements of space experience, the understanding of the space world can be reconstructed by applying the changes of matter, time, and space caused by virtual reality technology. In previous cognition, time was defined as linear and irreversible, and space was defined as forbidden and enclosed. Matter is defined as tangible and perceptible. But with the development of virtual reality technology, the real space where people live and the nonreal virtual space are often intertwined and infiltrated. This has greatly broadened people's cognitive scope, the traditional cognitive dimension has also undergone subversive changes, and the cognitive space has expanded into 8 quadrants, as shown in Figure 5. The super time, super space, and nonmaterial are a kind of transcendence based on the original cognition. Just like being in a virtual scene, it will give people a feeling that the space is wider, the time passes faster, and the objects in the field of vision are richer. But in fact, it only occupies a small space in the real scene. This is just a cognitive illusion caused by psychological effects. Based on this concept of space, the virtual space that transmits huge information and energy is integrated into the space constructed by reality, and space is no longer a pure reality enclosed by matter [19]. The designer dynamically displays the spatial structure by embedding the space with virtual functions into the actual landscape space and flexibly changes the spatial order, thereby extending new spatial forms and functions.

Table 1 lists the new classification of space under the virtual reality field of view. The material composed of objective objects is the real space, and the real space is the space for people to live in real life. The virtual space is often not limited by the objective world, and it is the space that people often touch through imagination [20]. Augmented reality space mainly enhances the reality experience by enhancing people's senses. Augmented virtual spaces are the opposite, enhancing virtual experiences through the properties of physical entities and the virtual elements contained within them. The purpose of physical virtual space is to bring people's spirit and senses into

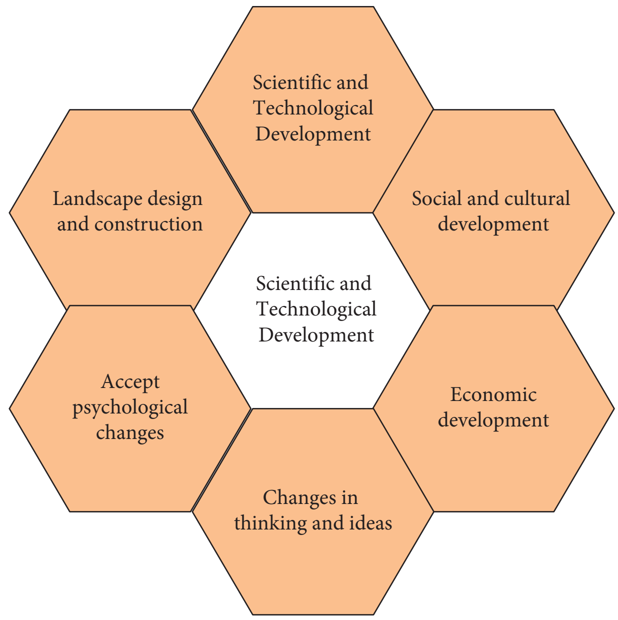

Figure 4: Deduction relationship between technological development and landscape creation.

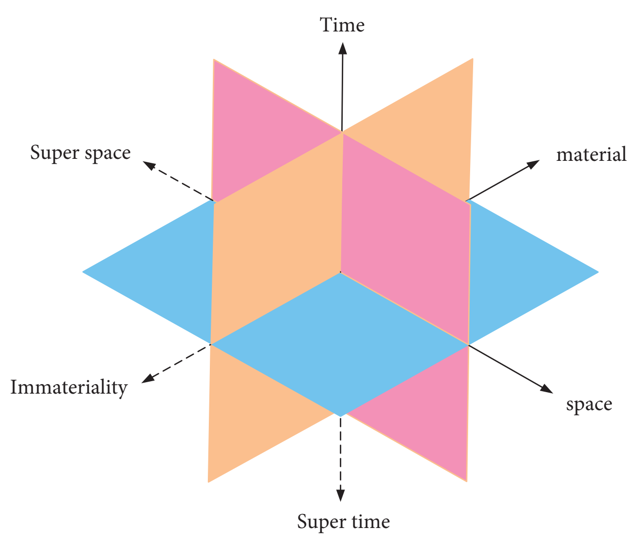

Figure 5: Multiple spaces of virtual reality.

Table 1: New forms of space extended by virtual reality.

Serial number	Time variable	Spatial variable	Material variable	Spatial classification	Spatial property
Group 1	Time Super time	Space Super space	Material Immateriality	Real space Virtual space	Realism Virtuality
Group 2	Time Super time	Space Super space	Material Immateriality	Augmented reality space Enhance virtual space	
Group 3	Time Super time	Space Super space	Material Immateriality	Physical virtual space Alternative real space	Coexistence of virtuality and reality
Group 4	Time Super time	Space Super space	Material Immateriality	Mirror virtual space Distort real space	

virtual scenes through virtual objects. It constantly proves its existence in reality and improves the real experience. Alternative reality space is based on the real space, incorporating virtual elements to enhance the virtual experience. Mirrored virtual space is to simulate the real world in real time and enhance the virtual experience, while distorted reality space is based on physical space and real objects, combined with virtual scenes to enhance reality.

3.2.2. The Modes of Virtual and Reality Complement Each Other. With the advancement and development of science and technology, more and more new garden construction technologies and new materials have been applied to garden landscape design, which can not only improve the effect of garden landscape design but also effectively promote the development of my country's garden landscape industry. The landscape modeling design under the concept of virtual reality includes not only the objective style of the physical world but also the virtual style based on the network, and the mixed style of the coexistence of virtual and reality [21]. On the sensory level, it is the actual object that people can hear, see, smell, touch, and perceive. From a spiritual point of view, it also includes the artistic conception formed by the integration of landscape and people's thinking and feelings. With the development of intelligent technology and digital film and television, the traditional stereotyped landscape modeling can no longer meet people's viewing needs. Landscape modeling design is changing in the direction of innovation and diversification. The landscape modeling design modes integrated with virtual reality are as follows:

(1) *Embedded Mode*. It applies high-tech interactive equipment to landscape design and uses digital holographic images, sensors, simulation, and other technologies to embed the landscape morphological structure. It strengthens people's senses and experiences in multiple directions and modes. The "embedded mode" retains the realistic spatial characteristics of the landscape and does not change the entire morphological attributes of the original landscape, but enriches the presentation of the original landscape modeling. It adds interest and enriches the connotation of landscape modeling.

(2) *Expansion Mode*. If the site is limited, the original landscape cannot adopt the embedded mode, and the traditional landscape presentation method can be expanded. It allows new styles such as traditional landscape styles and virtual landscapes to coexist in parallel. The expansion mode greatly improves the linear and spatial constraints of traditional landscape styles. It expands the landscape to any place and is a powerful complement and improvement to the traditional landscape style.

(3) *Progressive Mode*. This mode combines the features of embedded mode and extended mode. It combines traditional landscape styles with new styles guided by new technologies. In the process of people's landscape experience, the two styles are progressive and transformed into each other. The boundary between the traditional landscape style and the new landscape style is completely blurred, which forms a new landscape style, that is, the virtual reality landscape form, as shown in Figure 6.

3.3. Dynamic Visual Characteristics Based on BIM Technology. Vision is the key to landscape modeling design. As the most direct tool for humans to perceive the external world, eyes can not only identify external things but also judge features such as color, shape, and location [22]. Vision has the difference between active and passive. Active vision means that people choose what they want to see, while passive vision means that people cannot decide what to see. In landscape design, the initiative of vision is mainly to reduce the visual fatigue of viewers and improve the pleasure of viewing. The human eye is constantly moving, and people can form a dynamic visual picture in their minds when viewing the landscape. Therefore, in the design of environmental landscape modeling of urban public facilities, the dynamic nature of vision is taken into consideration. It can effectively enhance the viewing ability and make the viewer impress the landscape environment.

3.3.1. Plane View. Motion trajectory is the path of the object motion. It also refers to the spatial characteristics of the action consisting of the route that a certain part of the body travels from the starting position to the end. Supposing Q is a point of the movement trajectory of the near sight line, the coordinates are (E_Q, F_Q), and U is the viewer's gaze point (E_U, F_U). QU is the collimation axis, L is a point of the motion trajectory of the distant sight, and the dynamic field of view characteristic takes the length of QL to obtain the following equation:

$$\begin{cases} E_U = E_Q - QU \cos\alpha, \\ F_U = F_U + QU \sin\alpha, \end{cases}$$
$$\begin{cases} E_L = E_U + UL \sin\beta, \\ F_L = F_U + UL \cos\beta, \end{cases} \quad (1)$$

namely,

$$\begin{aligned} E_U^2 + F_U^2 &= \left(E_Q - QU \cos\alpha\right)^2 + \left(F_U + QU \sin\alpha\right)^2 \\ &= K^2 + QU^2, \\ E_L^2 + F_L^2 &= \left(E_U + UL\sin\beta\right)^2 + \left(F_U + UL \cos\beta\right) \\ &= K^2 + UL^2 + 2UL. \end{aligned} \quad (2)$$

When the lengths of QL and UL are fixed, L is an arc.

3.3.2. Longitudinal View. When a viewer is climbing a sloped curved plane such as a hillside or an arch bridge, there is a certain height difference between the viewer's viewpoint and the gaze point. When climbing up, the viewing angle is looking up, and when going down, the viewing angle is looking down. If the viewing angle is different, the impression of the scenery will be very different. When the viewing angle is looking up, the field of view is wider, the landscape should be relatively high, and the viewer may not notice the relatively short landscape plants. The field of view is framed by the sky. However, if the elevation angle is too large, there will be a greater sense of pressure. When the viewing angle is looking down, the landscape is based on the ground, with the ground as the background, and the viewer can see all the landscape, but if the depression angle is too

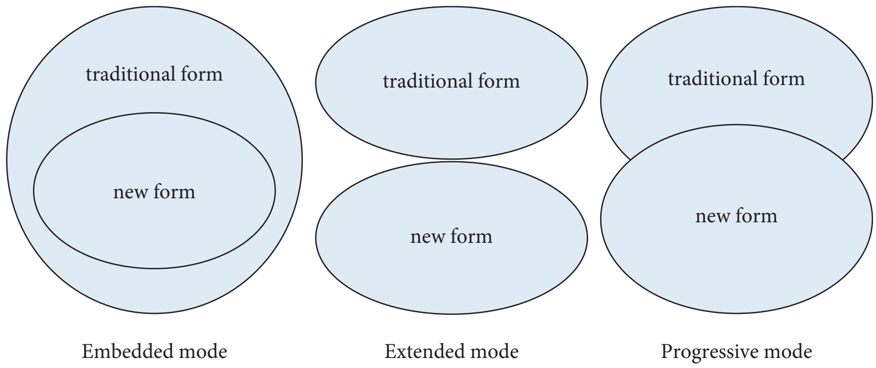

Figure 6: Presentation mode of landscape modeling.

large, it will be scary. Therefore, it is very necessary to reasonably select the height of the slope surface landscape.

Lambda expression is a new feature provided in JAVA8, and it supports JAVA and can also perform simple "functional programming." It is an anonymous function. Supposing K is a point of the line-of-sight movement trajectory, the coordinates are (E_K, F_K), and G is the viewer's gaze point (E_G, F_G). Dynamic field of view mainly refers to the range of moving objects that can be seen. Dynamic visual field measurement is a method of detecting the junction point between the invisible area and the visible area by moving a stimulus intensity optotype from the periphery of a visual field to the visible area. KG is the collimation axis, P is a point of the motion trajectory of the near sight line, V is a point of the motion trajectory of the distant sight line, the dynamic visual field characteristic is taken as the length of KP and KV, and we get

$$\begin{cases} E_G = E_K + KG \cos\lambda, \\ F_G = F_K + KG \sin\lambda, \end{cases}$$

$$\begin{cases} E_P = E_K + KP \cos\theta, \\ F_P = F_K - KP \sin\theta, \end{cases} \tag{3}$$

Getting the general equation for a vertical curve is as follows:

$$f(x) = \frac{1}{2v}x^2 + sx. \tag{4}$$

Slope of any point on a vertical curve is as follows:

$$s_n = \frac{x}{v} + s. \tag{5}$$

The radius of any point O on a vertical curve is as follows:

$$r = v\left(h + s^2\right)^{3/2}. \tag{6}$$

where s is a constant between s_1, s_2, and s_1; s_2 is a small value, so s^2 can be omitted; $s \approx v$, $v = H/J$, and H is the length of the vertical curve; J is the gradient difference, $J = s_1 - s_2$.

The slope of KG is as follows:

$$v_{KG} = \frac{E_K}{v} + s, \ \tan\lambda = v_{AB}. \tag{7}$$

Traditional graphic design can no longer meet people's visual needs. Graphic design based on visual thinking improves the way of information presentation, improves the visual effect and sensibility of works, and makes it easier to grasp people's psychology. When the viewer goes from the straight slope section to the vertical curve section, the tangent angle gradually changes from s_1 to 0, and after passing the highest point of the slope, it gradually increases from 0 to s_1. The value of v_{KG} is between s_1 and s_2, and if the angle between the near viewpoint and the slope is θ, the trajectories of G and P can be expressed as follows:

$$\begin{aligned} E_G^2 + F_G^2 &= \left(E_K + KG \cos\lambda\right)^2 + \left(F_K + KG \sin\lambda\right)^2 \\ &= E_K^2 + F_K^2 + KG^2 + 2KG\left(\frac{\cos\lambda}{2} + \frac{\sin\lambda}{2}\right), \\ E_G^2 + F_G^2 &\approx r_k + KG^2 + 2KG, \\ E_P^2 + F_P^2 &= \left(E_K + KP \cos\theta\right)^2 + \left(F_K - KP \sin\theta\right)^2 \\ &= E_K^2 + F_K^2 + KP^2 + 2KP\left(\frac{\cos\theta}{2} - \frac{\sin\theta}{2}\right), \\ E_P^2 + F_P^2 &= \frac{r_k + KP^2 + 4KP}{\sqrt{2}\cos\left(\theta/2 + 45^\circ\right)}. \end{aligned} \tag{8}$$

This results in a GP approximation circle.

3.3.3. Concave Surface Field of View. When walking on a road with low-lying terrain, assuming that M is a point on the trajectory of the sight line, the coordinates are (E_M, F_M), N is the viewer's gaze point (E_N, F_N), and MN is the collimation axis. D is a point of the motion trajectory of the near sight line, W is a point of the motion trajectory of the distant sight line, the dynamic field of view characteristics are the lengths of MD and MW, and we get

$$
\begin{cases} E_N = E_M + MN\ \cos\mu, \\ F_N = F_M - MN\ \sin\mu, \end{cases}
$$

$$
\begin{cases} E_D = E_M + MD\ \cos\ \omega, \\ F_D = F_M + MN\ \sin\omega, \end{cases}
$$

$$
E_N^2 + F_N^2 = (E_M + MN\ \cos\mu)^2 + (F_M + MN\ \sin\mu)^2 = E_M^2 + F_M^2 + MN^2 + 2MN\left(\frac{\cos\mu}{2} + \frac{\sin\mu}{2}\right), \tag{9}
$$

$$
E_N^2 + F_N^2 \approx r_M + MN^2 + 2MN,
$$

$$
E_D^2 + F_D^2 = (E_M + MD\ \cos\ \omega)^2 + (F_M + MD\ \sin\ \omega)^2 = E_M^2 + F_M^2 + MD^2 + 2MD\left(\frac{\cos\omega}{2} + \frac{\sin\omega}{2}\right),
$$

$$
E_D^2 + F_D^2 = \frac{r_M + MD^2 + 4MD}{\sqrt{2}\cos(\omega/2 + 45^\circ)},
$$

where ND is similar to a circle, because MD and MW have the same length, so the viewer's line of sight on the convex and concave surfaces is the same.

In summary, it can apply the line-of-sight analysis to the design of landscape modeling to determine the height of the landscape and the location of the display. Its reasonable planning and layout landscape can create a comfortable urban living environment.

4. Experiments and Improving Landscape Modeling

4.1. Elemental of Landscape Modeling Design

4.1.1. Line-of-Sight Analysis. The elements of a place can be divided into four types: space, ecology, function, and culture [23]. The landscape modeling analysis of the design elements in the place is first to describe the place with images and qualitative methods. It is then quantified, quantified, analyzed, and refined. It uses the most intuitive diagrams and text. It enables designers to easily grasp site information and better arrange site landscape.

All landscapes are reflected through landscape elements, and the landscape design materials and contents include topography, vegetation, water bodies, and paving and landscape sketches. Among them, topography is the design basis, and the rest are design elements. Line-of-sight analysis is an indispensable consideration in landscape modeling design. The analysis of the line of sight can get the visibility of the landscape, which is convenient for the designer to make a better overall planning and design. Affected by the terrain, sometimes, the landscape cannot be presented well, so it is necessary to analyze and design the location of the landscape. Location is positioning, and it can not only express the direction and position of the landscape but also reflect the internal connection between different landscapes in the site. Topography is the basic element that constitutes a site. Most of the landscape designs are based on natural resources. Analyzing topography is helpful to grasp the overall spatial characteristics of the target planning site, as shown in Figure 7.

As shown in Figure 7, through the line-of-sight analysis, people can get the best sight and sight distance of the site, help plan or adjust the functional partition, and guide the planning of the tour route or tour guide line.

4.1.2. Cost Analysis. Comprehensive cost analysis is the basic method of cost distance calculation. After each factor is dimensionless, it needs to be integrated into a unified evaluation system, and superimposed and evaluated. The richer the hierarchy of costs, the more paths there are to choose from.

This study uses 32 grades as the maximum grade to evaluate the comprehensive cost, compared with 9 grades and 12 grades. Compared with the longitudinal slope of the highway, the road selection in the urban public facility landscape environment can be slightly relaxed, but even this is not suitable for landscape construction on a slope of more than 30 degrees. Therefore, in this study, a 32-level unequal interval value is added for comparison. The importance of the unequal cut-off value is to classify the slopes suitable for construction in detail, thus enriching the classification comparison.

As can be seen from Figure 8, different colors represent different classifications, that is, different cost classification levels. The path selection direction of the 9-level equivalence discontinuity is similar to that of the 18-level equivalence discontinuity, and the results of the 32-level equivalence discontinuity and the 32-level unequal discontinuity are roughly the same. Among them, the first half of the 9-based path moves along the valley with a small inclination angle, and the second half of the path basically rises in a straight line to the end. The path of the 18-level dividing line advances along a stable ridge, and the overall slope presents a tortuous upward trend. The first half of the 32-level equally divided discontinuous value selection path is a long, very gentle slope, and the middle part and the second half rise with a relatively slow slope. The upper half of the 32-level unequal discontinuous value selection path is also a long and gentle slope, and the middle and second half of the path rise straight up at a smaller angle.

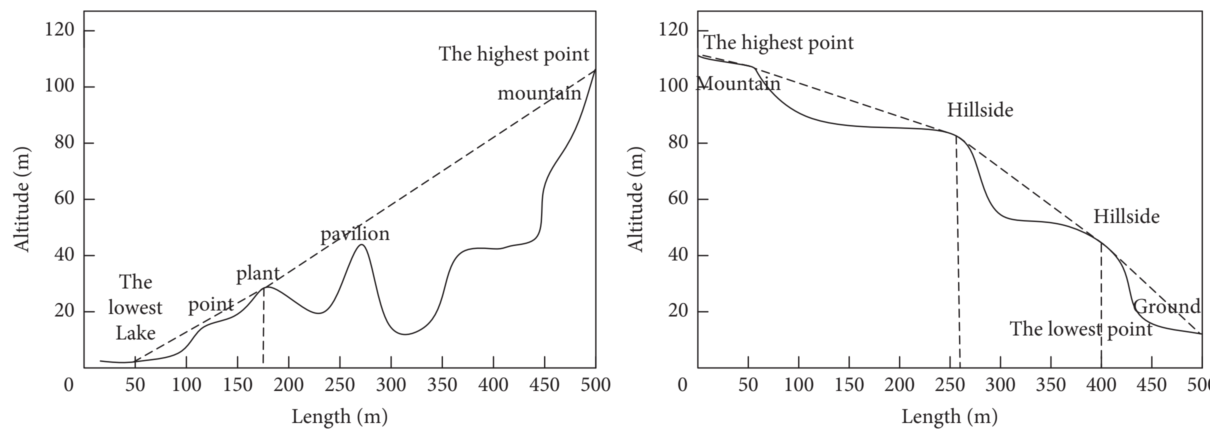

Figure 7: Schematic diagram of the sight range of landscape space.

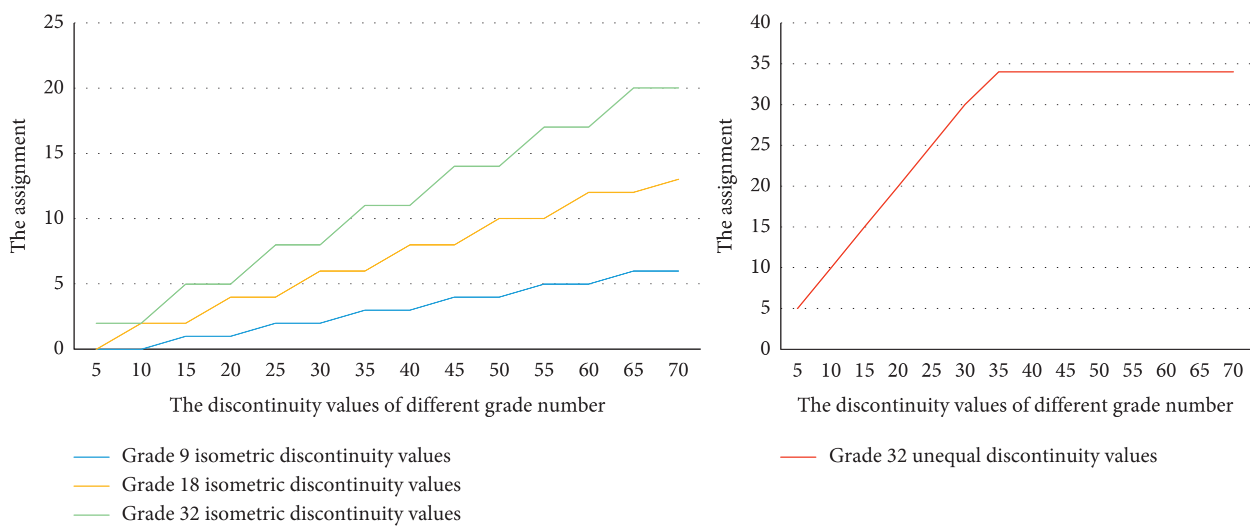

Figure 8: Corresponding relationship between different levels of equally divided discontinuous values and assignments.

The value attribute of the cost is reflected in the assignment, usually the area with a smaller slope has a lower cost. Sometimes, there is a problem when designing, that is, the cost assignment of two similar slopes differs by only 1 degree. However, during the calculation, the route selection only passes through one area and bypasses the other area, which causes the area with lower slope to be more expensive. Therefore, it is necessary to widen the gap of "cost" between each level. It uses the exponentiation method, increasing the level assignment. It is agreed that the area tends to be less sloped when calculating the line selection, as shown in Figure 9.

The path selected without power assignment is an area with sparse contour lines in the first half, and basically an area with a large inclination angle with dense contour lines in the second half. The selection path of the 1/2e power assignment is a slope with a gentle angle. The power-of-2 assignment chooses a tortuous, circuitous path. The rationale for the choice is that the slopes with higher inclinations result in a more winding and circuitous path than the landscaping cost of a straight path. This result is more suitable for the modeling design of the environmental landscape of urban public facilities.

It can be concluded that the cost map of adding power assignment more comprehensively and intuitively reflects the cost status of the landscape path design of the target site. Adjusting route selection through cost management helps avoid ecologically sensitive areas. It makes landscape design more scientific and rational. The path selected by the power-of-2 assignment effectively avoids areas with large inclination angles and dense contour lines. It optimizes the path better, and it is more in line with creating a high-quality urban landscape.

4.2. Landscape Modeling Design Based on Virtual Reality

4.2.1. Constructing New Logic. Logic is the abstract thinking that people generate when they recognize things, and it is a mode of analysis of things. Constructing a new logic of landscape modeling does not mean that landscape modeling must conform to traditional logic but starts with logical thinking. It explores new thinking modes and design schemes, and it obtains more novel and optimized landscape modeling.

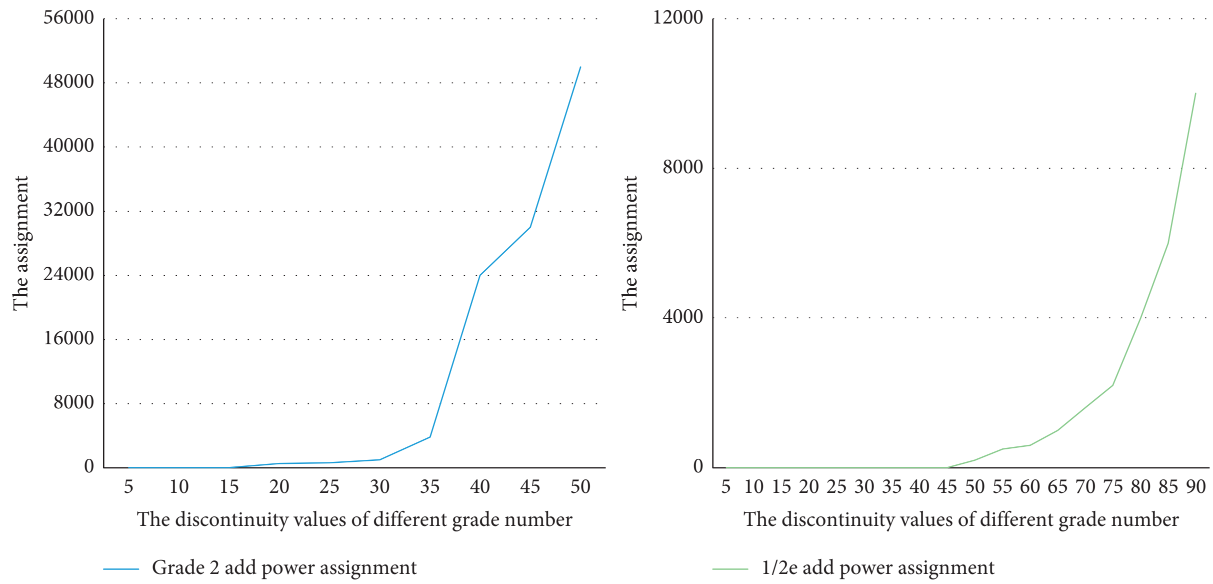

Figure 9: Correspondence between different levels of equally divided discontinuous values and assignments under the guidance of the exponentiation method.

Figure 10: Immersive landscape experience.

The result of landscape modeling design is not only simple appearance modeling but also should be combined with the realization of functions, and the design should be carried out in multiple directions and angles. Landscape modeling should be based on dynamic thinking, which can dynamically deduce landscape elements by establishing mathematical models. It processes the design, and it continuously optimizes to get the best design solution.

4.2.2. Mobilize the Five Senses. The traditional landscape perception is largely accomplished by vision, and the viewer can understand the whole picture of the landscape only by looking at it with the eyes. This is prone to lack of interactivity and experience, and viewers cannot establish a unique emotional connection with the landscape. Virtual reality technology can break this limitation. With the help of some instruments, viewers can experience any landscape they want to experience anywhere. These landscapes can be based on reality-enhancing experiences, or they can be completely imagined. Designers can place some special equipment or QR codes in certain locations to experience different landscape presentation methods through virtual reality technology. It can also set up an experience area, which uses holographic projection to project the virtual landscape with lights, and the viewer can shuttle on the light and shadow trail by himself. At the same time, it can also interact with the landscape, making the landscape lively. Furthermore, it can set up virtual levels, and viewers are integrated into the virtual landscape environment through task challenges. It can receive gift rewards for completing tasks, which not only enriches the interactive mode but also adds interest. As shown in Figure 10, in this mode of landscape modeling design, virtual technology creates a vivid and immersive interactive landscape experience for viewers.

4.2.3. Create a New Image. Imagery is an experience based on landscape modeling. The generation of intention is similar to the lyrical technique of borrowing objects, which is often used in art appreciation. The landscape modeling design under the guidance of virtual reality technology includes nonreal virtual elements. When designing landscape modeling, designers often integrate their own thinking into the design and express their emotions through works. Therefore, creating a new image of landscape modeling based on the viewpoint of virtual reality means that designers use virtual reality technology to place their thoughts and emotions on real materials and express them in the form of landscapes. It establishes a mutual connection through the sensory interaction with the viewer, thereby arousing the viewer's resonance and thinking process. Figure 11 shows the new image construction process of landscape modeling.

As listed in Table 2, the urban landscape is composed of multiple image elements, and the interaction between the traditional landscape and the viewer is limited. The intention is usually relatively single and fixed, which is easy to make the viewer feel boring. Under the interactive experience of virtual reality, people in different moods act their emotions on interactive devices. The equipment then feeds back the information to the set landscape modeling program, so that the landscape modeling changes with the viewer's mood changes. In this mode, the landscape can resonate with the viewer to the greatest extent possible, immersing the viewer in a unique landscape experience.

4.3. Investigation and Preferences of Landscape Modeling

4.3.1. Field Investigation. Taking the plant landscape as an example, this study conducts a questionnaire survey on the preference of plant landscape modeling among the residents of Meijingdongfang Community, Chaoyang District, Beijing. A total of 300 valid questionnaires were obtained in this study, and among these respondents, residents under the age of 25 accounted for 5%. About 32% of residents are 25–50 years old, 46% are 50–65 years old, and 17% are 65+ years old. The occupations of the respondents include civil servants, employees of public institutions, employees of enterprises, students, retirees, teachers, self-employed persons, and freelancers. For the convenience of statistics, the occupations of the respondents are collectively referred to as the following major types: government employees, public institution employees, enterprise employees, self-employed households, freelancers, students, and retirees. Among them, 5% are government employees, 10% are public institutions, 24% are enterprise employees, 7% are self-employed, 16% are freelancers, 9% are students, and 29% are retirees. Among the respondents, 54% were male and 46% were female, and the age structure was relatively average. The composition of the respondents is listed in Table 3.

The survey results of landscape modeling preference show that residents have a higher overall preference for community landscape. In terms of vegetation, residents prefer arbor plants, and the flora should have clear boundaries, preferably pruning. In terms of community landmarks, residents prefer human statues or well-designed and pruned-shaped plants and have a low preference for signs of iron plates or iron gates. In a specific plant landscape, a single plant community is more favored by residents than a variety of mixed plant communities, and the regular arrangement of plant planting rules is better than the disorderly arrangement rules. At the same time, the preference for all planted broad-leaved forest landscapes was higher than that of coniferous and broad-leaved forests or other mixed planting landscapes. In terms of the combination of vegetation, residents prefer the combination of trees and lawns, and they have a lower preference for a single slope with more vegetation. The specific survey results are shown in Figure 12.

4.3.2. Improvement Strategy

(1) Forming Regional Landscape Features. Due to the different natural conditions in different regions, the distribution of plants is correspondingly regional. Different regions have different landscapes, such as large tropical rainforests, temperate broad-leaved forests, and boreal coniferous forests. Different landscapes have their own unique scenes. Beijing is located in a temperate monsoon climate, the vegetation type is mostly warm temperate deciduous broad-leaved, and the winter is dry. There is plenty of sunshine in summer, which is suitable for planting weeping willows, cherry blossoms, other plants, and roses, wisterias, and other flowers.

(a) *Vegetation Size.* Like many other types of space design, the size of plants is actually relative. Even medium-sized trees will appear tall compared to cover plants and dwarf shrubs, regardless of the type of plant that people see and feel. In terms of plant selection, different combinations of plants can be used to form different spatial perspectives to decorate the space. The canopy and trunk of large trees can limit the scope of the space. Planting large trees at the entrance and exit of the area can not only highlight the position of the gate but also create a solemn visual sense. The combination of small trees and large trees can complete the enclosure or interconnect the space to complete the space, which can be widely decorated in all aspects of the space. Different low plants have their own unique colors and textures, which often constitute different ground landscapes. It has very good effects for viewing and resting. Figure 13 shows the framing effects of different vegetation sizes.

(b) *Vegetation Style.* When the style of plants forms a landscape space, although the size of the plant cannot act as a space skeleton, it can form different space types and enclosure qualities. Umbrella plants have wide branches and leaves to emphasize the top plane of the space, which can be planted on both sides of the road to shade the sun or in recreational areas to rest under the trees. The spherical plants are soft in shape and moderate in size, which can enhance the softness and fullness of the space. It is used to highlight key landscapes and create characteristic landscape shapes with good

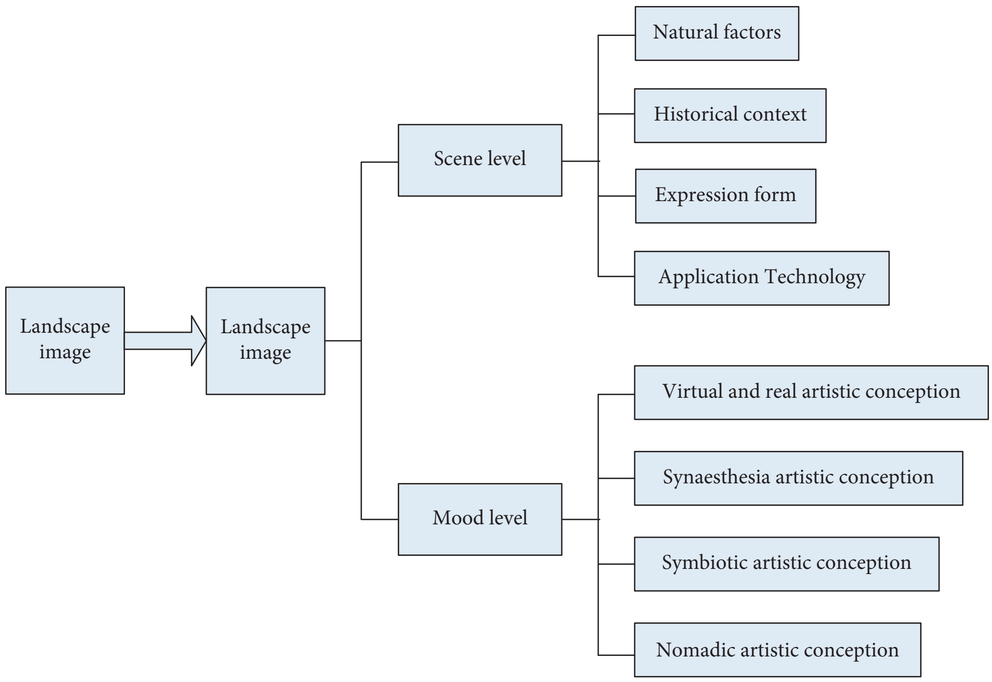

Figure 11: The new image construction process of landscape modeling.

Table 2: Composition of urban landscape image elements.

Urban landscape image			
Natural elements		Humanistic elements	
Intangible element	Tangible element	Physical and chemical elements	Nonmaterialized elements
Air temperature, wind direction, precipitation, humidity; sunshine, etc.	Geographical location, terrain, landform, lake, vegetation, etc.	Urban structure, street, buildings, public utilities, historic sites, etc.	Public awareness, mental structure, custom, language, rules and regulations, etc.

Table 3: Composition of respondents to the questionnaire.

Gender						
Male				Female		
54%				46%		
Age						
Below 25	25–50		50–65		More than 65	
5%	32%		46%		17%	
Profession						
Government workers	Employees of public institutions	Enterprise staff	Individual proprietor	Freelance	Student	Retiree
5%	10%	24%	7%	16%	9%	29%

results. Conical and tower-shaped plants are mostly used to coordinate the space structure and can be used for road guidance and space decoration. The dangling plants play an important role in guiding the space and connecting the ground landscape. The use of pendant plants can better create an atmosphere and artistic conception, which makes the overall picture vivid as if it has a sense of story. Figure 14 shows the framing effects of different vegetation styles.

(c) *Vegetation Color*. The color of plants will not directly affect the structure and type of the space, but it will affect the atmosphere and emotional resonance of the space, thereby optimizing the enclosure quality of the space. Plants of different colors are matched together to form a strong contrast or a soft sense of coordination, which greatly enriches the layered texture and visual

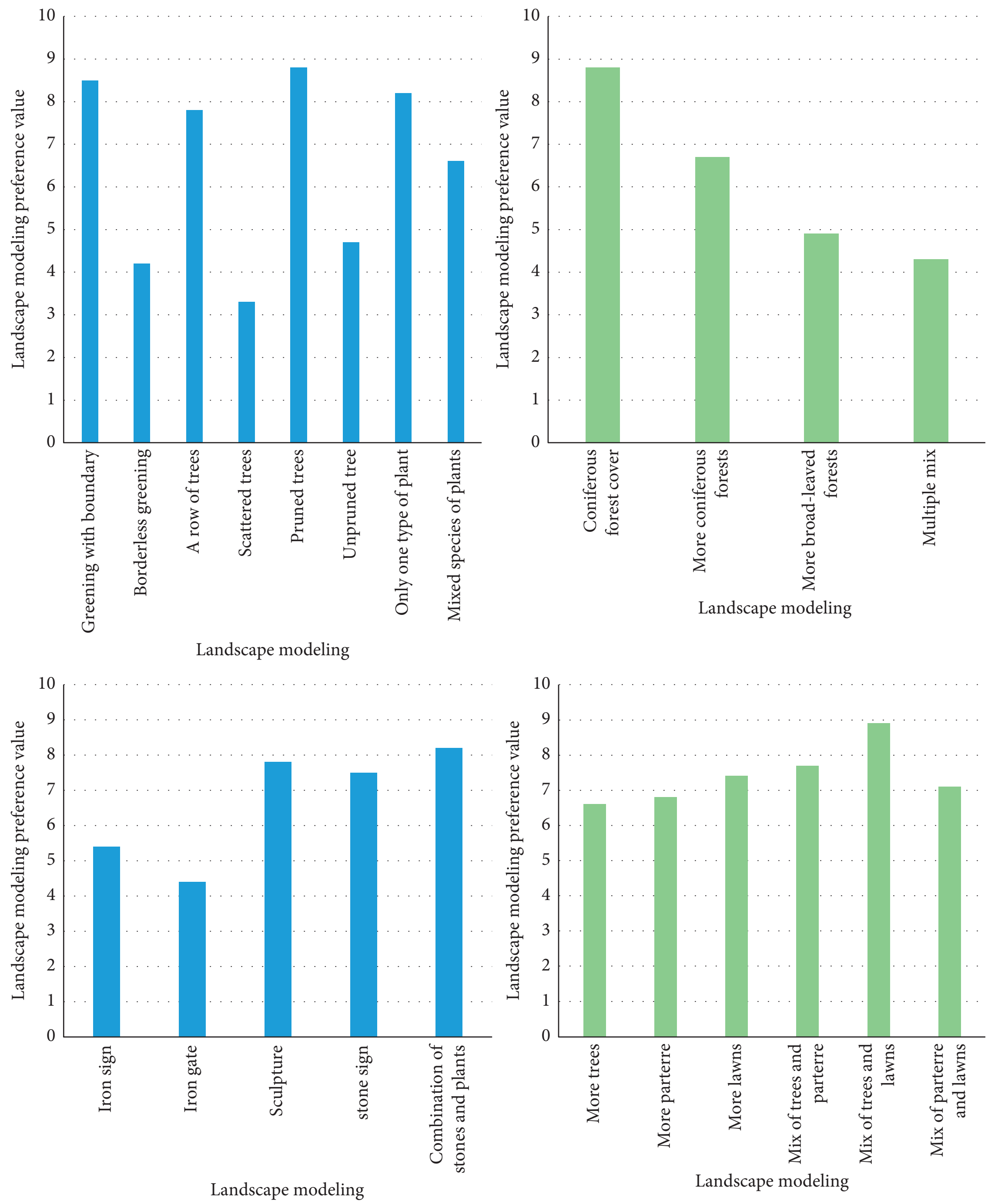

Figure 12: Survey results of respondents' landscape preference.

effect of the space. It enhances the diversity and coordination of landscape space. Plants in dark tones can be used around buildings with classic features to make the space look calm and storytelling. In addition, it also creates a melancholy atmosphere to a certain extent, highlighting the focus and character of the building. Mid-tone plants are often used as a medium to moderate and adjust, which can play a good role in the transition of different landscapes. Plants with bright tones can cause a strong visual impact, and their bright and brisk colors give people the visual sense of expanding the space. It can arrange bright-toned plants in the center of the area or beside the landmark building, which attracts the sight and impresses the viewer. At the same time, the incidental fruits and branches of plants are also an important part of the color matching of the space. When designing a landscape design, a variety of color combinations can

Figure 13: The composition effect of different vegetation sizes.

Figure 14: The composition effect of different vegetation styles.

be considered. It enhances and enriches the texture of the space. Figure 15 shows the composition effect of different vegetation colors.

(2) Clever Use of Plants for Contrast. The soft lines of plants are a natural texture unique to nature. In urban landscape design, the characteristics of this plant can be used to soften the sharpness of artificial building lines and create a friendly atmosphere. The composition relationship of plants should be comprehensively considered in the design. Generally speaking, plant species with tall stems, thick branches, and well-developed crowns should be selected around buildings with a solemn appearance and a wide field of view. Around buildings with smaller size and beautiful shapes, small, light, and dense plant species should be selected. For example, brightly colored low-to-medium plants and flowers are used to decorate near statues, fountains, and small pavilions with a single color, or hedges are used as a background. It emphasizes the texture of building materials through the strong contrast of colors and spatial organization, enhances the atmosphere, and deepens the viewer's impression of the landscape. The combination of plants and rocks in the space can outline the undulating lines and space structure, showing the interest of nature. The combination of plants and water can form a beautiful landscape and enhance the texture and story of the picture. Generally speaking, the staggered distribution of low bushes and tall bushes should be used, and the good growth of the bushes can highlight the beauty of the waters and mountains.

Common contrast methods are as follows: tall trees should be used to highlight the solemn atmosphere around memorial halls, ancient buildings, or gates. Brightly colored plants are used to enhance the visual impression around the iconic building. Hedges, bushes, and lawns are used as backgrounds around the sculptures and small fountains to enhance the texture of the picture. Figure 16 shows the framing effect of plants.

5. Discussion

This study is devoted to the research on the modeling design of the environmental landscape of urban public facilities. This study not only expounds and analyzes the elements and construction methods of landscape modeling design but also conducts investigation and research on the field. The landscape design is optimized through residents' preference for landscape modeling, which transforms the living environment of the community.

Figure 15: The composition effect of different vegetation colors.

Figure 16: The composition effect of plants.

This study analyzes the five elements that make up the landscape, point, line, surface, body, and color and lists the design cases that can be used in reality, which can be used for design reference. In this study, virtual reality technology and BIM technology are used in the optimization of landscape modeling and dynamic visual analysis. Compared with other methods, these two methods can better increase the viewer's sense of experience and interaction. It gives the viewer an immersive and wonderful experience. The last is the questionnaire survey and analysis stage. This study takes the modeling design of vegetation landscape as an example to collect the preference of the residents of the community for landscape modeling, which is used as a case reference for improving the landscape modeling design.

Through the analysis of this case, it shows that virtual reality technology can improve the way the landscape is presented. It enhances the interactivity and interest of the landscape experience, making the presentation of the landscape more lively. BIM technology plays an important role in dynamic visual analysis and cost analysis. It is beneficial to save the design cost and optimize the design scheme.

6. Conclusion

Through the analysis of this study, the following conclusions are drawn: (1) virtual reality technology plays an important role in the optimization of the five senses of landscape experience. The traditional landscape experience is too monotonous, but the landscape design under the guidance of virtual reality technology enriches the mode of landscape experience and enhances the interest of viewing and the interactivity of experience. (2) The cost map of power assignment can intuitively reflect the cost status of the landscape path design of the target site. It picks the best path through cost management, which helps avoid ecologically sensitive areas. It makes landscape design more scientific and rational. (3) Most of the landscape design is based on natural resources. This study analyzes the topography of the design space and helps to grasp the overall characteristics of the space. It is reasonable and effective for landscape modeling design. (4) Landscape modeling design should be considered from multiple perspectives, and the modeling elements should be refined. The design according to local conditions conforms to the characteristics of the place and the landscape shape of the target group. (5) The urban landscape modeling design should be more researched among residents. According to the feedback of the residents, the layout and shape of the landscape are adjusted so that the landscape environment can serve to improve the quality of life of the residents. (6) This study has a certain contribution to the research on the environmental landscape modeling design of urban public facilities, but it also has some shortcomings. How to carry out the landscape modeling design while ensuring the stability of the landscape security pattern is an area that needs to be studied in the future.

Data Availability

No data were used to support this study.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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