ISSN 2616-7433 Vol. 5, Issue 18: 111-117, DOI: 10.25236/FSST.2023.051819

Research on Urban Commercial Landscape Public Facility Design Model Based on Big Data

Qiumin Zhang, Zhi Cao

Nanchang Hangkong University, Nanchang, Jiangxi, 330100, China

Abstract: *The design of urban commercial landscape public facilities by using the current method has the problems of large regional space occupation and unsatisfactory design effect. A design model of urban commercial landscape public facilities based on big data is proposed. The method first build urban commercial landscape architecture, public facilities large data model on this basis, according to the theory of landscape ecology from the landscape naturalness, the broad vision, the diversity of public facilities and the characteristics of landscape, and overall coordination on the impact of the five aspects, such as quantitative expression, combining with the landscape ecology theory to quantify the, Using three-dimensional simulation space analysis technology to establish the equity index model of landscape public facilities to complete the design of urban commercial landscape public facilities. The experimental results show that, compared with the traditional method, the proposed method not only improves the vegetation coverage of commercial landscape, but also makes the commercial landscape and buildings develop harmoniously, and effectively improves the utilization rate of regional space.*

Keywords: *Urban commercial landscape; Design of public facilities; Three-dimensional simulation space analysis technology; Quantifiable*

With the rapid development of social economy, urban commercial landscape, public facilities and plant landscape design have attracted extensive attention [1]. As a result, more and more studies have been conducted in this area, such as low-carbon environmental protection and humanized public facilities, green economic commercial space construction and creative plant landscape, which have attracted people's attention and love [2]. However, unreasonable utilization of commercial landscape public facilities will result in grey space. Only with the coordinated development of commercial landscape and architecture can the maximum utilization of regional space be realized [3]. The types and elements of urban commercial space should be diversified as much as possible. Plants, water bodies, hard landscapes and public facilities in urban commercial landscape should be efficiently utilized to integrate regional space with characteristic landscape and cultural space [4]. Therefore, how to form an ecological and natural urban commercial landscape public facilities environment, create a green consumption concept, reflect the environmental characteristics of commercial landscape public facilities with urban characteristics, and form a natural oasis of urban commercial landscape has become the primary problem to be solved in this field [5]. Research on the design of urban commercial landscape public facilities has become an effective way to solve the above problems and has important practical significance [6-7].

Literature [8] proposes a design method of public facilities in commercial cities. This method firstly takes the city environment as the main content of the research, analyzes the behavior characteristics and needs of people, takes the urban public service facilities and public space environment as the main factors to evaluate the suitability of urban environment for living, and studies the characteristic distribution of urban living environment. Taking Harbin as an example, this paper analyzes the suitability of urban living environment and the needs of different levels of people.The optimization measures of different public facilities are made according to different demands, but there are problems of regional classification in this method. Wen Xian [9] proposed a design method for the integration of urban natural landscape and public facilities based on the inclusive theory. This method firstly analyzed and elaborated concepts related to urban transportation infrastructure, and summarized the development and problems faced by the current urban infrastructure. Through the above analysis, This paper puts forward the main idea of the design of public facilities of urban commercial landscape, so as to explore and study the common design of urban landscape view. Literature [10] proposed a design method of urban basic public facilities based on landscape principles, which firstly studied the concept of urban public facilities and target principles. This paper discusses the excellent design of urban public facilities in foreign countries, puts forward improvement suggestions on the existing problems of urban public

ISSN 2616-7433 Vol. 5, Issue 18: 111-117, DOI: 10.25236/FSST.2023.051819

facilities based on the design theory, and points out the direction of future development. At the same time, the management and maintenance of urban public facilities should be strengthened to beautify the urban environment. However, the design process of this method is complicated.

Aiming at the above problems, a design model of commercial landscape public facilities based on big data is proposed. The actual results show that this method not only improves the quality of people's life, but also forms an ecological and natural urban commercial landscape public facilities environment and maximizes the utilization of regional space, which has a wide range of application value.

1. Research on the design of urban commercial landscape public facilities

First based on the theory of landscape ecology from the landscape naturalness, the broad vision, the diversity of public facilities, landscape features and overall coordination on the impact of the five aspects, such as quantitative expression, can quantify the combined with the theory of landscape ecology, landscape spatial analysis of three-dimensional simulation technology to establish public facilities complete fairness index model for urban commercial landscape design research of public facilities. The specific steps are as follows.

1.1 Construction of public index of urban commercial landscape based on big data

In urban public facilities, commercial landscape is the main part, supplemented by other public facilities such as vegetation, roads and street lights. Among them, the natural landscape and public facilities construction of urban commerce have an important impact on people's life. The big data model structure of the public facilities of the urban commercial landscape is shown in Figure 1.

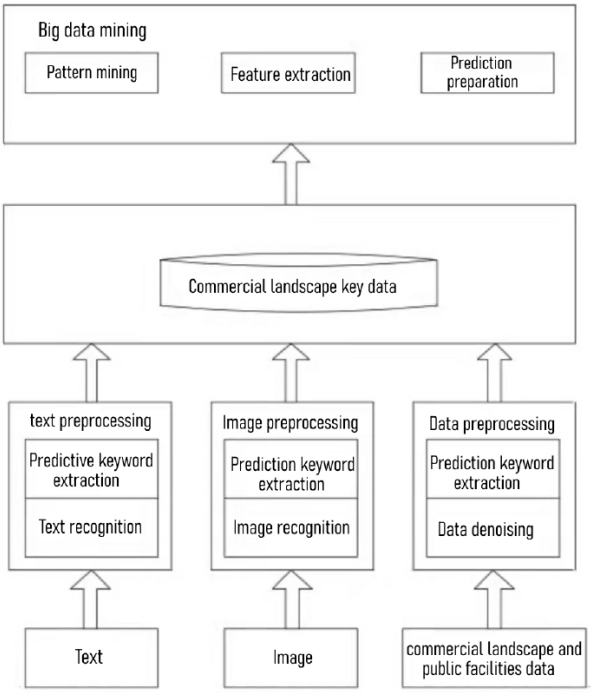

Figure 1: Structure diagram of big data model of urban commercial landscape public facilities

On the basis of Figure 1, according to the theory of landscape ecology and combined with the characteristics of urban commercial landscape, it can be quantitatively expressed in five aspects, including landscape naturalness, openness of vision, diversity of landscape public facilities, landscape strangeness and overall coordination.

(1) Landscape naturality refers to the distribution and growth of plants in cities. The naturality of urban commercial landscape is expressed by the coverage rate of vegetation. Vegetation coverage mainly refers to the percentage of the area covered by trees, lawns and some plants in the total area of the urban area, which mainly reflects the plant density in the urban commercial landscape. The higher the vegetation coverage is, the stronger the naturality of the commercial landscape. The vegetation coverage formula is as follows:

ISSN 2616-7433 Vol. 5, Issue 18: 111-117, DOI: 10.25236/FSST.2023.051819

$$C_v = \frac{S_v}{A} \times 100\% \tag{1}$$

In formula(1), C_v represents the coverage of vegetation, S_v represents the total area of vegetation coverage, and A represents the total area of the urban commercial landscape.

(2) The vision of urban landscape mainly refers to the degree to which people have their vision in the urban landscape. The narrow landscape buildings affect the environment of local commercial landscape and bring negative visual feelings to people. Thus, the density of architectural landscape and the crowding degree of architectural landscape are used to measure the broad visibility of commercial landscape.

The density of architectural landscape mainly refers to the percentage of the area covered by the bottom of the landscape in the urban area, reflecting the density of commercial landscape in the horizontal direction, the greater the density of commercial landscape, the lower the field of vision, and the formula is as follows:

$$C_b = \frac{\sum_{i=1}^{n} s_{bi}}{A} \times 100\% \tag{2}$$

In formula(2), Cb represents the density of the urban architectural landscape, s_{bi} represents the bottom area of the i^{th} architectural landscape, and n represents the total number of urban commercial architectural landscape.

Architectural landscape density is mainly when people walk attention to openness, when in a comprehensive view of landscape group space, building landscape crowding degree can better depict the landscape view of openness, can well reflect the distribution density in the landscape in the building space, the larger the distribution density index value, shows that the higher the crowding degree, the lower the openness. The available formula is expressed as:

$$SC_b = \frac{\sum_{i=1}^{n} V_{bi}}{\max\{H_b\} \times A} \times 100\% \tag{3}$$

In formula(3), SC_b represents the crowding degree of the architectural landscape space, V_{bi} represents the area of the i^{th} building landscape, and $\max\{H_b\}$ indicates the maximum height value of the urban commercial building landscape.

(3) The diversity elements of urban landscape public facilities can bring visual impact and freshness to people, and meet the needs of different levels. The diversity of landscape public facilities includes the composition and the richness of color. Therefore, this paper proposes to adopt the color and component composition of urban commercial landscape, and use the complexity of commercial landscape components to represent the diversity of landscape public facilities.

The complexity of commercial landscape components can reflect the color and diversification of constituent elements, which can be expressed by the formula:

$$F = CR * TY \tag{4}$$

In formula(4), F represents the complexity of commercial landscape components, CR represents the type of landscape color, and TY represents the type of landscape.

The available dimension of the landscape indicates the complexity of the shape of the commercial landscape. The buildings in the city have different shapes, which add characteristics to the city. The larger the average dimension, the more complex the shape of the landscape. The average dimension of the urban landscape can be expressed by the formula:

$$FD_b = \frac{1}{n} \sum_{i=1}^{n} \frac{2\ln\left(\frac{P_{bi}}{4}\right)}{\ln S_{bi}} \tag{5}$$

In formula(5), FD_b represents the average dimension of landscape, P_{bi} represents the bottom area circumference of landscape i, and S_{bi} represents the bottom area of landscape i.

(4) The strangeness of landscape mainly affects the attraction of landscape public facilities to people. Urban commercial landscape is mainly composed of a large number of architectural groups,

ISSN 2616-7433 Vol. 5, Issue 18: 111-117, DOI: 10.25236/FSST.2023.051819

which is easy to form the same style. The advantage of building volume can be used to measure the strangeness of urban commercial landscape.

Urban commercial landscape volume of advantage mainly represents the diversity of the maximum diversity of deviation, architectural landscape advantage mainly describes urban buildings few large building control degree, the greater the control value, said a building body dominant, usually larger advantage of architectural landscape has social and cultural functions, as the landmark urban buildings. According to the definition and calculation method of the dominance degree of the commercial landscape, the index can be calculated as:

$$D_b = H_{\max} + \sum_{i=1}^{n} (P_{bi}) \log_2 (P_{bi}) \tag{6}$$

In formula_(6), Hmax represents the index of diversity, and Pbi represents the proportion of the volume of the architectural landscape i to the total volume of the architectural landscape.

(5) The coordination of urban commercial landscape mainly refers to the coordination between the elements of landscape public facilities, including the collocation between architectural landscape and natural vegetation, which is expressed by using the volume proportion of natural landscape and artificial landscape.

Urban commercial landscape is mainly composed of natural elements and artificial elements. The main body of artificial elements is building building, and natural vegetation is the main content of natural elements. The architectural landscape contains humanistic spirit to meet the functional needs of activities, and the coordination between the proportion of landscape space architecture and plants is more important. The appropriate performance of the proportion of natural landscape and artificial landscape brings people the best visual enjoyment, which can be expressed in the formula as follows:

$$CO = \frac{V_V}{V_b} \times 100\% \tag{7}$$

In formula(7), CO represents the appropriate index of natural landscape and artificial landscape, VV represents the total volume of urban natural landscape, and Vb represents the total volume of urban artificial landscape.

1.2 Establish the fair index model of public facilities in urban commercial landscape

Based on the construction of the characteristic index of the urban commercial landscape public facilities based on the theory of landscape ecology, the fair index model is used to design the urban commercial landscape public facilities. Reachability is a function of the attraction index and isolation of urban commercial landscape utilities, which is expressed by formula(8). The model of landscape utilities and spatial impact is based on:

$$A_i = \sum_j f(W_j, S_{ij}) \tag{8}$$

In formula_(8), Wj is expressed as the gravitational index of the landscape utilities, and Sij represents the landscape space distance, mainly the landscape distance from i to j. According to the basis of formula (8), the model of urban commercial landscape public facilities index is:

$$E_{ij(k)} = W_{j(k)} \times S_{ij}^{-a} \tag{9}$$

In the formula(9), $E_{ij(k)}$ shows the fairness index of j (k) in architectural space i , i = 1,2,3... , I, k represents the k-class facilities of commercial landscape public facilities, k = 1,2... , k, $w_j(k) = Q_{j(k)} / Q_k$, and $w_j(k)$ represents the influence coefficient of the j^{th} facility in class k facilities.

S_{ij} represents the distribution of urban commercial landscape public facilities and the spatial distance between users, a represents the spatial distance parameters, a value range between 1 to 2, value is 2, the value of commercial landscape public facilities index is 2. Thus the building space i k distribution of j landscape public facilities fair index is:

$$E_{ij(k)} = W_{j(k)} \times S_{ij}^{-2} \tag{10}$$

Therefore, the total value of urban commercial landscape public index in commercial landscape space i is:

ISSN 2616-7433 Vol. 5, Issue 18: 111-117, DOI: 10.25236/FSST.2023.051819

$$T_i = \sum_{k=1}^{K} \sum_{j\langle k\rangle=1}^{j} E_{ij\langle k\rangle} \tag{11}$$

In formula(11), Ti represents the overall fairness index of the landscape in the i th city.

$$T = \sum_{i=1}^{j} T_i \tag{12}$$

In formula(12), T represents the sum of the fair index of urban commercial landscape public facilities, thus completing the study on urban commercial landscape public facilities design.

2. Experimental results and analysis

In order to verify the effectiveness of the public facility design model based on big data, an experiment is needed to build a public facility design platform of urban commercial landscape in the Mat-lab2016 environment. Experimental data were obtained from a certain area of a certain city. Table 1 shows the diversity of the methods of this paper and the methods proposed in [8] and [9].

Table 1: Comparison of diversity in commercial landscape utilities by different methods

Different methods	composition cost / kind	Composition cost / kind
Text method	10	88
Literature [8]	8	73
Literature [9]	7	66

Table 1, the diversity of commercial landscape public facilities is significantly higher than the literature [8] and [9], the diversity of commercial landscape public facilities, color richness of 88%, which shows that the method is diversity, and can satisfy people's visual feeling. Figure 2 shows the comparison between the vegetation coverage (%) of commercial landscape and the method proposed in [9] and [10].

According to the analysis of Figure 2, the vegetation coverage rate based on the theory of landscape ecology is significantly higher than that of [9] and [10], among them, the proposed method with the increase of vegetation area, vegetation coverage fluctuation is obvious, and the vegetation coverage is not more than 40%, indicating that the feasibility of the method is low. With the increase of vegetation area, the vegetation coverage rate is gradually increasing, which can be shown that the method proposed in this paper is feasible, can effectively improve the vegetation coverage rate, achieve low carbon environmental protection, but also can absorb carbon dioxide. Figure 3 shows the carbon dioxide absorption (%) of the proposed method in [8] and [9].

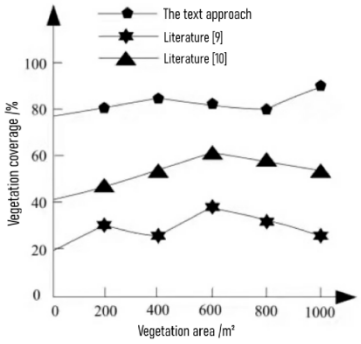

Figure 2: Comparison of vegetation coverage rate under different methods

ISSN 2616-7433 Vol. 5, Issue 18: 111-117, DOI: 10.25236/FSST.2023.051819

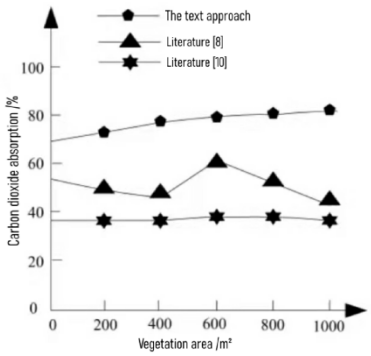

Figure 3: Comparison of carbon dioxide absorption under different methods

From the analysis of the vegetation coverage in Figure 3, the vegetation coverage is not low, but can see from Figure 3, the absorption of carbon dioxide is low, thus shows that although the vegetation coverage is not low, but the planting of carbon dioxide absorption ability is poor, and the paper using 3 d simulation space analysis technology for commercial landscape public facilities design vegetation coverage is not only high, but also the absorption capacity of carbon dioxide is good. Figure 4 shows the space occupancy (%) of the proposed method and the method proposed method in [8] and [9].

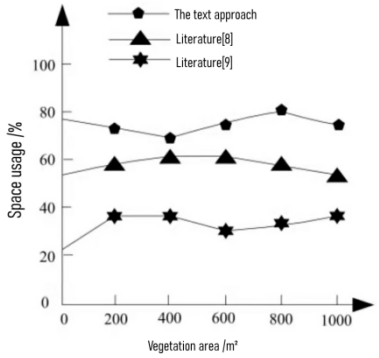

Figure 4: Comparison of space occupancy rates under different methods

Analysis figure 4, this paper proposed using 3 d simulation spatial analysis technology of commercial landscape public facilities design space share compared with the literature [8] and literature [9] method of spatial share is higher, while the literature [8] method of spatial share fluctuation has been flat, but with the growth of vegetation area, the fluctuation curve declined. Although the method proposed in this paper will fluctuate with the growth of vegetation area, the overall method is an upward trend. This shows that the design of commercial landscape public facilities can effectively improve people's quality of life and maximize the utilization of regional space.

3. Conclusion

The current method can not effectively improve people's aesthetic concept, can not create the characteristic commercial landscape public facilities design belonging to the city. Therefore, more attention needs to be paid to the establishment, planning and use of commercial landscape public facilities to guide people's aesthetic awareness of the environment. To this end, a model of public facilities design based on commercial landscape is big data. The experiment shows that through the design of commercial landscape public facilities, the concept of low carbon and environmental protection is deeply rooted in the people, and the harmonious development of human and natural environment is constructed.

References

[1] Shi Zhibin. Landscape Reconstruction of traditional commercial pedestrian Street from the perspective of Cultural communication: A Case study of Characteristic Street reconstruction of Hangzhou Silk City [J]. Chinese landscape architecture, 2016, 32 (10): 22-25.
[2] Guo S , Tang J , Liu H ,et al.Study on Landscape Architecture Model Design Based on Big Data

ISSN 2616-7433 Vol. 5, Issue 18: 111-117, DOI: 10.25236/FSST.2023.051819

Intelligence[J].Big Data Research, 2021:100219.DOI:10.1016/j.bdr.2021.100219.
[3] Zheng Yuanyuan. Three-dimensional Image Optimization design and Simulation of Plant Landscape on Two Wings of Urban Road [J]. Computer simulation, 2016, 33 (11): 250-253.
[4] Dave. Design of public Space in urban agglomeration [J]. Science and technology bulletin, 2015, 31 (12): 83-84.
[5] Chang Zhijian. Design and Experimental Research of virtual 3D tourism Landscape System [J]. Electronic design engineering, 2016, 24 (16): 131-133.
[6] Cheng Peng, Wang Yong, Wang Yanli, et al. Research on ventilation environment and optimization design of i-shaped urban underground pedestrian passage [J], science technology and engineering, 2016,16 (33): 255-261.
[7] Qian Chunyang, Lu Wenlong, Wang Jianchun, et al. Design of wireless sensor node for greenhouse monitoring system based on Internet of things [J]. Computer measurement and control, 2015, 23 (2): 673-676.
[8] Xun Ping, Huang Shuai, Chen. Study on landscape Design of Small public Green Space in Mountain City [J]. Sichuan building research, 2015, 41 (5): 106-109.
[9] Zhao Chao. A study on the Design of Urban Transportation Facilities [J]. Packaging engineering, 2017, 38 (2): 8-14.
[10] Jia Peiyi, Li Chunjiao. Research on the Design of urban Public Open Space [J]. Chinese landscape architecture, 2015, 31 (1): 110-113.