Public Space Humanized Transformation of Community Based on Depthmap

Jiaqi Hu, Jinhong Zhuang, Zhengyang Li and Luke He*

School of University of South China, Hengyang, China

*Corresponding author e-mail: hujiqiqi@nhdhjzyhs.onexmail

Abstract. With the rapid development of urban modernization in China, residents are paying more and more attention to the quality of outdoor public space. Aiming at insufficient aspects of modern community public space design, this paper investigates mingshihuafu community in Hengyang City by means of questionnaire and field interview and summarizes the relevant factors that affect human activities. From the perspective of spatial fabric, this paper will use the space syntax software Depthmap to analysis the humanization demand of the community public space quantitatively and put forward the humanized transformation design strategy of modern community public space, hpping to enhance the vitality of modern community, improve the living environment, and provide reference of the transformation design for the existing community public space in China.

Keywords: Depthmap Software, Space Syntax, Public Space, Humanized Design, Community Transformation

1. Introduction
In the process of the overall development of Human Settlements Construction, Residents pay more and more attention to the construction of community public space. People's requirements for public space are no longer limited to "survival needs", but expect that the community can provide a humanized living place [1-4]. However, the design of a large number of modern communities are not the humanized design, such as single form of public space, road design oriented by motorized traffic, excessive green space, and service facilities unuseful [5]. Therefore, the transformation of modern community public space with human orientation is very important to the construction of human settlement environment.

The application and research of spatial syntax has mostly been on a large scale and the analysis of the spatial morphology of the city level. There is less analysis of the spatial morphology of blocks with smaller scales. This paper choose a typical case named Mingshihuafu community as the object of study to develop the Hengyang modern community field research. Based on the perspective of space syntax theory and with the help of DepthMap software simulative calculation, this paper makes quantitative analysis and research on the public space in modern communities. According to the residents' physiological and psychological characteristics and combined with the investigation results
of the actual use of public space by community residents, the humanized transformation design method and strategy of modern community public space are put forward.

2. Case Analysis

2.1 Community Profile
Mingshihuafu, a typical modern residential district model, belongs to a multi-group determinant community. An east-west greening group divides the community into North and South parts. The south part of the building faces the urban highway and is arranged in an east-west direction, with pedestrian entrances into the central green square; the north part of the building is in an "L" shape, with entrances in the northeast and west. Its interior contains five groups of green space, which are numbered A–E for distinguishing, as shown in Figure 1.

![Figure 1. Community scene condition](image)

2.2 Quantitative Analysis of the Humanized Demand of Community Public Space
Taking the community map as the base map, the spatial structure axis map is drawn in CAD, and the axis model is established by importing it into Depthmap [6]. Mean Depth, Integration HH, Connectivity value and Choice are selected to quantitatively describe the humanized demand of community public space.

2.2.1 Mean Depth. Mean depth is the convenience of the node in the spatial system. The lower mean depth is, the easier the public space between adjacent residential buildings is to reach [7]. Depthmap analysis shows that the mean depth of axis 6 and 10 connecting the North and South parts of the community is the lowest, and it is the most convenient for people to reach the B and C areas. The central square and the main supporting landscape and service facilities are set around the two axes, making it an area where people are willing to gather. However, mean depth in the group is relatively high, the local and overall relevance is very low, and the degree of convenience is not very high, the public space in area D is mainly a large pool without water all the year round, and the path connecting the activity space is single, so the space attraction is low, while the average mean depth of the axis in area C is relatively low, because the path of the apartment building is ample and not complicated, the residents reach the C area with convenient public space and high frequency of use.
2.2.2 Integration HH. Integration indicates the degree of integration and segregation between a certain space and other spaces. As the integration degree is higher, the space accessibility will be higher and the flow of people will be easier to concentrate [8]. Among them, axis 4, 5, 6, 10, 11 are highly integrated and easy to gather people. The entrance square is one of the places with the highest flow of people in the community. However, due to the large area occupied by vegetation and sculptures, the activity space can not meet the needs of crowds. The important street space axes 4 and 5 connecting the east and west entrances of the community are highly active, but the problem of mixed traffic between people and vehicles at axis 4 is serious, and there are potential traffic safety hazards. The low integration of axis 1, 2 and 7 leads to the low accessibility of space and the inability to form natural monitoring, which makes the residents have a relatively low sense of security and less activities.

2.2.3 Connectivity. Connectivity is the number of spaces in the system where a space intersects. As the connectivity is higher, the direction of people flow in the space will be more, and the connection with other spaces will be closer. Axis 2, 6, 7, 8 and 9 have the highest connectivity, and the corresponding space has the potential to become a central activity space. Among them, the public space in group A connected by axis 8 is occupied by tall trees, with few rest seats and multiple public trash cans, resulting in poor restability and low participation of residents. While the roads connected by axis 2 and 7 are close to the border wall of the community and connected to the remote space at the end, with high connectivity, which is prone to crime escape.

2.2.4 Choice. Choice is a measure of the potential of an element to attract crossing traffic. The warmer the color of the axis is, the more likely the space corresponding to the axis is to be crossed by pedestrians. The selection diagram of Mingshihuafu residential area is generally cold, and part of it is warm, which indicates that the spatial structure of the residential area is not mobile, the interior of the group is relatively closed, and the communication of residents is relatively weak, as shown in Figure 2.

![Figure 2. Analysis based on Axis Map](image-url)
3. Renovation Design

3.1 For A High Degree of Integration of the Region, Consideration Should Be Given To the Convenience of Space in Different Populations

Depthmap's analysis shows that the entrance plazas of "Famous Washington" are highly integrated, have the potential to attract people and their activities, and attract more people to the area. Through field investigation to learn that the entrance to the brink of urban main road, where there are plenty of people; the entrance space through a combination of multi-step steps combined with the falling water landscape, guiding people to the entrance square; which is the only one that allows people to pass through but not allowed cars into the neighborhood, through interviews to know that most residents here have a greater sense of security, but due to the lack of barrier-free ramps at the main entrance, for the elderly with poor legs and strollers residents have great inconvenience [9]. Therefore, barrier-free ramps should be added here to meet additional high degree of integration of regional accessibility.

3.2 Avoid Large but Impractical Landscape Space Design

The theme of community landscape design is that of the natural environment should be integrated into the activities of the residents in space, but not only to satisfy the green rate and make it exist independently from the subject of public spaces. Therefore, to abandon the practice of landscape design is greater than the content, while ensuring the enjoyment but also to take into account the participation of the residents.

Data analysis from depthmap software shows that the integration of inter-group venues is low and does not stimulate the potential for public space. Therefore, take a treatment to interrupt the large but impractical landscape space between the groups, set up the path, public facilities and so on that contacting two buildings in the middle to form a clear division of space, so that residents can participate in activities and exchanges.

3.3 Public Service Facilities are Arranged in a Highly Integrated Space

The public supporting service facilities such as fitness equipment, rest seats, etc. placed in the remaining corner space after being divided by the building, it seems to make full use of the site resources, but has failed to meet the psychological needs of users, most of the facilities in the negative space is nobody interested in and unattended. Service facilities should be located in a high degree of spatial integration, large traffic space, with a high utilization rate, in addition, public supporting service facilities should not be near the layout of the road, as vehicles will rise dust on the ground, bring entertainment to the residents discomfort.

3.4 Improve the Phenomenon of Mixed Traffic by the Way of "One Entrance, Two Doors"

Accessed through the research was informed that the " noble Washington " east of the community, private cars squeeze the community road is an increasingly serious problem, and traffic conflicts occur frequently, which causes inconvenience to the Pacers. In addition, it is a great security risk that private cars often occupy fire lane parking. The depthmap data analysis shows that the highest integration roads in eastern district and the entrance of underground garage distribute together, which makes sense to pedestrians, vehicles crossing the major roads are intertwined, conjectured as a result of underground garage layout unreasonable traffic chaos phenomenon. Therefore, to increase the entrance to the underground car garage south of the entrance to the community, and then add a new gate in order to meet the demand for vehicles turning, the two doors need to leave a certain distance between the two doors as a human vehicle diversion buffer zone, in the buffer zone vehicles into the underground garage, while residents through the second door into the residential area, which can achieve the diversion of people, to create a "ground car-free zone."

3.5 Additional Monitoring and Lighting Systems in the Low Degree of Integration and Connection of High Value Space
Crime incidents tend to occur in low integration, high connectivity corner space with low flow, and because of the intersection of the road, the murderer easily fled the scene after the crime, hence the need to strengthen the monitoring and control facilities within this space and night lighting system, and efforts to increase security patrols in the community, as shown in Figure 3. [10]

![Figure 3. Scheme of community public space transformation](image)

### 4. Conclusion
In the context of space syntax, this paper makes a quantitative analysis of the community public space through the Axial Map data in the DepthMap software and the results of field survey and interview, putting forward reconstruction suggestions from five aspects, “the accessibility of entrance”, “the Participatory of landscape space”, “the rest of entertainment space”, “the order of traffic space”, and “the Security of corner space”. It hopes to put forward human-oriented design strategies for the transformation of urban community public space in China, accumulating the experience of exploring humanized design mode of public space in Chinese urban communities.

### Acknowledgments
This work was financially supported by 2019 Hunan University Student Research Learning and Innovative Experimental Program National Projec fund.

### References
[1] Alongduo Qi, Ma Hang, Yang Biao. Research progress of public space vitality in China since 2000. Modern city research, 2020 (10): 123-130(in Chinese)
[2] Ye Y, Li D, Liu X. How block density and typology affect urban vitality: An exploratory analysis in Shenzhen, China. Urban Geography, 2018, 39(4): 631-652.
[3] Ye Yu, Zhang Zhaoxi, Zhang Xiaohu, Zeng Wei. Quality measurement of street space on human scale: a large-scale and high-precision evaluation framework based on street view data and new analysis technology. International urban planning, 2019,34 (01): 18-2(in Chinese)
[4] Lu Fei, Yang Jing, Dai Jian. The way of regeneration of external environment for health promotion -- Thinking on the transformation of external environment of old urban residential areas. Urban development research, 2018,25 (04): 141-146(in Chinese)
[5] Shu Ping, Zhang Ran, Wang Lijun. Research on spontaneous participation of "social centripetal space" in existing residential areas. Journal of architecture, 2020 (02): 50-55(in Chinese)
[6] Luhui Qi, Weiliang Liang, Mingbo Xi. The Public Space Pattern research of Guangfu Traditional Villages Based on Spatial Syntax: A Case Study of Huangpu Village in Guangzhou City, China. 2019, 267(6)
[7] Shaoyao He, Lu Na, Zhuo Gong, and Chengjun Tang. Research on the opening strategy of residential public space based on space syntax -- a case study of three residential areas in Changsha. Urban Development Studies,2018,25(01):63-69+96(in Chinese)
[8] Gao Hui, Yang Shan, Wang Yujuan, Yang runlin. Road network structure and spatial perception of block system and community system based on Spatial Syntax: a case study of Xianlin area in Nanjing. Resources and environment of Yangtze River Basin, 2018,27 (04): 745-755(in Chinese)
[9] Zhang Luo, Zhang Shuo. Research on micro renewal strategy of entrance space based on space syntax and pspl: a case study of Hanyang rose block in Wuhan. Huazhong architecture, 2020, 38 (08): 75-79 (in Chinese)

[10] Qiang Jingqi, Du Yaxing, Chen Zhengying. Residential street space planning and design and crime prevention and control based on CPTED theory and Space Syntax: a case study of wahutong district and Yanming District in Xi’an. Intelligent building and smart city, 2020 (09): 97-100 (in Chinese)