Hindawi
Mathematical Problems in Engineering
Volume 2022, Article ID 2183373, 12 pages
https://doi.org/10.1155/2022/2183373

Research Article

Numerical Analysis and Calculation for Urban Street Landscape Spatial Pattern

Fangfei Bi[1] **and Haotian Liu**[2]

[1]*Xi'an Polytechnic University, Xi'an, Shaanxi 710048, China*
[2]*China Jikan Research Institute of Engineering Investigations and Design Co Ltd, Xi'an, Shaanxi 710048, China*

Correspondence should be addressed to Fangfei Bi; sophiebi@xauat.edu.cn

Received 20 April 2022; Revised 24 May 2022; Accepted 8 June 2022; Published 6 July 2022

Academic Editor: Sagheer Abbas

In recent years, there are many problems in the construction of street landscape spatial pattern, such as emphasizing the surface, ignoring the substance, focusing on construction, and ignoring protection. The reason is closely related to the lack of visual evaluation of streetscape for guidance. This research mainly discusses the numerical analysis and calculation for the spatial pattern of urban streetscape. This study clarifies the related concepts of visual evaluation of urban streetscape and discusses the formation process, overall characteristics, and constituent elements of streetscape. It emphasizes the importance of two subjective and objective factors of "landscape" and "vision" for evaluation. This paper studies this spatial composition relationship from the perspective of street space and the building itself. In the research process, it selects the pedestrian street in the northwest of the city as the object and uses the questionnaire survey method and the multifactor evaluation method to carry out the visual evaluation of the streetscape. It deeply discusses the application of evaluation methods in practice and counts the relevant evaluation results. In the urban street space proportion curve and the corresponding comparative analysis, it is found that most of the street space proportion is between 0.6 and 3.0. This kind of space composition has mutual inclusive symmetry, which enhances the order and communication of urban architecture. This somewhat improves this alienated spatial morphological pattern. This research is helpful to promote the development of streetscape visual evaluation.

1. Introduction

What can leave a deep impression in a city is often the ancient scenic spots with historical meaning and historical characteristics in the urban street pattern. Historic features are also the most important elements to demonstrate the regionality and uniqueness of a city. This is largely due to the fact that the historical elements of the city entrust the spiritual sustenance of the citizens to a city. It is a concentrated reflection of the historical creation and past life of the city. This will make the people living here love the city even more and be proud of their city. Numerical analysis of urban space will also make people more clear about the structure of the city.

The layout of the urban street pattern should start from the overall point of view, making it a harmonious and coexisting whole, and better highlight the typical characteristics of a city. Its spatial composition design should always adhere to the big concept of urban design, conduct unified research, and unified planning. And it needs to be fully prepared for a rainy day. In the planning stage, the urban roads, landscape nodes, auxiliary facilities, lighting, green planting, and other detailed components should be planned and arranged scientifically. Only in this way can the design of our streetscape, the urban ecological environment, and the humanistic and historical style be organically integrated into a whole, so as to fully display the overall style of the city involved and show its unique charm.

In order to better analyze the important role of the principle of space composition in the design of streetscape space, it is necessary to scientifically and rationally evaluate the application effect of the principle of space composition in a specific streetscape and to establish a scientific evaluation system. According to the evaluation results, it is necessary to

take optimization measures to improve its application status in modern street landscape design, aiming at some deficiencies in the application of space composition principle in street landscape. Based on the detailed analysis of landscape ecology and landscape pattern, this paper uses multispectral remote sensing data to obtain the surface coverage data of the study area in view of the massive data in large areas and the more complex ecological environment. It establishes the index data of the ecological environment and constructs the landscape pattern index of the research experimental area based on the geographical ecological division.

2. Related Work

The spatial pattern of streetscape reflects the comprehensive strength of the city's political, economic, and cultural aspects. It has become a consensus in the industry to actively guide people-oriented urban construction and create high-quality, vibrant, and attractive urban public spaces. Semenov discussed the relationship between Russian physical geography and landscape planning. He recommended evaluating geographic system components and identifying target functions for their territorial development based on a landscape map contour grid adapted to landscape planning goals. This opens up the possibility to exploit all the information accumulated in the database, including at all stages of work [1]. Li and Hou used virtual reality technology to build a virtual roaming system of rural landscape. He also randomly selected 25 people, with 5 people in each group and for a total of 3 groups. He entered the system in batches with real reduction degrees of 30%, 45%, 60%, 75%, and 80% for experiments and scored the system after the experience [2]. Liu et al. believed that in the era of rapid urban development, creating spaces where people can stop and live a slow life was one of the ways to improve people's quality of life. As the place of daily activities of modern people, the living space of residential street is a slow space that is usually neglected. Modern people tend to have a relatively fixed choice of accommodation space on the street. Taking Guangchang East Road in Nanchang City as an example, he analyzed the factors that affect people's staying activities on the street, the types of staying space and the existing problems, and put forward some design suggestions [3]. Ghaleh M R believed that streets play a very important role as the most important factor in civic perception. Therefore, if the urban space has the character of street and edge at the same time, it becomes a very important element in the city. Such elements, not just streets or city fringes, can help enhance citizens' sense of belonging to the city [4]. Mendiguren and Ramezani broadened the traditional paradigm by emphasizing the spatial pattern of evapotranspiration (ET). The differences in spatial patterns can be explained in part by the hydrological models being configured to operate in six domains that were calibrated independently of each other. This is often the case for large-scale multibasin calibrations. To overcome this limitation, he employed an improved version of the DK model. LAI, RD, and Kc were derived empirically using remote sensing data and detailed soil property maps. This in order to generate a higher degree of spatiotemporal variability and spatial consistency among the six domains [5]. Their research on urban streetscape is still only in generalization, and it is necessary to combine numerical analysis to further optimize urban streetscape.

Wang et al. believed that traffic accidents may bring vehicle fires in street canyons. The flue gas produced by vehicle fire has high temperature and many harmful substances, which may cause serious injury to human body and nearby properties, such as the glass curtain wall of buildings [6]. Soderman et al. investigated the relative contributions of different habitat types to landscape-scale species richness of vascular plants in farmland with different landscape complexity. He also analyzed pollen collected by bees to examine the extent to which different habitat types contribute to the provision of floral resources for the three taxa [7]. Nematollahi et al. used the InVEST module (Integrated Assessment of Environmental Services and Tradeoffs) to model the habitat quality of Capra aegagrus. He then assessed the ecological impact of the road network using the Spatial Landscape Index. Finally, he determined the level of protected areas and introduced some mitigation measures [8]. Heo et al. investigated the feasibility of using mobile lidar to estimate tree height and diameter at breast height in urban streets and urban parks. He compared measurements from a mobile lidar unit with field measurements of tree height and DBH in urban parks and streets [9]. Landscape planning lacks an evidence-based approach for reflecting planning models at an imaginary level. This is in order to present the image content and the relationships in the image in a verifiable manner as a basis for interpretation. Taking two urban and landscape development planning sketches as examples, Schneider and Scharmann used Gestalt theory perceptual analysis to describe and explain according to standard themes, essays, principle sketches and composition lines, interpretations, conclusions, and results of Gestalt theory [10]. China's urbanization has experienced a stage of initial development and rapid development, especially since the reform and opening up. With the acceleration of the industrialization process, China's urbanization has developed rapidly despite its low starting point and has achieved world-renowned achievements. The projection of the side surface of the street on the ground and the city skyline can be understood as a rhythmic line formed in the human mind. This line forms people's abstract understanding of road space and even urban space in psychological activities. A line with a strong sense of rhythm can bring a sense of identification and orientation and form a deep impression in the heart. The numerical value of the streetscape will be further analyzed later.

3. Methods

3.1. Index Values of Street Landscape Spatial Pattern. Modernist urban planning theory (It introduces in detail the historical process of the formation, development and evolution of modern urban planning in combination with the historical development of social economy. It reveals the basic context of the development of modern urban planning theory and expounds the main topics of current urban

planning theory in depth.) pays attention to the simplicity, efficiency, and functionality of design. In the process of urban planning, it is inevitable to mention the street landscape pattern. Therefore, in this paper, we select typical variables that reflect the overall landscape or various types of changes as much as possible and have little correlation; the selected index can fully express the composition and structure of the landscape. The formula for per capita green area MG is [11]

$$\mathrm{MG} = \frac{A_i}{P}, \tag{1}$$

where A_i is the area of type i in the green space system and P is the urban population.

The formula of green space coverage rate G_0 is [12]

$$G_0 = \frac{A_i}{S} \times 100\%, \tag{2}$$

where S is the total area of the study area.

The expression of the diversity index is [13]

$$H = -\sum_{i=1}^{m} (p_i)\log_2(p_i), \tag{3}$$

$$H_{\max} = -N\left(\frac{1}{N}\ln\frac{1}{N}\right) = -\ln\frac{1}{N}. \tag{4}$$

Among them, H is the landscape diversity index and N is the number of landscape elements.

The formula for calculating the uniformity index E is [14]

$$E = \frac{H}{H_{\max}} = \frac{-\sum_{i=1}^{m}(p_i)\log_2(p_i)}{\log_2 m}. \tag{5}$$

The calculation formula of dominance index D is [15]

$$D = H_{\max} + \sum_{i=1}^{m} (p_i)\log_2(p_i). \tag{6}$$

The formula for calculating the separation index D_i is

$$F_i = \frac{D_i}{S_i}, \tag{7}$$

$$S_i = \frac{A_i}{A}, \tag{8}$$

$$D_i = \frac{1}{2}\sqrt{\frac{n}{A}}. \tag{9}$$

The formula for calculating the plaque number fragmentation index $FN2$ is

$$FN1 = \frac{(N_P - 1)}{N_C}, \tag{10}$$

$$FN2 = FN1 + \frac{MPS(N_F - 1)}{N_C}. \tag{11}$$

The formula for calculating the plaque shape fragmentation index is as follows:

$$FS1 = 1 - \frac{1}{MSI}, \tag{12}$$

$$FS2 = 1 - \frac{1}{ASI}, \tag{13}$$

$$MSI = \sum_{i=1}^{m} \frac{SI(i)}{m}, \tag{14}$$

$$ASI = \sum_{i=1}^{m} \frac{A(i)SI(i)}{A}, \tag{15}$$

$$SI(i) = \frac{P(i)}{4[A(i)]^{1/2}}, \tag{16}$$

$$A = \sum_{i=1}^{m} A(i). \tag{17}$$

The average fractal dimension FD is used in this study, and its calculation formula is

$$FD = \frac{1}{m}\sum_{i=1}^{m} FD_i. \tag{18}$$

FD_i is the fractal dimension of patch i and m is the number of patches of the landscape type.

The proportion p_i of patch types to landscape area is as follows:

$$\mathrm{PLAND} = p_i = \frac{\sum_{j=1}^{n} a_{ij}}{A} \times 100. \tag{19}$$

The urban streetscape pattern is shown in Figure 1. In the space sequence design planning, the designer should pay attention to maintaining the design theme and should not introduce unnecessary or contradictory factors into it. They need to create and further strengthen the design theme experience through the formal sequence of the space. A good space design is a plot design, which has the origin, climax, and ending of the story. The designer should control the sequence and direction of its development. These different scenes in the same time and space interact to produce a more global concept. Furthermore, sequences play an important role in spatial perception. The person in the space travels through the space in a certain period of time and generates the cognition of the place. Among them, the road affects the speed, direction, and process of perceiving the sequence. In order to achieve the effect of communication, the spatial form and the perception ratio are in harmony with each other. In order to achieve a rich landscape experience, it is necessary to reasonably add hints, reasoning and other plots into it. The general narrative plot is carried out by multiple clues at the same time, but it always develops in one direction. In this process, the way of narration is various, either rigorous and orderly or loose and improvised. Different methods will bring different effects.

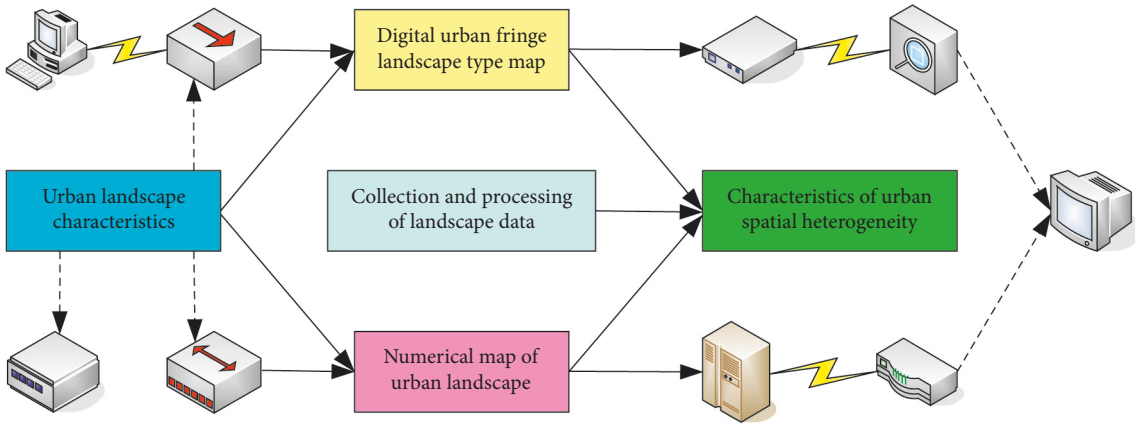

Figure 1: Urban streetscape pattern.

3.2. Numerical Analysis Methods. Landscape index is not uniform now, and it is still developing, there are many models.There are two types of common forms. One is to artificially determine the spatial pattern and dynamics of the landscape, then to perform a functional analysis of the existing landscape index, and then to determine the attribution. This method is relatively subjective. Starting from the landscape index as a whole, without considering the landscape function first, the landscape index is divided into different categories by applying statistical methods, and then the various indexes are descriptively analyzed and classified.

3.3. Space Volume and Scale. Scale can not only express the specific size of an object itself but also indirectly reflect the relative relationship between various spatial elements. Scale is very important to the characteristics of the street's ductility, directionality, site, and other aspects. The scale design is reasonable, and tourists are willing to enter the tour. If the scale design is unreasonable, it will cause the embarrassing situation that although the scenic spot looks good, few people enter to watch it. Street space is an important component of public space, and it is a key area to highlight the image of the city and optimize the quality of urban life. The scale of streetscape can be divided into two categories: horizontal and vertical. In order to conduct specific research on the volume and scale of the scenic space, this paper selects one main road, one branch road, and two main landscape nodes as the research object. It makes scientific measurement and evaluation through data measurement and analysis.

Statistics of Landscape Pattern Changes: according to the five geographical ecological divisions of the study area, the classification result data of each division are obtained by cutting according to the ecological divisions. It converts the classification results into Arcgrid format by the Raster toother Format conversion function in ArcGIS. It uses Fragstats3.3 software to select the index that needs to be counted and calculates to get the index result. It counts the six landscape pattern indices in two periods of each division, obtains the landscape index results of the same geographical division in the two periods, and then analyzes the results.The attribute of the area of the land type is connected with the corresponding grid, and the grid data of each land type are obtained and rasterized. The specific process is shown in Figure 2. Perform grid calculation in ArcGIS to obtain the required landscape spatial pattern indicators.

3.4. Comprehensive Safety Evaluation. This paper adopts the expert scoring method to determine the weights of the three index systems of the natural and humanistic status subsystem, the ecological environment subsystem, and the socioeconomic status subsystem. In this paper, the comprehensive evaluation method is used to represent the ecological security status, that is, the comprehensive ecological security index is used to represent the ecological security status. The formula for calculation is as follows:

$$\mathrm{ESI} = \sum_{i-1}^{n} A_i W_i. \tag{20}$$

3.4.1. Patch Area. Average patch area: average patch area of the entire landscape = total patch area/total number of patches; The average patch area of a single landscape type = the total patch area of the type/the total number of patches of the type, which is used to describe the landscape granularity and reveal the degree of landscape fragmentation in a certain sense; Qandscape similarity index: type area/total landscape area, measuring the degree of similarity between a single type and the whole landscape; largest patch index: the largest patch index of the landscape = the largest patch area/landscape total area; and the largest patch area of the type = the largest patch area of the type/the total area of the type, showing the impact of the largest patch on the entire type or landscape.

3.4.2. Number of Patch Blocks. Number of patches in the entire landscape, the number of patches of a single type; the patch density of the entire landscape (mosaic degree) = total number of landscape patches/total landscape area; type of patch density (porosity) = type of patch number type area; per unit perimeter of the patch number of patches of unit

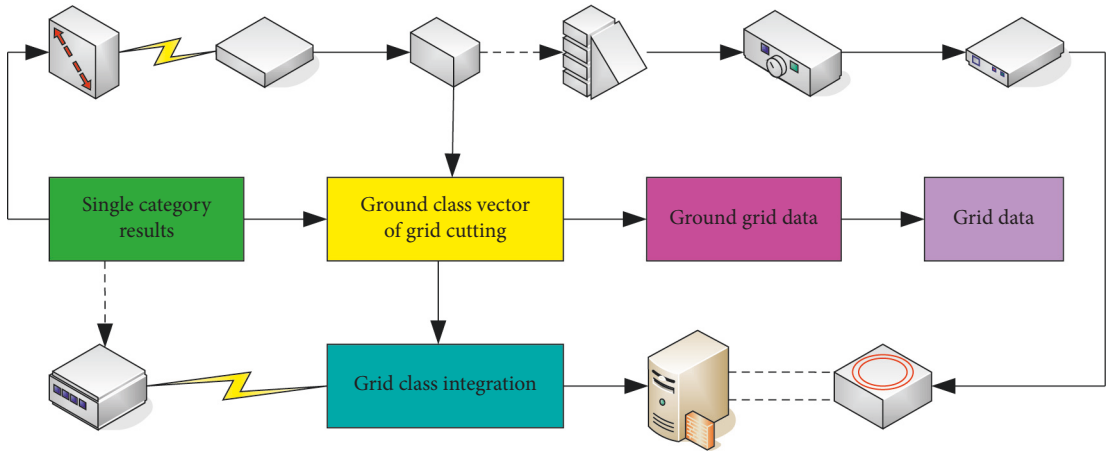

Figure 2: Flowchart of making ground grid data.

perimeter whole landscape = total number of patches of landscape/total perimeter type of landscape = number of patches of type/perimeter of type, revealing the degree of fragmentation of the landscape.

Richness R refers to the total number of different components (ecosystems) in the landscape. $R = (T/T_{\max})\ x$ 100%, where R is the relative richness index (percentage).

$$R = \left(\frac{T}{T_{\max}}\right) \times 100\%. \tag{21}$$

Dominance RD is negatively correlated to evenness, which describes the degree to which a landscape is dominated by a few landscapes.

$$\mathrm{RD} = 100 - \left(\frac{D}{D_{\max}}\right) \times 100\%. \tag{22}$$

The arithmetic mean of the area of a patch in the landscape:

$$PA = \frac{1}{N} \sum A, \tag{23}$$

where N represents the total number of patches of the i-th landscape.

3.5. Representation of Road Spatial Sequence

3.5.1. Construction of the Field. The locality of the field is strong. It has clearly defined areas and facilities for movement and stay. In a broad sense, the design of the field should be the design or rendering of an atmosphere. It is realized through planning and layout, guiding pedestrian circulation, and shaping landscape. In a narrow sense, a field refers to a place, and a place is composed of a series of spaces for human activities. The shaping of a place often refers to its environment and landscape design.

3.5.2. Organization of Lines. The projection of the side surface of the street on the ground and the city skyline can be understood as a rhythmic line formed in the human mind. This line forms people's abstract understanding of road space and even urban space in psychological activities. A line with a strong sense of rhythm can bring a sense of identification and direction and form a deep impression in the mind.

The street evaluation basis is shown in Figure 3. For the axial sequence space of the street, the research on scale and proportion mainly considers two aspects: the sight control of the sense of spatial scale and the geometric proportional relationship of the spatial scale. For the first point, it is often said that the ratio of the distance D from the observer to the target building to the height H of the target building is controlled. When $H/D = 1$, the observer's attention is more concentrated, and it is easy to notice architectural details. When $H/D > 1$, the space is relatively closed, and the observer can see the lower half of the building. People's line of sight is easy to focus on the architectural details, and the space feels more compact. When $H/D > 2$, the space will have a sense of claustrophobia, which is often seen in traditional streets. When $H/D = 1/2$, it is a closed boundary, and the observer can see the facade and details of the building. When $H/D < 1/3$, people can have a sufficient distance to view the building's space composition. The vision begins to be scattered, the details begin to disappear, and the space is not closed at this time. When $H/D = 1/4$, the outline of the building can be seen clearly.

Road Interface Optimization: the urban road interface referred to in this paper mainly refers to the side interface of the road. It also focuses on the impact of the space enclosed by the projection of the side interface on the road on the psychological feeling of the road space by means of quantification. In this paper, the quantitative research of the building interface on both sides of the urban landscape avenue is carried out through the three quantities of interface density, average road alignment rate, and open rate. It conducts a quantitative study of buildings at commanding heights by their aspect ratios. In urban planning, openness is an important indicator to measure urban space. It is of great significance for the control of building density, building height, plot ratio, and other indicators.

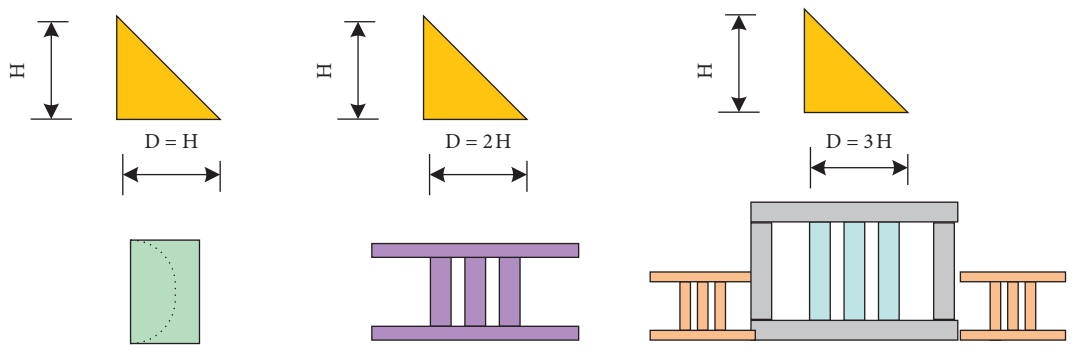

Figure 3: Evaluation basis.

4. Numerical Analysis Experiment of Street View Spatial Pattern

When studying the coordination between buildings and street space landscape, we must first consider the visual characteristics under different traffic conditions. Urban traffic streets have certain requirements (for example, a road without a road centerline is 30 kilometers per hour for urban roads and 40 kilometers per hour for highways.) for vehicle speed, and the visual characteristics of people on motor vehicles are the main factors. However, in the design of residential street landscape, low speed should be the main consideration, which mainly considers the visual characteristics of pedestrians. Under the condition of automobile traffic, due to the fast movement of people on the street, the objects on both sides of the street move faster relative to the people. Only by increasing the width of the street can there be sufficient viewing distance between motor vehicles and roadside buildings. The minimum distances for identifying roadside scenes at different speeds are shown in Table 1.

Table 1: Minimum distance to identify roadside scenery at different speeds.

Speed (km/h)	Minimum distance (m)
20	2
40	3
60	5
80	6

Scale is the concept of quantity, and proportion reflects the relationship of scale. Scale and scale are not two juxtaposed concepts of different nature. Proportion should be a subordinate concept within the scale. Scale reflects the amount of objects from different spatial scales. It includes the length, width, range, volume, volume of space, and granularity of particles, which can express different aesthetic feelings such as grand and majestic, simple and friendly, delicate, and exquisite. Experience tells us that a speed of 30 km/h is a comfortable space relationship. At a speed of 1.5 km/h (walking speed), people will feel empty and boring, while the speed of 15 km/h in the city is close to the speed of 30 km/h in the suburbs. Table 2 shows the relationship between the distance recognized by the driver's front vision and the vehicle speed.

Table 2: The relationship between the distance recognized by the driver's front vision and the vehicle speed.

Speed (km/h)	Recognition distance (m)	Identify object size (cm)
20	200	100
40	300	150
60	500	200
80	600	260

In general, it is necessary to establish the concept of scale system in the street space landscape. From the perspective of the city's street system, different types of streets correspond to different speeds and different viewing methods. A single scale system obviously cannot meet the requirements of the audience in different street types. The comparison between urban branch roads and main roads is shown in Figure 4.

It is necessary to respect the original texture structure of the city, make full use of the existing roads, communicate, and improve the branch road system. For the existing arterial roads with a large number of express and slow lanes with a total width of 12 m or a express lane of 10 m, widening and reconstruction are likely to cause damage to the historic interface or street greening. It needs to be retained and transformed into a branch road, and at the same time a new parallel road is built. Part of the unnecessary traffic volume for the plot can be directed to the parallel main road, so as to reduce the traffic pressure on the branch road and improve the living environment on the branch road. This thus enables the two to be coupled into a composite traffic system with a main street and a diversion branch. This approach may be more sensible than simply widening and remodeling. In some areas with high road network density, some roads with high commercial value can be transformed from three-board trunk roads to one-board living streets, which is also a means of revitalizing the economic vitality of the central area of the city. The reconstruction method of urban arterial road is shown in Figure 5.

According to the actual situation of the built landscape environment, combined with the characteristics of human visual activities on street landscape cognition mentioned above, this paper carefully designs a questionnaire survey for the visual evaluation of the road section. Landscape visual

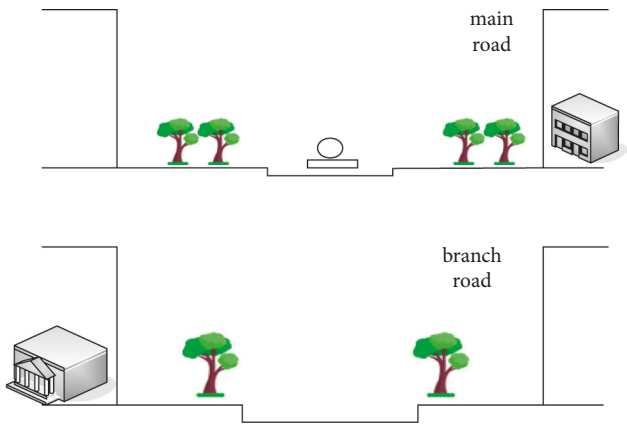

Figure 4: Comparison of urban branch roads and arterial roads.

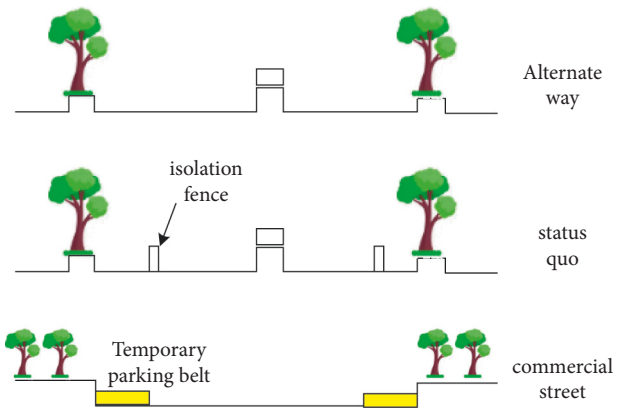

Figure 5: Reconstruction methods of urban arterial roads.

evaluation was performed on the street using the questionnaire survey method and the multifactor evaluation method (the good and better evaluations in static traffic are shown in Figure 6(a)). Through the vigorous cooperation of 20 experts and 80 randomly selected members of the public, it collected 100 valid questionnaires (general and poor evaluations in static traffic are shown in Figure 6(b)).

According to the survey, people think that the street landscape problems are mainly due to poor facilities (good and better evaluations are shown in Figure 7(a)), disordered buildings, less greening, less landscape, no features, difficult parking, and poor sanitation (the poor and poor evaluations of landscape richness are shown in Figure 7(b)), etc.

People also hope that the streetscape will highlight the regional characteristics, highlight the cultural connotation (the good and better evaluations in the evaluation of landscape interest are shown in Figure 8(a)), increase the visual beauty, clarify the nature of the street, the buildings are uniform, the colors are diverse and coordinated, and the facilities are novel and interesting (the bad and very bad evaluations in the interestingness evaluation of the landscape are shown in Figure 8(b)).

According to the weight index of street visual landscape evaluation, the value of the visual landscape quality evaluation index B∗ under the ideal state of this paper is 4.74. Combined with the evaluation results of the multifactor evaluation method, the value of the landscape visual comprehensive evaluation index B of this road section is calculated to be 2.45. The final value of M is 50.58%. The classification of the visual quality of the streetscape in the text shows that the visual quality of the streetscape is grade II, which means that the overall visual quality of the streetscape is average. The multifactor evaluation method statistics are shown in Table 3.

The landscape of the main roads of urban life is mainly artificial landscape. Combined with the actual situation of the streetscape, it focuses on the distribution of the weights of each evaluation factor and highlights the key points. The weight distribution recommended in this paper is shown in Table 4.

In the evaluation of uniqueness of streetscape, 4% are good, and 18% are better (as shown in Figure 9(a)). The bad one's accounted for 28% and the very poor ones accounted for 50% (the poor and very poor evaluations of landscape uniqueness are shown in Figure 9(b)).

The weight of multiple indicators in the study area is also an important content. There are subjective weighting method and objective weighting method to determine the weight. Subjective empowerment method is to make subjective judgments based on expert experience. It makes full use of the valuable experience accumulated by experts for many years and has high accuracy for specific research areas. The weights of the comprehensive indicators are shown in Table 5. The objective empowerment method is a means of defining and evaluating the competitiveness of enterprises. It determines the weights through certain mathematical methods according to the relationship between the original data. The result of the judgment does not depend on the subjective judgment of people and has a strong mathematical theoretical basis.

Pedestrian Street is a pedestrian street that is naturally formed by its topography. The width of the street is about 6–9 meters, and the buildings on both sides of the street are mostly two-story buildings with a height of about 6–9 meters. Its scene space composition is shown in Figure 10. Pedestrian Street is located in the northwest of the city and is named for its abundance of magnets. Ciqikou has always been the main port of the city's foreign trade. With the increasing development of railways and highways, it has lost its former position as a material distribution center. Today, the folk customs in the ancient town are simple, and the buildings on both sides of the street are well preserved. It is a typical famous street with Chinese historical and cultural traditions.

By observing the spatial proportion curve of streets in ancient towns and the corresponding comparative analysis, it is found that the spatial proportions of streets are mostly between (0.6 and 3.0). Such a spatial composition has a symmetry that accommodates each other. It not only has a cohesive sense of stability but also does not suppress or separate. The pedestrian street scene is shown in Figure 10.

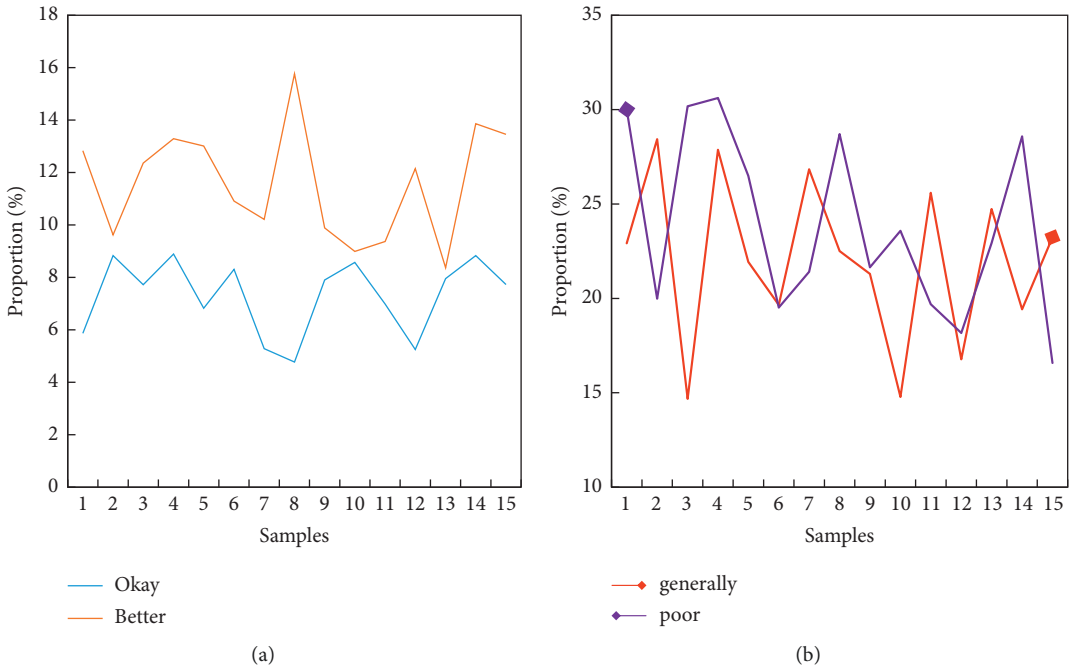

Figure 6: Evaluation of static traffic. (a) Good and better ratings in static traffic. (b) Fair and poor ratings in static traffic.

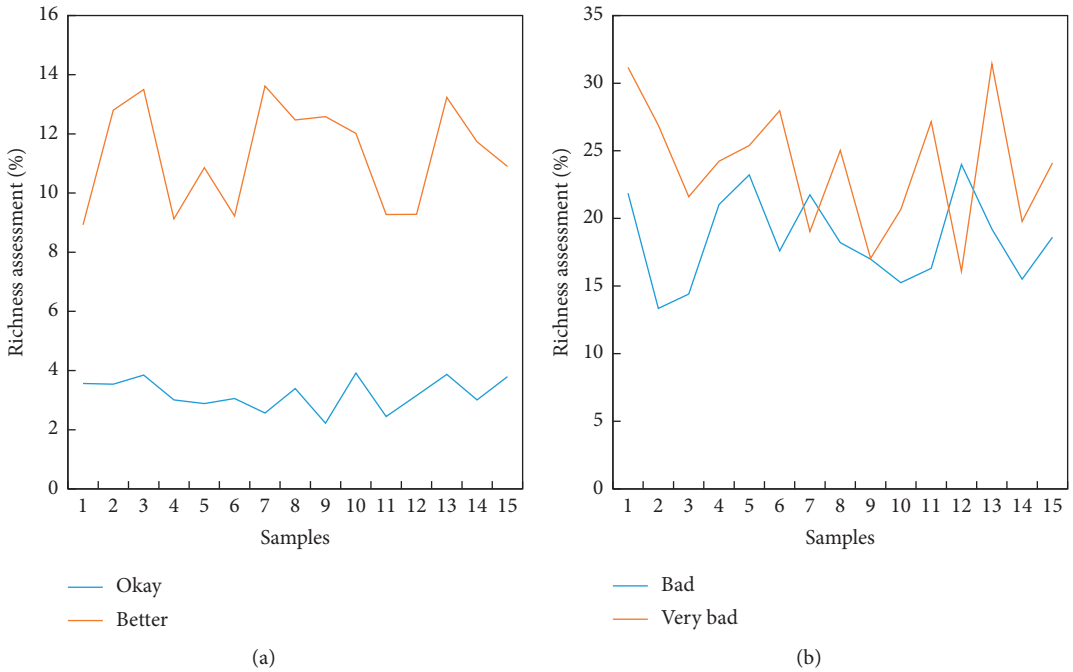

Figure 7: Landscape richness assessment. (a) The richness of the landscape is rated as good and better. (b) Bad and very bad assessments of landscape richness assessments.

5. Discussion

The formation of urban landscape imagery is restricted by certain internal factors. It is based on this mechanism that our conscious organ recognizes, recognizes, and remembers cities. In this process, people tend to consciously pay attention to the "explicit image" landscape elements that produce strong psychological perception impressions. People tend to overlook the subtle influence of the deeper urban spatial structure on the formation of urban images. But, in fact, from the perspective of urban streetscape as the carrier of urban image, the true level of an urban streetscape image also has the barrel principle. The degree of reflection of the landscape intention to the spatial structure is the

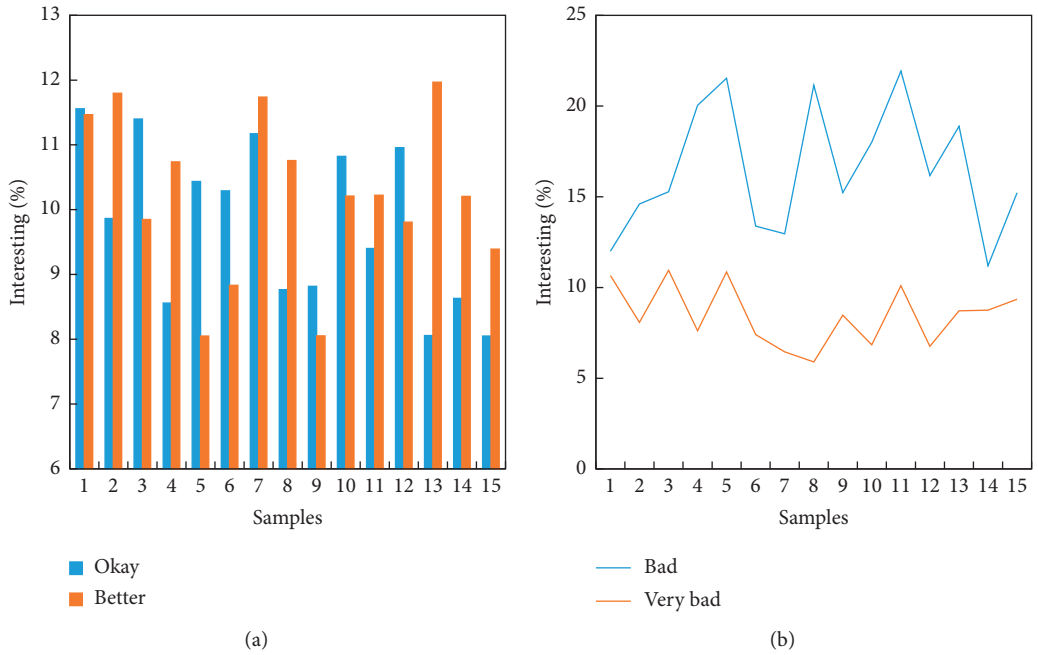

Figure 8: Interesting evaluation of landscapes. (a) Good and better evaluations in the evaluation of landscape interest. (b) Bad and very bad ratings for the interestingness of the landscape.

Table 3: Multifactor evaluation methods.

Evaluation factor	Evaluation results			
The degree of difference and ordinary degree of the evaluation subject	Larger	(6 people, 20%)	Generally	(28 people, 56%)
Evaluation subject's knowledge and length of years	Higher	(8 people, 32%)	Generally	(20 people, 40%)
Naturalness and stability of topography	Strong	(9 people, 16%)	Generally	(19 people, 38%)
The degree of transformation and singularity of astronomical seasons	Higher	(10 people, 18%)	Generally	(14 people, 28%)

Table 4: Weight assignment recommended in this paper.

Classification	Evaluation factor	Weight
Landscape subject	The degree of difference and ordinary degree of the evaluation subject	0.06
	Evaluation subject's knowledge and length of years	0.07
Natural landscape	Naturalness and stability of topography	0.05
	The degree of transformation and singularity of astronomical seasons	0.06

determinant of the true carrying capacity of a city's image information. On the other hand, the landscape system used for structure is farther away from the complex and impetuous utilitarian purpose than the expressive landscape expression. It is closer to the city's connotation and regional characteristics and is actually closely related to people's lives. While serving the public, it truly displays the image of the city at one time and one place.

There are many studies on urban streetscape in China. The research direction mainly focuses on the construction of humanized landscape environment of streets, regional cultural characteristics, green streets, rainwater management, building facades, interfaces, and so on. Streetscape is an important part that affects the overall landscape effect of a city. The better accessibility of the street, the reasonable spatial scale, the landscape integrated with the regional characteristics, and various functional facilities are the aspects that should be paid attention to in the design.

Streets, as traffic passages, are subordinate to roads, and roads refer to the collective name of various passages for vehicles and pedestrians to pass. Compared with the two, the road is mainly for the traffic function. In addition to traffic, the street also has other functions such as socializing and resting. People, cars, and the buildings that define their space are the main factors that distinguish streets from roads. Briefly, it can be summarized that roads with building restrictions are called streets, and those without building restrictions are called roads. Streets connect various landscape nodes in the city, form a continuous landscape sequence, and form urban landscape corridors. Streets are important public spaces in cities. Different types of streets play different roles in people's daily lives. Because each city's structural

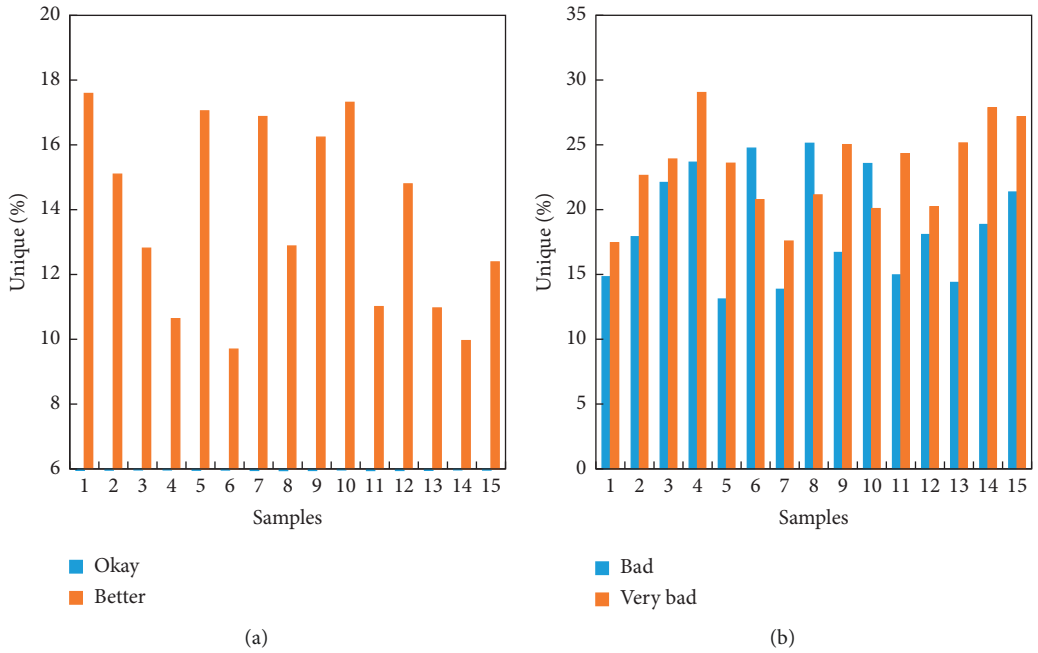

Figure 9: Uniqueness assessment of landscapes. (a) Good and better evaluations of landscape uniqueness evaluations. (b) The poor and very poor evaluations of the uniqueness of the landscape.

composition and traffic demand are different, it is difficult to classify with a single standard. From the comprehensive consideration of the traffic characteristics of the street, the nature of the land on both sides of the street and the role it plays in people's lives, the streets can be divided into: urban traffic streets with traffic functions as the main function, the commercial functions main urban commercial streets, and the urban living streets mainly focus on life service functions.

The urban streetscape is a complex composed of the traffic pavement, various landscape requirements in the street space, and the people who are active on the street. From the perspective of urban space, streetscape is an urban public space enclosed by building facades, passages, street facilities, greening, and street signs. It mainly meets the needs of people's passage, communication, rest, and stay and is an important part of the city. From the perspective of landscape viewing, streetscape should meet the visual aesthetic needs of users. Its design elements need to follow certain aesthetic principles. From the perspective of the overall urban landscape, the streetscape is the vein that constitutes the urban landscape and is an indispensable part of the urban landscape.

As a public space, the most direct user of the street is people. Whether it is the visual experience or the function used, it should be designed from the main body of the human being. The dimensions of street width, building height, color, etc., as well as the psychological and behavioral effects of these dimensions on people, will affect the establishment of pleasant scales. When establishing these scales, we should take into account the important role of the human line of sight because most of our perception of space comes from visual perception.

As an important part of the city, the street is also an important embodiment of the urban landscape. Streets are the main areas for people's production, life, and public activities. Our memories of a certain city will be reflected in the street space, such as whether the buildings have features, whether the trees have good shading effect, and whether the walking width is comfortable. These feelings will affect our perception positively or negatively, thus affecting our emotions, giving us sensual pleasure, psychological pleasure, and even spiritual pleasure. This will make the people living here love the city even more and be proud of their city. It will also make people who have been here more aware of the goodness of the city and want to come back again. The streetscape image reflects the comprehensive strength of the city's politics, economy, culture, and other aspects.

Urban living streets pay more attention to meeting the daily needs of residents while ensuring the normal passage of people. Because residential land occupies most of the urban land, urban living streets have become the most numerous street types in cities and are closely related to people's daily life. Residential streets have the characteristics of slow speed, few lanes, narrow road width, large flow of people, and the coexistence of motor vehicles, nonmotor vehicles, and pedestrians. The buildings on both sides of the street have various service functions, but they all have strong life services. The obvious difference between living streets and traffic streets and commercial streets is that the service groups of living streets are mainly the surrounding residents. The activities of people on the streets are also mostly family behaviors. Street is an important part of urban skeleton and texture, which connects different functional spaces in the city. Before the era of automobiles, the street not only played

Table 5: Composite indicator weights.

Indicator system	Evaluation indicators	Weight
Socioeconomic indicators	Population	0.07
	Per capita output	0.04
Natural environment indicators	Average temperature	0.03
	Average sunshine	0.01

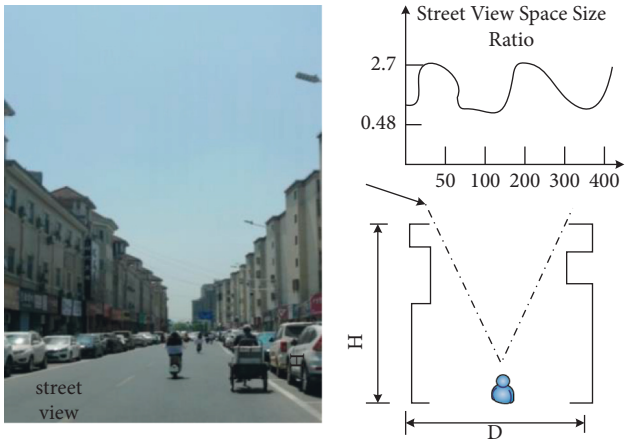

Figure 10: Pedestrian street view.

the role of transportation but also a place of life and social interaction with social attributes.

The traffic safety design of urban living streets mainly focuses on the travel safety of pedestrians. It reduces the chance of motor vehicle and pedestrian contact through the comprehensive design of pedestrian space, crossing facilities and the surrounding environment. It uses the change of street shape and the device of deceleration facilities to reduce the speed of motor vehicles. This reduces the incidence of pedestrian traffic accidents and reduces the severity of accidents. In addition, it emphasizes the configuration of greenery along the street to create a green landscape with transparent sight, which is an important aspect to ensure pedestrian traffic safety. The safety design of urban living street activities is mainly to comprehensively design the street space environment according to the occurrence law of hidden dangers. It sets a reasonable walking space to eliminate and reduce the harmful factors in the space environment to the safety of pedestrians. It strengthens space protection, improves people's ability to identify and respond to harmful factors, and try to avoid people's contact with these factors. This thus prevents and reduces the occurrence of accidents and improves the safety of activities. Urban living street defense safety design is mainly through the organization of street structure, building layout, and defense facilities. This makes the street space well-monitored, territorial, identifiable, using activity levels and belonging to increase the likelihood of crime being detected. It prompts criminals to give up the idea of committing crimes and strengthens the potential victims of the street's ability to control the environment. It also pays attention to enriching street life, promoting the communication between people, enhancing the vitality of the street, and improving the quality of defense and safety of the living street space.

The ability of urban street space to meet the needs of urban people in terms of quality and quantity, the degree of perception, and identity of the users to the space. Among them, the ability to meet the needs of people's use activities refers to that the street space can support and meet the needs of people's use activities in the place at the material level. The ability of this space to satisfy people is the basis for judging the quality of space. The degree of perception and identity of the users to the space place reflect the subjective consciousness of the street space to a certain extent. People thus assess whether their needs will be met and decide whether they are willing to travel or use street space. In material space, people and their activities are the two basic elements that make up the quality of street space. People and their activities are the subject, and material space, as the material carrier of people and their activities, is the object. The foundation of landscape is an emerging direction of landscape development in recent years. Its theory does not emphasize the purpose of social activities, but rather goes deep into the regional basis of "people-land" relationship. The two elements complement each other and are indispensable. Street space is the basis of quality evaluation, which mainly refers to the physical environment quality of street space and the level of space meeting the needs of people's activities. The former includes the physical environment, such as noise, temperature, and sunlight, in the street space. The latter refers to whether the pavement, environmental facilities, leisure facilities, green landscape, and other material elements in the street can support the use of the crowd. Second, for the users of the street, what is really important is the perceived street space, so the subjective perception identity is an important prerequisite for the quality of the street space. Psychology proposes that people make independent choices on the surrounding environment information to form the individual's cognition of the environment, so as to decide whether they are willing to use the place. Therefore, the quality of street space must include the content of psychological environment quality such as safety, comfort, and beauty.

6. Conclusion

Street space is an important part of urban public space system. Compared with other urban public spaces, streets are the type of urban public space that have the closest relationship with urban residents and have the most contact with them. Urban streets have important functions and roles in the city: the streets are the skeleton of the city, the pattern of the streets is an important reflection of the characteristics of the city, and the streets represent the image of the city to some extent. On the other hand, the street is also a stage for reflecting urban life. As an important part of the city, the city street is also an important embodiment of the urban landscape. This research mainly explores the attributes of the street, the utilization of buildings along the line, recreation facilities, green vegetation, recognizability, street

atmosphere, and so on. It distributes questionnaires and uses numerical analysis methods to conduct rigorous and objective security assessments on the data obtained from the questionnaires and analyze the weights of various influencing factors. This provides suggestions for the improvement of the living streetscape in the urban built-up area and also puts forward some strategies on how to create a safer and more comfortable urban living streetscape. The analysis of this study is not comprehensive and in depth, and more aspects are needed to be further explored in the future.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Yu. M . Semenov, "Landscape planning: the applied branch in complex physical geography," *Geography and Natural Resources*, vol. 38, no. 4, pp. 319–323, 2017.

[2] J. Li and T. Hou, "Application of virtual reality technology in analysis of the three-dimensional evaluation system of rural landscape planning," *Mathematical Problems in Engineering*, vol. 2021, no. 5, pp. 1–16, 2021.

[3] Q. Liu, J. Wu, C. Li, and S Wang, "The diagnosis and treatment strategy of occipital skull mass in hemophilic patients: a rare case report and literature review," *Chinese neurosurgical journal*, vol. 5, no. 01, p. 8, 2019.

[4] M. R. Ghaleh and M. Ramezani, "The street as the edge: street landscape design based on social studies: case study: aran and bidgol common street," *Asian Journal of Water Environment and Pollution*, vol. 15, no. 4, pp. 121–129, 2018.

[5] G. Mendiguren, J. Koch, and S. Stisen, "Spatial pattern evaluation of a calibrated national hydrological model – a remote sensing based diagnostic approach," *Hydrology and Earth System Sciences*, vol. 21, no. 12, pp. 5987–6005, 2017.

[6] Y. Wang, C. Ji, and J. Zhou, "Experimental and numerical analysis of an improved melt-blowing slot-die," *E-Polymers*, vol. 19, no. 1, pp. 612–621, 2019.

[7] A. M. E. Soderman, T. I. Street, and K. Hall, "The value of small arable habitats in the agricultural landscape: importance for vascular plants and the provisioning of floral resources for bees," *Ecological Indicators*, JAN, vol. 84, pp. 553–563, 2018.

[8] S. Nematollahi, S. Fakheran, and A. Jafari, "Landscape planning for conservation, based on the InVEST model of habitat quality and ecological impact assessment of road network in chaharmahal & bakhtiari province," *Iranian Journal of Applied Ecology*, vol. 8, no. 4, pp. 67–81, 2020.

[9] H. K. Heo, D. K. Lee, J. H. Park, and J. H. Thorne, "Estimating the heights and diameters at breast height of trees in an urban park and along a street using mobile LiDAR," *Landscape and Ecological Engineering*, vol. 15, no. 3, pp. 253–263, 2019.

[10] G. Schneider and I. Scharmann, "Perceptual analysis according to rudolf arnheim's Gestalt theoretical approach in structuralist landscape planning," *Gestalt Theory*, vol. 42, no. 1, pp. 43–61, 2020.

[11] L. Cheng, S. Chen, S. Chu et al., "LiDAR-based three-dimensional street landscape indices for urban habitability," *Earth Science Informatics*, vol. 10, no. 4, pp. 457–470, 2017.

[12] M. Fabey, R. Scott, and M. Streetly, "Tactical targets: US addresses naval aviation challenges in a rapidly changing landscape," *Jane's Navy International*, vol. 122, no. 5, pp. 18–25, 2017.

[13] P. Nataraj, A. Kemal Fauzie, P. N. Sandhya Rani, and G. V. Venkataramana, "Dispersion of nitrogen dioxide and particulate matter concentrations in street canyons and open landscape in urban mysore," *Shanlax International Journal of Arts Science and Humanities*, vol. 7, no. 3, pp. 36–43, 2020.

[14] P. Csorba, "Present tendencies in landscape planning and recognition of the opinion of local citizens on the example of the Tiszazug," *Landscape & Environment*, vol. 15, no. 1, pp. 1–9, 2021.

[15] P. Gladysz, W. Stanek, and L. Czarnowska, "Thermo-ecological evaluation of an integrated MILD oxy-fuel combustion power plant with CO 2 capture, utilisation, and storage – a case study in Poland," *Energy*, FEB.1, vol. 144, pp. 379–392, 2018.