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| RESEARCH ARTICLE

Evaluation of Street in Luohu District of Shenzhen on Semantic of Street Image

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| ABSTRACT
Based on the theoretical extension of the greening vision and the application practice of streetscape big data, the average green vision rate within the planned green area coverage block of Luohu District, Shenzhen is calculated by PHOTOSHOP and FCN software, and the differences in spatial distribution and current status characteristics between its 3D green vision rate and the management unit control guidance map of Shenzhen Green Space System Planning (2014-2030) are explored, and the results show that the green space rate in the main urban area of Luohu District, Shenzhen is 36.78%, which is much better than the average level of major cities in the world, but there is still a gap compared with the management unit control guidance map of Shenzhen Green Space System Planning (2014-2030), and this paper proposes optimization suggestions for the current deficiency.

| KEYWORDS
Road Green View Rate, Streetscape Big Data,
Green Coverage.

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1. Introduction

view rate is the percentage of green in the human field of vision, and it's used as an evaluation index of urban greening. Unlike the previous urban green space indicators (green space rate, green coverage rate and per capita green space area), Green Vision Ratio emphasizes the feeling of people in the environment and elevates the perspective of landscape evaluation from two-dimensional (flat) to three-dimensional (three-dimensional), which is a quantitative way to comprehensively examine the degree of the greening of space and the psychological perception state of citizens. The traditional road greening evaluation index is based on the two-dimensional greening index of green area rate and green coverage, ignoring the three-dimensional green volume and human psychological perception, which has certain limitations in measuring the ecological benefits of green areas.

The current domestic and international research on green sight rate focuses on the influencing factors of road green sight rate[1-2], investigation of green sight rate[3-4], and the application of green sight rate in road design[5]. There is less current research on how the new indicator reflecting three-dimensional green volume, green view rate, relates to traditional two-dimensional green indicators such as green cover. Exploring the relationship between road greening rate and traditional greening index is beneficial for municipal departments to achieve a better three-dimensional greening effect by improving the two-dimensional greening index.

2. Methodology and data processing

2.1 Data Acquisition

Obtain road greening data and attribute data of Nanshan District from Earth Online Street View Map. The shooting time is May 2020he camera angle is uniformly set to 0°, that is, flat view, based on the management unit control guide map of Shenzhen Green Space System Planning (2014-2030), the Futian District is divided into 24 blocks (Figure 1) Each block within a randomly selected point, the green view rate of the pictures taken in the southeast and northwest directions of the same point is added up and divided by 4, which is the average green view rate of this shooting point.

Figure 1 the Futian District is divided into 24 blocks.

2.2 Formula and method of calculating green view rate

The formula for calculating the green view rate is; green view rate(%)= area of the plant part of the photo (m^2)/total area of the photo (m^2) × 100%[4].

For Shenzhen Nanshan District, the data information sources are acquired through the following three stages: street photo data acquisition, street photo green view rate calculation, and sampling point green view rate calculation and block green view rate settlement. Specific information for each phase is shown below.

①Earth online street map photo acquisition. Street photos from the Earth online street map, real-time anti-Shenzhen Luohu District area around the street conditions[5]. Find and download the street photos you need with the Earth Online Street View Map. Based on the management unit control guide map of Shenzhen green space system planning, the coordinates of the sampling points of the blocks were confirmed, and the streetscape photos were downloaded, with a zero-degree angle of view of the photos, i.e., flat view capture, and the streetscape photos were acquired for each point in the four directions of front, back, left and right (Table 1).

Table 1 Example of four-directional street photos of sampling points

Number	Description	Street view photos in front, behind, left, right and four directions of the sampling point.			
A1	Nanshan Park Block Network Sampling Site 1, Nanshan District, Shenzhen	 Front	 Rear	 Left side	 Right

② Calculation of the green view rate of street photos and calculation of the green view rate of sampling points. The parsing of the color composition of streetscape photos is accomplished by FCN network, a visual image semantic segmentation software based on deep learning full convolutional network (FCN), which semantically segments each streetscape photo, presents color blocks representing different color elements, and extracts the value of each color phase channel from the digital image (Table 2); for each pixel[5-6], the pixel color represents a different classification meaning, corresponding to a class of objects in the city, and is shown as 0 for unknown features (Tables 3 and 4); the ratio of the number of green pixels to the total number of pixels in each photo is used as the green view rate. The green view rate of each sampling point is the average of the green view rates of streetscape photos in the four directions of front, back, left and right. Take sampling point A1 as an example: the green view rate of the front streetscape is 37.33%, the green view rate of the back streetscape is 37.23%, the green view rate of the left streetscape is 18.67%, the green view rate of the right streetscape is 54.00%, and the green view rate of this sampling point is 36.81%.

③ Block Greenview settlement. By getting the data of each sampling point on the block division line, the green view rate of the sampling points is integrated into the block division network, and the road green view rate is calculated. The value of the rate is the average of the green rate of all sampling points on the block.

Table 2 Example of four directions of sampling points after FCN network resolution

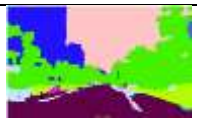
Number	Description	Street view photos in front, back, left, right, and four directions of the sampling point after FCN network resolution.			
A1	Nanshan Park Block Network Sampling Site 1, Nanshan District, Shenzhen	 Front	 Rear	 Left side	 Right

Table 3 Example of street view photo attributes in the front direction of the sampling point.

Value	Count	Value	Count
0	37694.00000000000	21	3515.00000000000
2	196947.00000000000	26	3802.00000000000
3	316158.00000000000	33	1814.00000000000
5	438248.00000000000	44	88.00000000000
7	267679.00000000000	53	110.00000000000
10	64026.00000000000	88	754.00000000000
12	13974.00000000000	91	1.00000000000
14	5759.00000000000	94	2471.00000000000
17	4448.00000000000	137	2.00000000000
Total		1357490.00000000000	

Table 4 Example of Street View Photo Attribute Reference Table

Object	Reference	Object	Reference
0	Unkown objects|unknown objects	21	car;auto;automobile;machine;motorcar|automobile
2	building;edifice|building	26	house|house
3	sky|sky	33	fence;fencing|fence
5	tree|tree	44	signboard;sign|sign
7	road;route|road	53	path|path
10	windowpane;window|window	88	streetlight;street lamp|street light
12	sidewalk;pavement|Sidewalk	91	airplane;aeroplane;plane|airplane
14	earth;ground|ground	94	pole|rod
17	mountain;mount|mountain	137	traffic light;traffic signal;stoplight|traffic signal

2.3 Data processing and database construction

In arcgis, data cleaning is performed on the green view data of the sampling points on the block network: non-urban green streetscape[7], such as green billboards and other special streetscape features, are removed by analyzing streetscape photos.

2.4 Road Green Vision Statistics and Analysis

Through the statistics and collation of the green view rate pictures in the study area blocks, it is concluded that the average green view rate is xx%, and those areas with the highest and lowest green view rates among all sampling points are concluded and totalled for solutions, so as to derive the overall green view rate and optimization solutions, as well as using the results to combine and compare with the management unit control guide map division of Shenzhen Green Space System Planning (2014-2030), summarize and analyze the proposed solutions[8].

3. Results and Discussion

3.1 Study area

Luohu District is part of Guangdong ProvinceShenzhenand isShenzhenIt is one of the central urban areas inShenzheneast of the city (Figure 2It is located in the east of Shenzhen, withYantian Districtadjacent; west to Hongling Road, with Futian Districtadjacent to Futian District; south to Luohu BridgewithHong Kongadjacent; north to the former SAR management line, with Longgang DistrictHenggang、NanwanandBujiBantianBantianandLonghua is located between 114°04′ -114°21′ East longitude and 22°31′ -22°40′ North latitude, with a total area of 78.75 square kilometres [2-3]. As of 2015, there are 10 streets under the jurisdiction of the Luohu District. The topography of Luohu District is high in the northeast and low in the southwest, mostly hilly mountains and small alluvial plains, with the highest peak in ShenzhenWutong MountainThe highest peak in Shenzhen are located in the eastern part of the district, which has a subtropical maritime climate and an average annual temperature of 22℃. Luohu District is the Shenzhen Special Economic Zone, the earliest developed urban area, and is Shenzhen Central Busine is an important part of Shenzhen's Central Business District and has been honoured as a national model district for harmonious community construction and a national advanced cultural district[9-10].

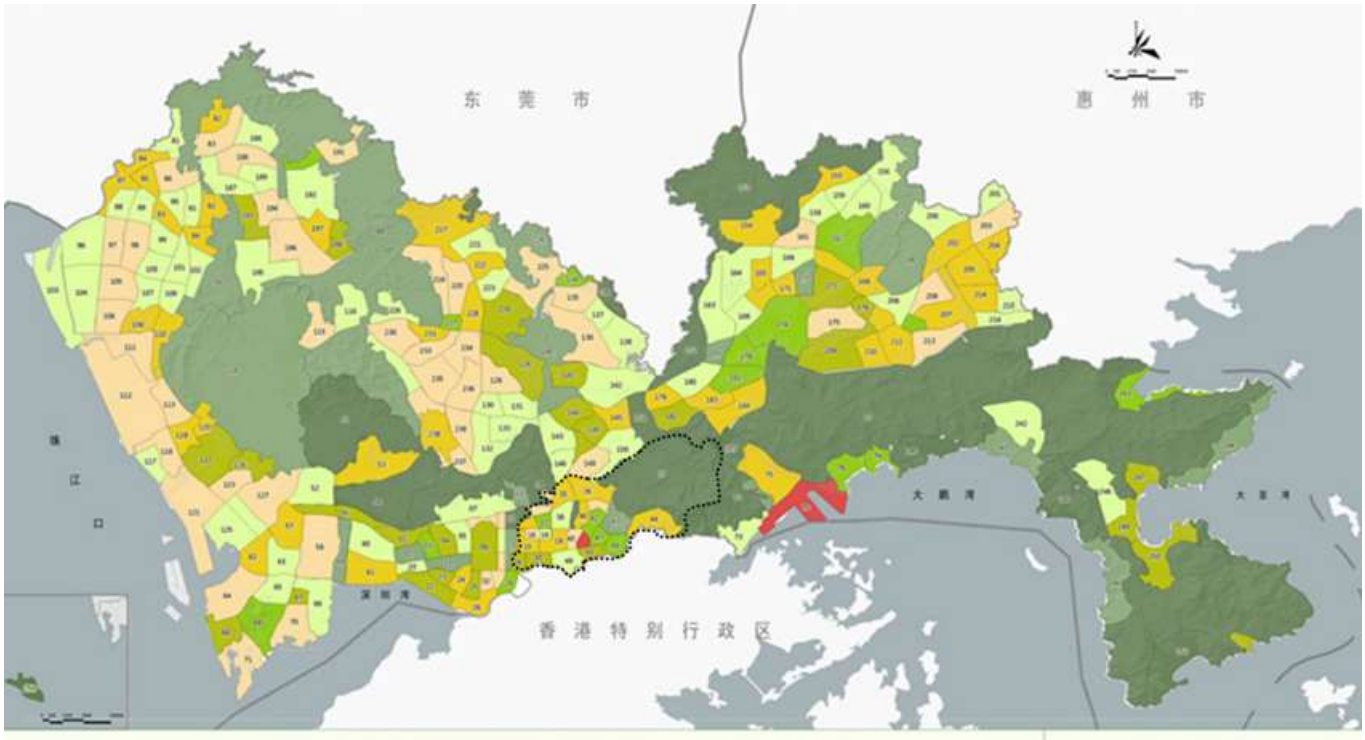


Figure 2 Range of study locations

3.2 Street View Image Acquisition

In order to make the pictures of Baidu Street View correspond to the points on the remote sensing images one by one, 45 observation points (Figure 4) were set in the road network with equal spacing for the road network in Luohu District, Shenzhen, with each sample point at a distance of about 50m-100m, and their latitude and longitude coordinates were recorded in this paper. With the help of Baidu Street View API, we set a fixed angle of view and elevation for each image according to the rules of interface parameters provided by Baidu API to make the street view fit the human field of view as much as possible. The latitude and longitude coordinates of each sample point are used as the unique identifier, and a total of 180 city street view images are crawled from the front view (0°), right view (90°), back view (180°), and left view (270°) of each sample point in turn(Figure 3). The streetscape photos collected in this way from 4 angles can provide a better representation of the surrounding green environment of the sampling site. The results were then calculated by performing the same green-visibility calculations as in the South Mountain area.

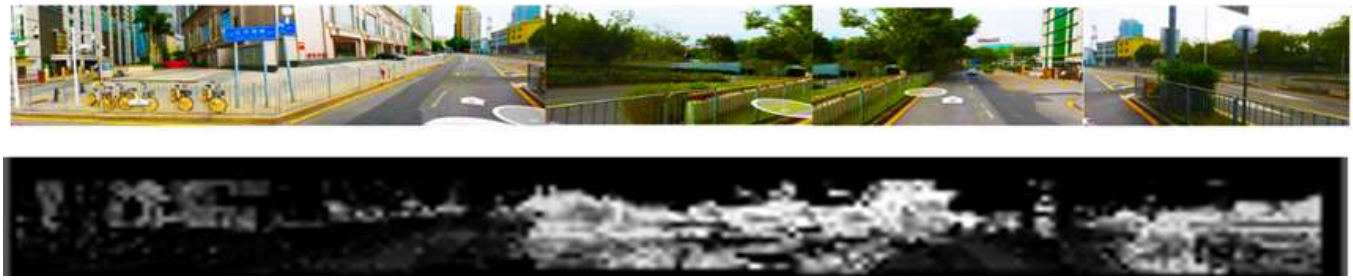


Figure 3: Hsl Acquisition

Figure 4: Sampling points

3.3 Derive the evaluation of the greening level

In 2014, the Shenzhen Land Research Center announced the Shenzhen green space plan [2014-2030], which recorded in detail the planning to 2030 (Figure 5), overall Shenzhen green space rate to meet the standard degree, from this data is calculated by the macro overhead perspective, but most of the urban green space degree should be more obvious by the human perspective of the green space degree performance, so this study to the human perspective of the green space rate and the planning of the green space rate for comparison, the analysis of the distribution characteristics so as to compare with the planning of the degree of green space to draw conclusions.

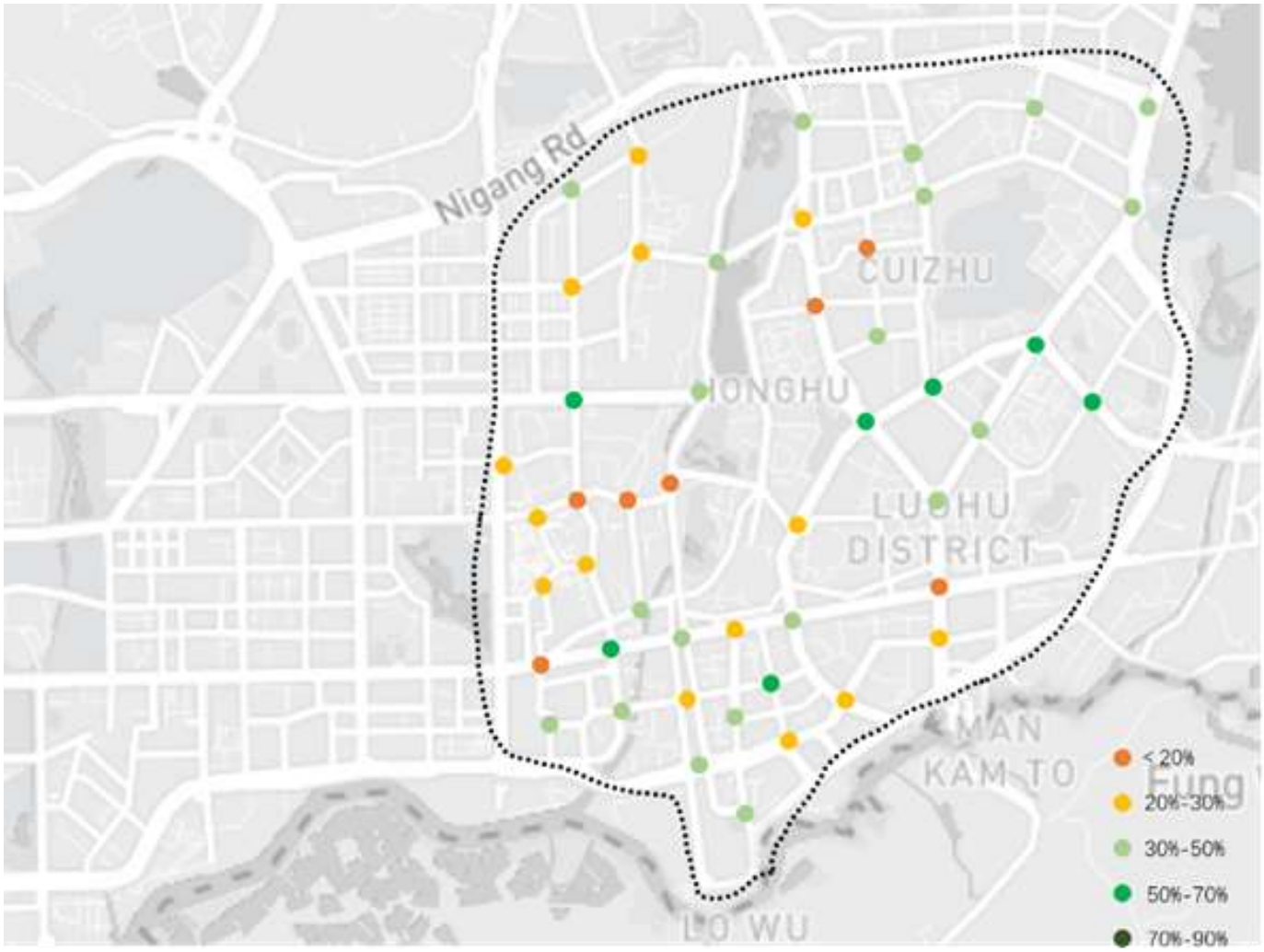


Figure 5 Green view distribution map

4. Evaluation and Suggestion

4.1 Evaluation of greening rate in Luohu District

As seen in the following comparison chart (Figure 6), the overall 25 blocks, green vision rate and greening rate qualified blocks have 14, Luohu District qualified rate of 56%, green space planning 2030 Luohu District average greening rate of 36.78%, while Luohu District in the green vision rate of only 28.68%. This shows that there is still a slight gap between the degree of greening rate in the pedestrian viewpoint and the planning greening rate. Compared with the planning greening rate, more attention should be paid to the degree of greening from the human viewpoint. The greening rate in the human viewpoint should be considered when planning green areas, and the vertical greening configuration should be increased.

The results can be seen in the Luohu District, although the old city (Figure 4), the overall Luohu City, the northeast region around the East Lake Park Shenzhen Reservoir green visualization degree is high, the south change the main road green visualization rate is slightly weaker, the situation is as follows: 1. Within the long large canopy trees in large numbers and evenly distributed, and subsequently accompanied by good pedestrian perspective greening rate results, especially: Magnificent Road, Yijing Road, Aiguo Road. Because of good large canopy trees called on the green space and small-scale ecological landscape partition in the data performed well (Figure 6), the overall green vision rate of about 50% on average; there are also the results of later greening works to improve good (Figure 7), such as Shennan East Road, Nai Gang East Road, Buxin Road; because of good and rich plant configuration and reasonable green space planning, resulting in an overall green vision rate of about 45%. The southern district has poor performance sections: Wenjin Road, Chunfeng Road, Meiyuan Road, Tianbei Road; among them, Wenjin Road is mainly dominated by small isolation zone greening on both sides of the road, with only scattered and small crown size of trees, the overall level of street greening is low (Figure 8). There is no regular road greening on both sides of Chunfeng Road, but only scattered spot street greening, mainly alpine banyan species; despite the large crown size, but a single point of greening can not drive the whole street greening level. Plum Garden Road is mainly green vegetation for Bauhinia because the crown width of Bauhinia

planted when the road was widened in recent years is small, it is difficult to have a high plane vegetation coverage index, and its three-dimensional greening rate index is also low, the overall greening level of the road has not yet been revealed.

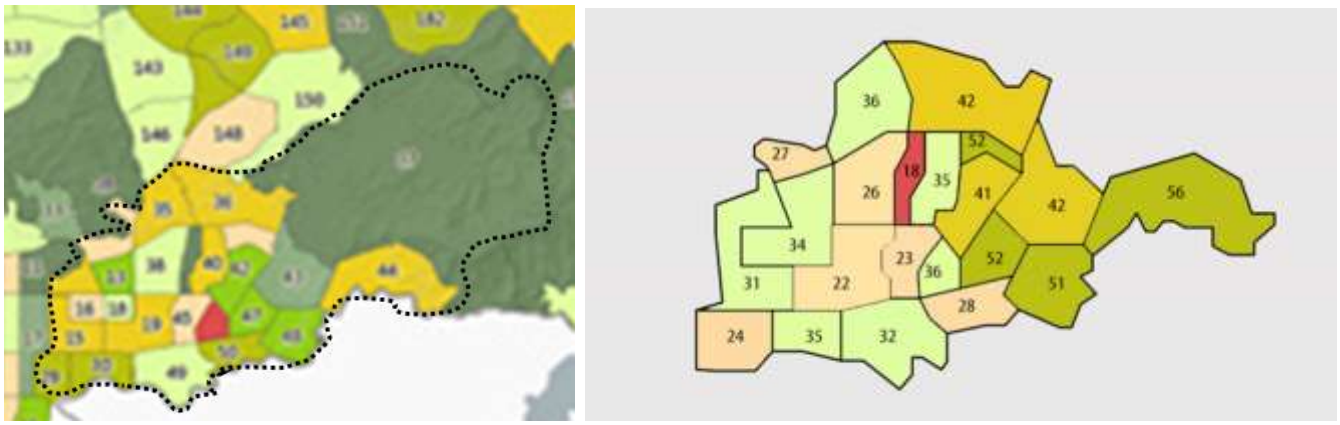


Figure 6 Shenzhen 2030 plan green area rate vs green view rate

4.2 Suggestions of Shenzhen landscape planning

Shenzhen is a high-density megacity with a high concentration of population, high spatial concentration and high concentration of functional activities. Urban green space is a guarantee for maintaining a good urban ecological environment and providing residents with a livable, workable and playable living space. Therefore, in the process of constructing urban green space indicators, the urban planning field needs to fully simulate residents' behavioural perceptions and form an urban green space planning plan that meets their needs. The article suggests applications for possible sites of green-visibility in Shenzhen cities and for potentia. There are several suggestions:

(1)***Establishing the scope of the application scale of the green rate:*** At present, most of the research methods for urban green sight rate focus on exploring the stable way to obtain accurate values of case cities. In the process of green sight rate development, although foreign research scholars have tried to use specific source algorithms to compare global urban green sight rates, there is still a lack of thinking about cities themselves, and what is missing is the comparison of different cities' spatial scales. The scale of green sight rate application of excellent cases is not necessarily suitable for other cities, and there is still a gap between large and small cities. For this reason, the following principles for establishing the scale of green sight rate application are proposed, involving the spatial scale and temporal scale of cities, which are divided into latitude and scale in space and moment and season in time;

(2) ***Establishment of green rating credit enforcement system***: While conducting a complete data model study, acquiring urban streetscape image data at the same time, the current urban streetscape image data need to have a certain expected value, and then hypothesis testing data accuracy and feasibility after the estimation. As most methodological studies on green ratings exist at the anticipatory stage, there is a lack of subsequent reflection and discussion on the reliability of the acquired data. In the living scene, there are often a lot of artificial green items, such as green-based street light poles and pedestrian guardrails. In the past, the manual handheld camera for sampling, taking images and acquiring the green vision rate was only suitable for small-scale spatial scope, and the overall study down the image data volume is relatively small, but now the use of streetscape big data to obtain image data to investigate the green vision rate in a large urban area, compared with the traditional survey methods, more efficient and more significant. Therefore, there is an urgent need to improve the technology in exploring image data creditworthiness and to establish a system for enforcing green rating creditworthiness to improve image data creditworthiness.

(3) ***Expansion of urban green space system green view rate connotation development:*** The overall idea of national urban development is changing from development-oriented to promoting people's well-being, and the improvement of internal quality will become the focus of future territorial spatial planning. At present, the country's top-level design for territorial spatial planning has been successfully reached, and the future needs to face the new era of territorial spatial planning and how to appeal to further enrich the framework internal guidelines. As special support for the national spatial planning, the urban green space system planning focuses on how to embed the internal quality improvement under the existing urban green space system planning framework. Residents' perception is even more as the direction of connotation space quality improvement exploration, the integration of green sight rate into the urban green space system planning is a big step towards the connotation development of urban green space system green sight rate. However, the basic guidelines, implementation strategies and specific measures of the planning program are still to be discussed in detail.

5. Conclusion

The current research on urban built environment combined with streetscape pictures is still in the exploration stage, and the overall consideration of greening rate is mostly based on the overhead plane viewhe greening rate based on streetscape pictures can reflect the multi-dimensional greening spatial information that cannot be characterized by plane indicators, which is in line with the public's humanized demand and expectation of urban greening in multiple dimensions. Based on this, according to the actual situation in Shenzhen city, from the following aspects of reference. First, a reasonable allocation of greening land resources in urban areas with a limited number of greening land conditions is a priority to ensure the plane greening requirements. Secondly, to enrich the form of greening, enhance the proportion of three-dimensional greening in the form of greening configuration, continue to promote the wall, roof and other forms of three-dimensional greening. Third, strengthen the maintenance of greening seedlings and greening construction level in the protection of old and valuable trees based on local conditions to select tree species while focusing on plant configuration and comprehensive layout. In the future, with the development of spatial information technology, the use of accurately matched road data, higher resolution remote sensing, UAV images and multi-temporal street images can effectively compensate for the lack of spatial and temporal accuracy of current data. At the same time, based on the air-sky-sky sensor platform combined with large-scale machine learning algorithms, it is expected to realize online automated urban multi-dimensional greening level assessment, effectively improving the accuracy and efficiency of urban greening environment assessment. Integrating the consideration of the greening rate in the greening planning assessment helps to understand the psychological needs of citizens for urban greening from a humanistic perspective, to plan and configure urban greening more scientifically, to effectively improve the overall urban greening level, and thus to promote the application of governance in urban greening construction according to local conditions.

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