

Research on the Micro-Regeneration of Public Space of Pingshan Village in Shenzhen based on the Social Network Analysis

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Abstract: There is a serious lack of public space in urban villages in China, so the micro-regeneration of it is widely concerned. Taking Pingshan Village in Shenzhen as the research object, this paper constructs the network of public space and public activity of Pingshan village based on the social network analysis. By comparing the connectivity, equilibrium and relevance of two types of network structure, it is found that there are three problems of the public space in the village: lack of space level; failure of space function and decline of space environment. Finally, the paper puts forward the micro-renovation strategies of public space from three aspects of optimization of spatial structure; integration of spatial function and improvement of spatial environment so as to improve the adaptability of the public space to complex and changeable social relations, which can provide a certain reference for the future micro-regeneration of urban village.

1. Introduction

Urban village is a special product in the process of urbanization in China. It means that in the process of urbanization, all or part of the original cultivated fields are expropriated, and the original villages are surrounded or included in the scope of urban development land, becoming "urban villages". Under the background of urban development shifting to both increment construction and inventory optimization, a large number of urban villages in the city restrict the development quality and construction order of the city, which need to be renovated urgently. Since the 1990s, many scholars have gradually carried out research on urban village, and obtained rich research results. Among them, the research on the public space in urban village are more concentrated on the structure and form of public space ^[1], space vitality and characteristics ^[2], and the social production of space ^[3].

Social network analysis originates from the field of sociology and is used to analyze and study social relationships between people within a group or a certain region. In recent years, scholars in the field of planning and landscape architecture have begun to conduct more and more relevant research based on social network analysis. At the community scale, there are studies on the renovation of old communities and public participation ^[4], while the social risks and safety of urban public spaces ^[5]. There are also many studies on the characteristics of urban public space and public activities in it. The research objects include historical blocks ^[6], commercial blocks ^[7], urban communities ^[8], traditional villages ^[9], urban parks ^[10] and so on. The use of social network analysis to study public space pays more attention to the relative positional relationship and connection path between space nodes, which can effectively analyze the overall characteristics and problems of the public space network in urban village, and find the matching of resources between public activity and public space, so as to make the renovated public space to meet the residents' public activities more effective.

The object of this study is Pingshan Village, which is a typical mixed urban village in Shenzhen

that locates in Nanshan District, Shenzhen, and close to Shenzhen University Town. Pingshan Village has a total land area of 13.46 hectare. (Figure 1) The research focuses on the following questions: (1) How well does the public space network of Pingshan Village match the public activity network? (2) How to improve the adaptability of public space to public activity through micro-renovation of urban village?



Figure 1 Location of Pingshan Village

2. Research methods

The social network analysis is essentially to describe and quantify the network structure. With the help of special network analysis software Ucient and Netdraw, the network structure can be analyzed and visualized more simply and clearly. The principle of social network analysis is to formally express the network structure with a graph that contains points and links between them. In practical application, it is necessary to select a suitable research carrier according to the researched object and problem, construct an appropriate semantic model, and determine the "point" and "line" elements in the model. According to the "point" and "line" determined, actual surveys, data collection, and data collation are needed to generate the network structure, and then the overall characteristics of the network are analyzed from a structural perspective.

Using the social network analysis, a "point-line" network model of public space and residents' public activities in Pingshan Village was established in this paper. By calculating the density, degree, betweenness, clustering coefficient and average path length of these two types of networks, the structural characteristics and existing problems of the network are interpreted. Then, the adaptive analysis of the public space in Pingshan Village is carried out, and the micro-renovation strategies are proposed by comparing the characteristic parameters of the two types of networks, combined with actual investigations.

3. Network analysis of public space and public activity in Pingshan Village

3.1 Network analysis of public space

Pingshan Village has an irregular square shape, the main two horizontal road and one vertical road in the village divides Pingshan Village into several areas. The three main roads have a large flow of people and there are many shops and various business activities along the roads. In the

high-density building environment, there are still many public spaces in Pingshan Village, such as Pingshan Park, the square in front of the subway entrance, the square in front of the ancestral hall, the basketball court, the corner space of the road and other open spaces between the houses. The distribution and number of each public space are shown in Figure 2.



Figure 2 Distribution of public space in Pingshan Village

In public space network, each space node is regarded as a "point" element, and the walking distance of 500 meters is taken as the standard. If there is a path that can be directly connected between two space nodes and the path distance does not exceed 500 meters, meanwhile, the path does not pass through other space nodes, then use a "line" to connect each other in the public space network. Using the software "Nerdraw", the network of public space in Pingshan Village can be shown clearly (Figure 3). Using the software "Ucient", the overall characteristic parameters of the public space network can be calculated, such as the density, degree, betweenness, clustering coefficient and average path length (Table 1). The degree of a node is the number of nodes directly connected to it in the network, and the betweenness of a node measures the times of the node on the shortest connection path of any two nodes in the network, both degree and betweenness reflect the importance of the node. The clustering coefficient is used to measure the tightness of the network, while, the average path length reflects the connectivity and accessibility between nodes, and measures the dispersion of the network. It can be seen from the calculation results that the public space network of Pingshan Village has the following characteristics:

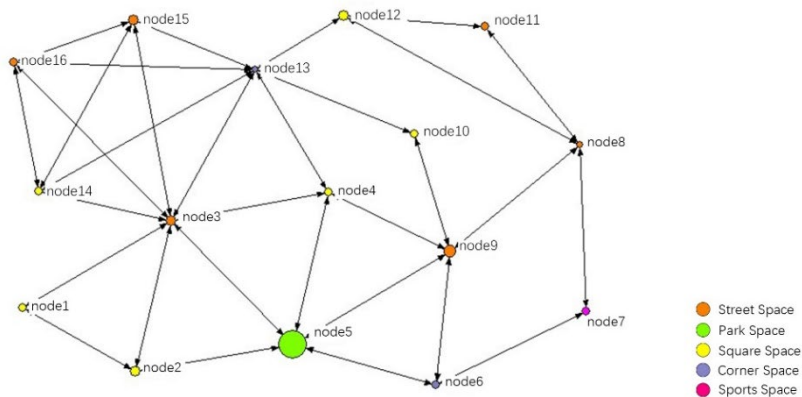


Figure 3 Public space network of Pingshan Village

Table 1:Overall characteristic parameters of public space network of Pingshan Village

Nodes	Density	Mean Degree	Mean NrmDegree	Mean Betweenness	Mean nBetweenness	Network Centralization Index	Clustering Coefficient	Average Path Length
16	0.258	3.875	25.833	8.500	8.095	21.08%	0.518	2.133

(1)From the perspective of the overall space network, the public space in Pingshan Village can be divided into three groups: the group around Pingshan Park and the ancestral hall, the group around the east entrance and the group on the north around the Fang's Ancestral Hall. The density of the space network is 0.258, which is relatively low, indicating that the nodes in the public space network are not related strongly and the space is not utilized fully also. The average path length is 2.133, which is relatively low, indicating that the accessibility of public space is good.

(2)Judging from the position of each space node in the network, nodes 3, 5, 8, 9, and 13 have higher degree and betweenness, which occupies a more critical position on the network. Although nodes 4 and 12 have low degree, they both occupy structural holes and play an important role in maintaining the stability of the space network. On the other hand, the existence of structural hole also reflects that the distribution of public space in Pingshan Village is unbalanced.

(3)Comparing the degree and betweenness of different nodes, we can find that the nodes with higher degree and betweenness are basically the same, such as nodes 3, 5, 9, 13, 8 and so on. However, comparing the degree network and betweenness network with the space network, it is found that the size of area of each space node is not completely consistent with its degree and betweenness. For the space nodes with large area, their degree and betweenness is not the largest, on the contrary, some nodes with small area but in key position will have higher degree and betweenness, especially nodes 3, 5 and 13 (Figure 4).

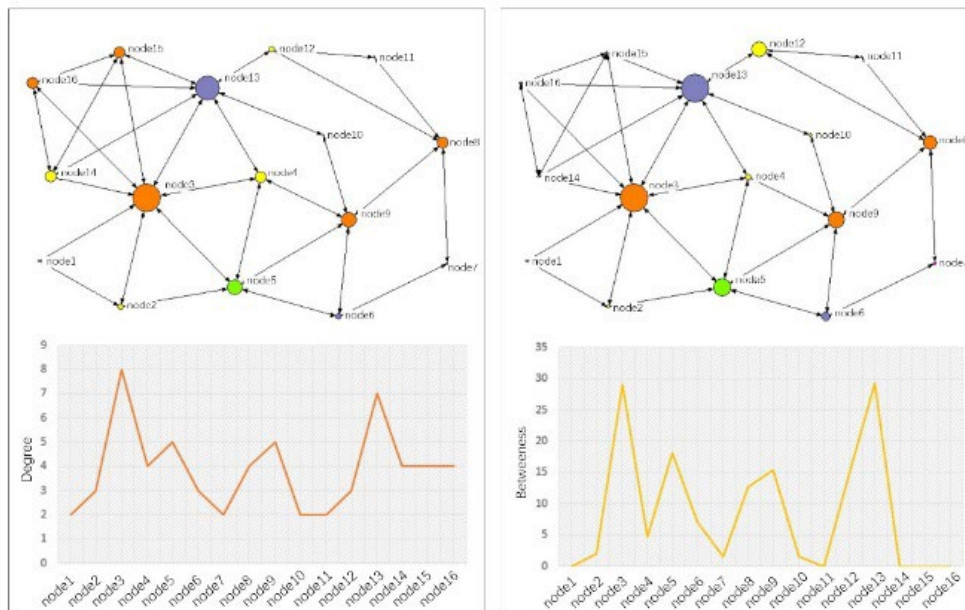


Figure 4 Graph of degree network and betweenness network of public space

3.2 Network analysis of public activity

The analysis of the activity path network is to collect the paths of residents' public activities within the scope of Pingshan Village and the space nodes where they stay or pass when taking part in these public activities. The space nodes are regarded as "point" elements, and the number of times they pass or stay is taken as the nodes' point rights; if the residents start from one space node to the next adjacent space node, then use a "line" to connect each other. By superimposing the activity paths of multiple interviewees, the network of the activity path of residents in Pingshan Village was finally drawn (Figure5).

In this study, we selected the types of public activities in Pingshan village, such as shopping,

grocery shopping, sports, fitness, recreation and so on, to track the activity path. Finally, we got 83 effective activity paths, and drew the graph of activity path network of residents (Figure 6). Using the software "Ucient", the overall characteristic parameters of the activity path network can be calculated (Table 2). It can be seen from the results that the activity path network of residents in Pingshan Village has the following characteristics:

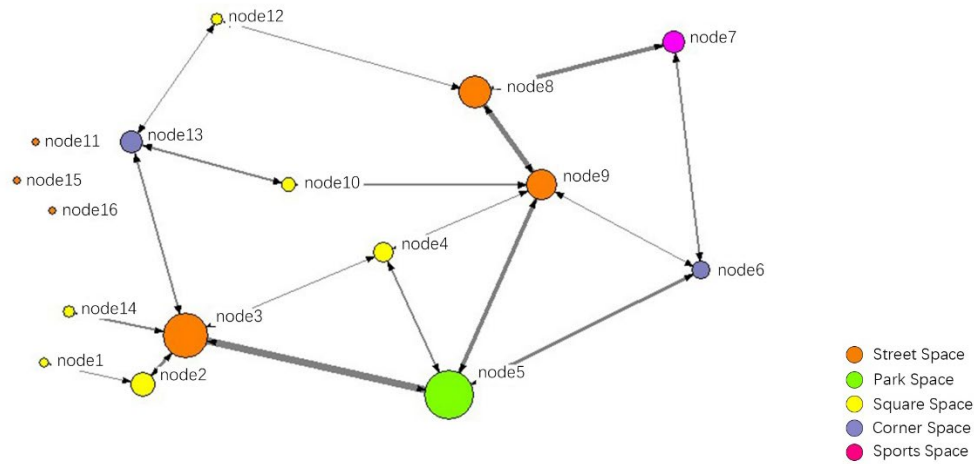


Figure 5 Activity path network of residents in Pingshan Village

Table 2: Overall characteristic parameters of the activity path network of residents of Pingshan Village

Nodes	Density	Mean Degree	Mean NrmDegree	Mean Betweenness	Mean nBetweenness	Network Centralization Index	Clustering Coefficient	Average Path Length
16	0.691	10.375	4.323	6.438	6.131	26.48%	1.133	2.231

(1) From the perspective of the overall activity path network, the density of the activity path network is 0.691, which is relatively high, indicating that the nodes in the activity path network are related strongly. The clustering coefficient of the network is 1.133, which is high, indicating that most of the residents' public activities are concentrated in a certain area. After practical investigation, it is found that the public activities of residents are mostly concentrated in the areas which around the entrances of the subway or around Pingshan Park (nodes 4, 5, 9 etc.). The average path length of the network is 2.321, which indicates that residents need to pass through 3 space nodes at least from one space to another when taking part in public activities, and the connectivity of the network needs to be improved.

(2) Judging from the size of each node in the network, nodes 5 and 3 are the space nodes that residents will pass through more often or spend more time in when taking part in public activities, node 9, node 8, and node 2 follows. These nodes are mostly located on both sides of the main three commercial street or at the corner of these street, which have a good position or have relatively complete space facilities and complex space functions.

(3) From the perspective of the density and strength of the activity paths, the path selected by residents' when taking part in public activities is relatively concentrated, which mainly along nodes 3-5-9-8-7, node 3-2, node 5-6 and node 4-5-6 /9, followed by node 13-10-9. The preference in path selection reflects that Pingshan Park and its surrounding public space are the core space group within Pingshan Village.

(4) The degree and betweenness of each node in the network are basically the same but slightly different, such as nodes 3, 5, 8, 9, 13 and so on. These nodes are mostly distributed on both sides of the path that residents need to pass through often, or these space nodes are chosen to conduct public activities more by residents, which is of great significance for maintaining the stability of the whole network (Figure 6).

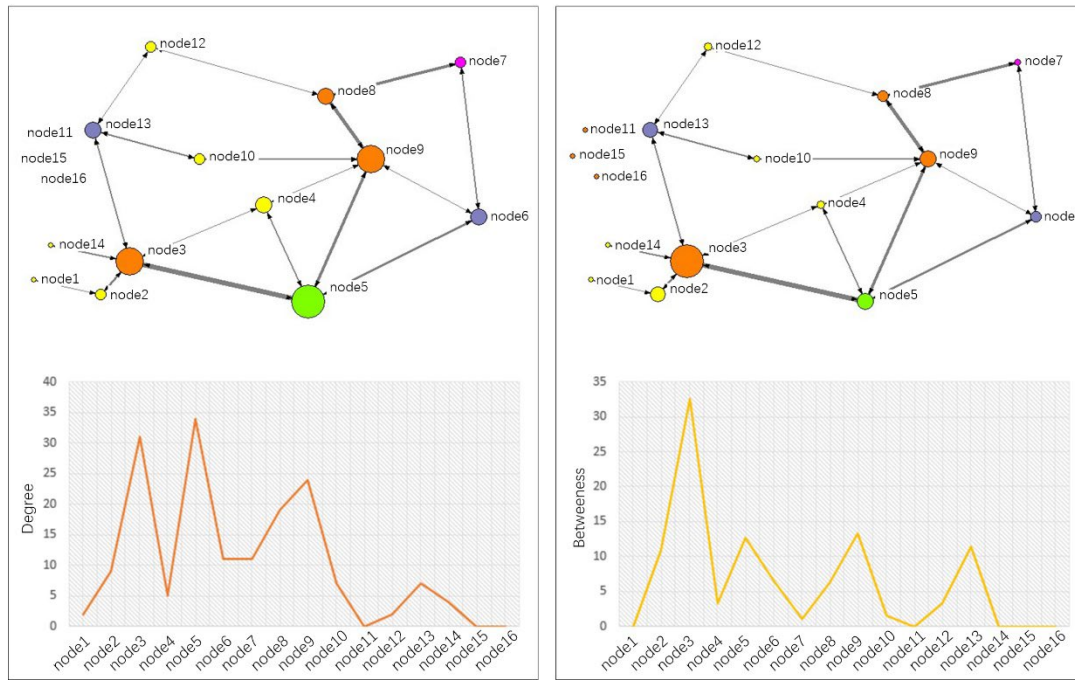


Figure 6 Graph of degree network and betweenness network of activity path

3.3 Comparative analysis of public space network and public activity network

Comparing the public space network with the activity path network of residents, it is found that there is a certain difference between them (Table 3):

Table 3: Comparison of the overall characteristics of public activity network and public space network

Types	Nodes	Connectivity	Equilibrium					Relevance	
			Mean Degree	Mean NrmDegree	Mean Betweenness	Mean Nbetweenness	Network Centralization Index	Clustering Coefficient	Average Path Length
public activity network	16	0.691	10.375	4.323	6.438	6.131	26.48%	1.133	2.231
public space network	16	0.258	3.875	25.833	8.500	8.095	21.08%	0.518	2.133

(1) Comparison of connectivity: The density of the public space network is 0.258, and the density of the public activity network is 0.691, which is relatively higher, indicating that the residents' public activities is relatively concentrated in a certain area, but it also leads to insufficient utilization of public space.

(2) Comparison of equilibrium; The network centralization Index of activity path network and public space network are relatively low, indicating that these two types of networks have low centripetality. The actual investigation found that the space group around Pingshan Park and the ancestral hall has obvious effect on behavior aggregation and resource integration. The reason for the lower network centralization Index of the two is mainly due to the unbalanced distribution of the public space in Pingshan Village, while the residents' public activities are relatively concentrated in a few spaces.

(3) Comparison of relevance: The clustering coefficient of the activity path network is higher than public space network, indicating that most of the residents' public activities are concentrated in a certain area. The average path length of the public activity network is relatively higher, reflecting that when residents participate in public activities, factors such as the accessibility of space do not have an absolute impact, and various social factors such as whether there are acquaintances will also affect residents' choice of space nodes.

Comparing the degree and betweenness of each node in the two types of networks, it is found

that there is a difference between them (Figure 7):

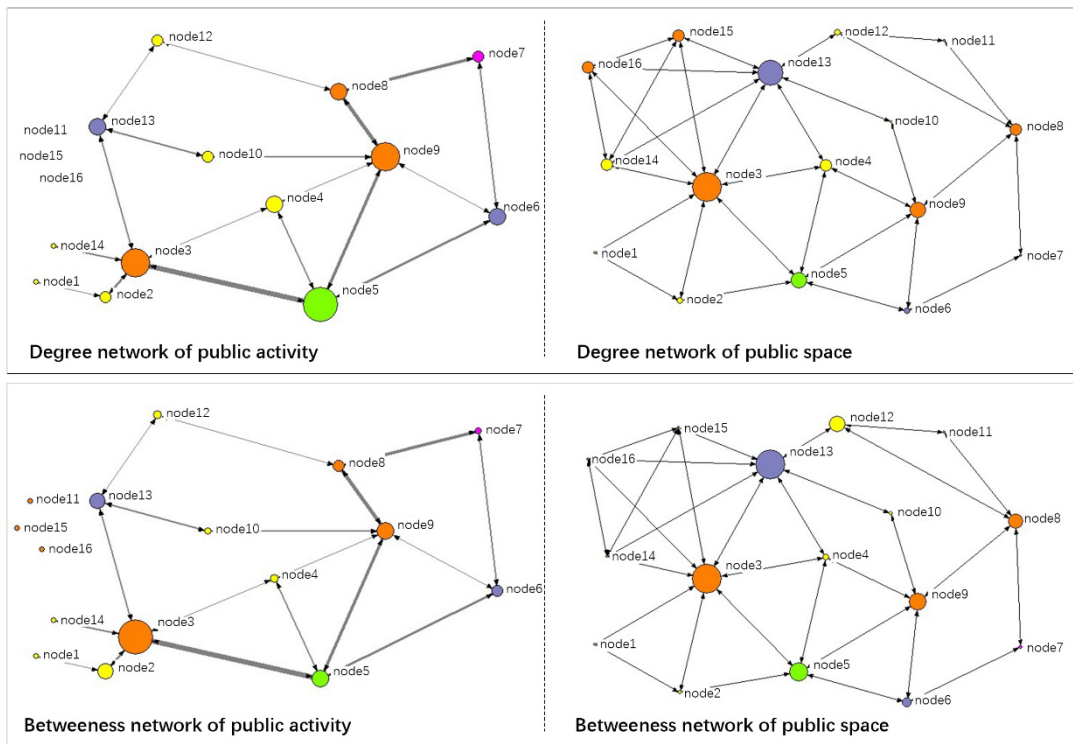


Figure 7 Comparison of public space network and public activity network

(1) Comparative analysis of degree: The nodes with higher degree in activity network such as nodes 6, 7 have lower degree in public space network. However, these two nodes are close to the space group around Pingshan Park and the ancestral hall where the activities of residents are concentrated. On the other hand, these two nodes are closely related to residents' activities, therefore, they both have a high degree in activity network. Nodes 3, 5, 8, 9 and so on have relatively high degree in the two networks and are in a more critical position in the network.

(2) Comparative analysis of betweenness: Nodes 3, 5, 8, 9 and so on have higher betweenness in both types of networks. It shows that these nodes are more critical in the public space network of Pingshan Village, and are also the space nodes that residents will pass or stay with higher frequency when they participate in public activities. However, the point weights of these space nodes in the activity aggregation network are quite different. It shows that the quality of the space environment, whether the space facilities are perfect will have an impact on the residents' public activities also.

4. The micro- regeneration strategy of public space in Pingshan Village

Through the comparative analysis of public activity network and public space network of Pingshan Village, the following problems are found in the public space: First, the distribution of public space in Pingshan Village is unbalanced, the space nodes in the northwest area of the village are relatively dense, the public activities are more concentrated, while in other areas the space nodes are relatively sparse. Secondly, Pingshan Village has been built for a long time, its built environment is gradually declining, such as road damage, garbage dumping, public space desolation, and damage to public activity facilities. The low quality of public space greatly limits the polarity of public activities of residents. In response to the above problems, the micro- regeneration strategies of public space need to be carried out from three aspects: structural optimization, functional integration and environmental improvement

4.1 Structural optimization of public space

The structural optimization of public space includes increasing the node density and enhancing the hierarchy and complementarity between nodes. The hierarchical division of public space is

based on the location of each node in the overall network, the size of the space, the public activities in the space, and the types of function carried. The public space is divided into central space nodes, secondary space nodes and general space nodes so as to meet the needs of activities with different intimacy and intensity. By dividing the hierarchy of public space, it can provide the basis for the functional integration of public space later.

4.2 Functional integration of public space

There are many types of public space in Pingshan Village, but the functions of the public space are often simpler, with less consideration of the complementarity and compoundness of each space function. By releasing idle space function, integrating superior space function and inserting new space function, the efficiency of public space, compatibility of activities and complexity of functions are improved to better adapt to the characteristics of residents' public activities.

4.3 Environmental improvement of Public space

On the basis of improving the overall space environment of the village, the environmental improvement of public space in Pingshan Village focuses on beautifying and improving public activity facilities of the existing important nodes, such as nodes 3, 5, 9, 12; it also involves the reuse of abandoned lands at some key positions in the network, such as nodes 17, 18. Through the improvement of infrastructure, the goal of improving the overall space environment and the quality of life of residents in Pingshan Village is achieved, and the residents' sense of community identification is enhanced.

5. Conclusion

The paper takes public space in Pingshan Village as the research object and intervenes in the regeneration of public space in urban village from the perspective of social network, which provides a new theoretical perspective and research method for the study of public space in urban village. Based on social network analysis, the public space network and residents' public activity network are established in this paper. The connectivity, equilibrium and relevance of the above two networks are calculated and evaluated also. The results suggest that the public space in Pingshan Village mainly has problems in three aspects: lack of space level; failure of space function and decline of space environment. Based on the analysis results above, the paper puts forward the micro-renovation strategies of public space from three aspects: optimization of spatial structure; integration of spatial function and improvement of spatial environment, which can provide some reference for the future renovation of urban village in China.

The next step is to conduct a comparative analysis of the public space before and after the micro-regeneration through social network analysis to further verify whether the micro-renovation strategies proposed in this article is effective in promoting the good development of the social network of residents in Pingshan Village.

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