IEEE Access
Multidisciplinary ⋮ Rapid Review ⋮ Open Access Journal

Received 6 June 2023, accepted 12 July 2023, date of publication 20 July 2023, date of current version 7 August 2023.

Digital Object Identifier 10.1109/ACCESS.2023.3297507

RESEARCH ARTICLE

Analysis of Public Space in Historic Districts Based on Community Governance and Neural Networks

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This work was supported in part by the National Key Research and Development Program of China under Grant 2020YFB1807500 and Grant 2022YFC3803503; in part by the National Natural Science Foundation of China under Grant 62072360, Grant 62001357, Grant 62172438, Grant 61901367, Grant 52078404, and Grant 52008327; in part by the Key Research and Development Plan of Shaanxi Province under Grant 2021ZDLGY02-09, Grant 2023-GHZD-44, and Grant 2023-ZDLGY-54; in part by the Shaanxi Provincial Philosophy and Social Science Foundation Project under Grant 2018K29; in part by the Natural Science Foundation of Guangdong Province of China under Grant 2022A1515010988; in part by the Key Project on Artificial Intelligence of Xi'an Science and Technology Plan under Grant 2022JH-RGZN-0003 and Grant 2022JH-RGZN-0103022JH-CLCJ-0053; in part by the Xi'an Science and Technology Plan under Grant 20RGZN0005; and in part by the Xi'an Key Laboratory of Mobile Edge Computing and Security under Grant 201805052-ZD3CG36.

ABSTRACT Based on the perspective of community governance, this paper explores the research path of public space renewal in historic city districts. Taking the historical public space of Lhasa city as an example, this paper analyzes the causes of the characteristics of public space, analyzes the logical relationship between public space and urban renewal and community governance, applies the neural network evaluation model. Firstly employed cell rasterization, indicator classification, and population density estimation to calculate the score for each indicator. And then the principal component extracted by principal component analysis is used as the input node of the neural networkit determines the weight of each indicator by adopting the entropy method, based on which it built a multi-dimensional indicator system to evaluate public space satisfaction of historic District of Lhasa and finally, optimizes the pattern of historical public space of Lhasa city by improving the spatial structure. In conclusion, this study underscores the importance of public space renewal in historic districts for human-oriented development, community governance, and overall urban renewal implementation. By optimizing the life modes in historical blocks, we can achieve a harmonious and sustainable living environment for residents, benefiting both individuals and society as a whole.

INDEX TERMS Community governance, Lhasa, public space, the historic districts.

I. INTRODUCTION

At this stage, China's economy has shifted from a stage of high-speed growth to a stage of high-quality development, involving advanced social theory [1], modern IC (information and communication) technology [2], leading 5G mobile communication infrastructure [3], booming AI evolution [4], etc. The development and changes of China's main social contradiction at this stage have highlighted new characteristics of China's urbanization, making it clear that we face new tasks, including driving force transformation, mode transformation, and structural adjustment [5]. In the past, one-sided radical construction methods were often adopted in single projects and individual interests, but these methods can hardly meet the needs of the new era [6]. In 2021, it was clearly pointed out in the 14th Five-Year Plan for National Economic and Social Development of the People's Republic of China and the Outline of the 2035 Vision Goal that the aim is to implement urban renewal actions and improve the quality of urbanization development. In the future, urban construction will enter an

The associate editor coordinating the review of this manuscript and approving it for publication was Sunil Karamchandani.

era of refined operation from past extensive development. Therefore, the renewal of the old urban districts of Lhasa focuses on individuals' yearning for a better life under the background of stock, which has been the consensus of the times for urban planning and development [7].

Due to their high altitude and harsh environment, cities in Tibet were opened late, and the traditional urban spatial forms have been preserved relatively intact. The historical districts of Lhasa have also been well preserved. In part due to its presentation of history and culture, the city is an example of the unique charm of traditional Tibetan cities. Camillo Sitte once said, ''The characteristics of a city are mainly reflected in the public space widely enjoyed by citizens''; thus, the importance of urban public space involving public services such as public transportation [8], [9], public health [10], and public community [11] to the city can be imagined.

For local residents, the Barkhor historical district is not only a cultural heritage site but also a long-term home for the community. It forms a multidimensional bond, encompassing material, social, functional, and symbolic aspects, between residents and the local environment. The public space within the district holds both asset value and use value, serving as an emotional and practical space that intertwines material and immaterial needs. These aspects collectively influence the understanding and value choices of community residents regarding historical heritage.Therefore, from the perspective of community governance and utilizing neural networks, it is imperative to reevaluate the public space value of Lhasa's Barkhor Historic District. This entails organically integrating heritage preservation with block space development and achieving the simultaneous improvement of the material and spiritual environment of the city and surrounding communities. This task is crucial in fostering cultural confidence in the new era.

II. QUESTIONS IN FOCUS

The public space in historic districts, as the basic urban space unit, was not only a place where residents lived their daily life but also a flexible space in which they dealt with emergencies. People have increasingly realized the diversity and inclusiveness of basic public spaces, as well as their important value in responding to crises and improving urban tenacity, especially during the national campaign against COVID-19 [12]. As the comprehensive value of the renewal planning of public space in the historic districts was not fully recognized in the past, certain gaps existed between the implementation level and the planning vision. The practical needs of residents' daily lives were often ignored, and simplified renewal work was pushed forward slowly; thus, the residents were not satisfied with the renewal results. As public spaces lack vitality and self-renewability in the historic districts, it is difficult to form a good and sustainable development model. Therefore, the future renewal of historic districts aims at the following aspects: to correctly understand the organic connections between public space renewal, community governance and urban renewal in the stage of high-quality development in China's historic districts of historic cities, to respond to current student demands and to actively build vigorous and healthy public spaces in historic districts. It is also an inevitable requirement to promote the high-quality development of the city [13], [14].

Influenced by natural climate, historical and cultural background, religion, and folk customs, the public spaces in the historic districts of Lhasa demonstrate a unique spatial format with distinct regional characteristics and strong ethnic characteristics based on historical accumulation [15]. However, in reality, it is difficult to balance and coordinate public space renewal in the historic districts of Lhasa. Because of the contradictions between regionalism, national characteristics, and urban renewal, public spaces are declining in the historic districts of Lhasa [16].

Modern urban planning streets and alleys are relatively simple in their spacelacking in changes and charm, especially during walking outingsand the surrounding landscape is relatively simple, which easily makes people feel tired. Due to the relatively regular building layout, there are many crossroads and T-junctions, which easily cause traffic jams [17], [18], [19]. The streets and alleys in the old city were generally formed at different time stages. There has been no mandatory intervention in the formation process; thus, the development is more in line with the laws of nature.

Studies on the existing Barkhor historic district space tend to ignore the participation of the community, and focus on the traditional material environment within the location or region, namely the well-preserved and typical historical features such as street pattern, river system and architectural style. Therefore, in the process of urban construction, it is easy to cause a sense of alienation between cultural heritage and surrounding communities. Because of its special resource characteristics and spatial distribution characteristics, communities in historic districts are more vulnerable to the adverse effects of urban renewal. The weakening of community attribute and social value leads to the absence of emotional support and community connection in historic districts and historic districts, which leads to the dissociation from community life and reduces the value utilization level of historic districts. We should analyze the advantages and disadvantages and summarize a new model that is more suitable for the region.

A. MODEL CONSTRUCTION AND EMPIRICAL ANALYSIS

The study of the degree of community fullness began in 1960. As of today, community satisfaction has gradually become a mature social evaluation index. The measurement method of community full meaning mainly includes single index measurement method and multi-dimensional measurement method [20]. Fried divides community satisfaction into four dimensions, including environmental satisfaction, public resources and services satisfaction, interpersonal satisfaction, and administrative (management) satisfaction [21]. Research on community satisfaction within a country is weak. Some scholars have conducted empirical studies on community

TABLE 1. Indicators for cross-analysis with community satisfaction.

type	variable	index	Problem Description
resident	space quality	Reasonable design	Reasonable planning and design of public space in Barkhor block
		Complete facilities	Barkhor block public space supporting facilities are complete
		build quality	The building quality of public spaces in the neighborhood is excellent
		Manage service levels	The management and maintenance level of the public space in the neighborhood is good
	Perceived safety	The road is clear	Convenient access to nearby public spaces in real life
		Plenty of entrances and exits	Adequate number of entrances and exits to public spaces near the residence
		Plenty emergency fire protection	The firefighting facilities in the public space in the neighborhood are complete
		Sufficient emergency broadcast	Adequate emergency broadcast facilities in public spaces on the block
		Parking convenience	Parking in the Barkhor area is more convenient
	community engagement	Frequency of religious activities	frequent religious activities
		Reduce frequency of use	Express dissatisfaction by reducing the frequency of use of public spaces
		refuse to participate in the event	Expressing dissatisfaction by refusing to participate in activities in the public spaces of the Barkhor neighborhood
		active participation	Actively participate in the activities of the community public space in Barkhor District
	community image	community belonging	Feeling nostalgic if you move out of the community
		space attraction	The public space in the neighborhood is spatially attractive
		level of trust in public services	Public spaces serve residents with more trust
		Complaint flow	The channels for the community to accept residents' complaints and supervision about public spaces are unblocked
		Degree of response to comments	The community responds promptly to residents' comments or suggestions about the public space

satisfaction in Beijing, Shanghai [22], Shenzhen [23], Tianjin [24], Qingdao, Dalian and other cities. However, to sum up, there are some studies on the study of the Angle of view and the boundary of the area: (1) In terms of visual Angle of the research, social science leaders mostly chose non-spatial index as the shadow factor analysis of the full significance of the community, and evaluated the result that it was difficult to direct the finger to guide the establishment of the community. (2) From the perspective of research scope, the existing research generally focuses on specific types of communities (such as small property houses, demolition and resettlement housing communities, large commercial housing communities, urban villages, etc.) or special groups of people. Lack of a comprehensive analysis of the historic district residents' overall community satisfaction.

Based on the characteristics of Lhasa Barkhor Historic District, 18 items in the 4 dimensions of space quality, perceived safety, space participation, and space image were selected as evaluation indicators. Then, an evaluation index system of public space service quality in Lhasa Barkhor Historic District was constructed. The main indicators are listed in Table 1 and the location of the common space is shown in Figure 6.

1) DATA COLLECTION

For this paper, a questionnaire on the quality of public space services in the Barkhor Historic District in Lhasa was designed based on the index system constructed above; then, 15 community residents in 3 administrative districts (subdistrict offices) within the Barkhor Historic District in Lhasa were selected as the research objects. The questionnaire was distributed to residents of 15 communities in the historic district of Lhasa Ancient City.As the historic district consists of 15 communities,approximately 50 copies of the questionnaire were distributed to each community. This approach ensured representation from a diverse range of residents within the historic district. The distribution of the questionnaires was conducted through a systematic approach. We collaborated with community leaders and local authorities to facilitate the distribution process. The questionnaires were handed out during community gatherings and events, ensuring that residents had the opportunity to participate. Additionally, we engaged community volunteers who assisted in distributing and collecting the questionnaires, ensuring a fair and representative sample.This questionnaire used the Likert scale method to divide residents' perceived public space service quality into five levels, namely, ''very dissatisfied'', ''not very satisfied'', ''average'', ''relatively satisfied'', and ''very satisfied'', with corresponding scores for each level of 1, 2, 3, 4, and 5, respectively. A total of 500 questionnaires were distributed, and 470 valid questionnaires were returned. The number of valid questionnaires was tested for reliability, and the value of the Cronbach's alpha coefficient was 0.909. The overall reliability of the questionnaire was relatively high; thus, further research and analysis can be carried out on this basis.

2) ESTABLISHMENT OF THE NEURAL NETWORK EVALUATION MODEL

In the era of big data, the use of artificial neural network methods to construct a comprehensive evaluation model for evaluation research has also become the focus of scholars. For example, Gao Ruihua and Qi Huimin built a BP neural network evaluation model and identified and evaluated the components of innovation capability in high-tech zones, namely, investment capability, technology incubation capability, organizational management capability, and innovation output capability [25]. Zheng Yuwen, Xue Weixian, etc., made a comprehensive evaluation of the production efficiency and R & D efficiency of China's high-tech zones based on the SBM dynamic network mode [26]. The FNN evaluation model is the core of heating potential. Its design

idea is to express fuzzy rules and membership functions by a neural network [27], and the generated neural network is used to realize fuzzy reasoning. It is an interactive evaluation method that can continuously modify the weights of indicators according to the user's desired output until the user is satisfied [28]. Therefore, in general, the results obtained by the artificial neural network evaluation method will be more in line with the actual situation [29], [30].

It is necessary to consider many aspects such as ecology, society and economy to evaluate the satisfaction of residents in historic districts. In the face of multiple factors, it is difficult for traditional methods to make a comprehensive evaluation on the influence of all factors. With the development of big data, Internet of Things, cloud computing and other related technologies, artificial neural network has been widely used in urban planning and construction. With its powerful nonlinear mapping ability, it can approach any nonlinear continuous function infinitely under any determined accuracy, so it can synthesize all indicators to make systematic and comprehensive evaluation.

3) DETERMINATION OF THE INDEX WEIGHT OF THE HEATING POTENTIAL

Because the indices of heating potential are both primary and secondary, and they play different roles in the evaluation of heating potential, the weights of each green principle index are different; thus, it is necessary to find a suitable method to determine the weights. It is more suitable to calculate the index weight of the heating potential using the sequential relationship analysis method.

According to the classification of the indicators of the first pressure layer, status layer, and response layer, the hierarchical structure is established, as shown in Figure 1:

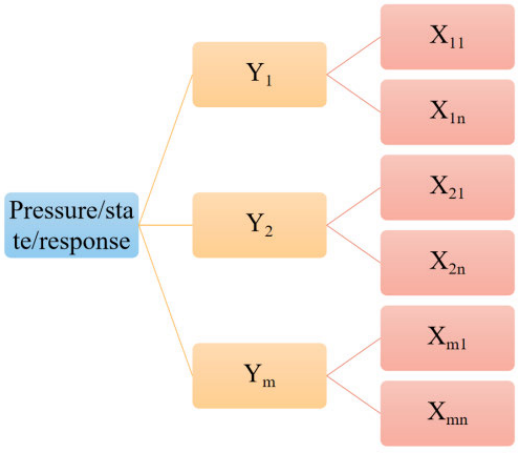

FIGURE 1. Structural hierarchy of relational analysis method.

Assuming that the element $x_{i1}, x_{i2}, \ldots, x_{in}$ of the next layer is related to the target element Y_i of the previous layer, it is necessary to determine their proportion in Y_i.

According to the scores of each index, in the index set $\{x_{i1}, x_{i2}, \ldots, x_{in}\}$, the index with the highest score under the target Y_i is selected as x_{i1}^*; then, from among the remaining $n-1$ indices, the index with the highest score under the target Y_i is selected as x_{i1}^* after $n-1$ selections, and the unique order relationship is as follows:

$$x_{i1}^* > x_{i2}^* \ldots > x_{in}^* \tag{1}$$

Then, the comparative judgment of the relative importance degree between the indices is given. Under the target Y_i, the ratio $\frac{w_{i,k-1}}{w_{i,k}} = r_{ik}, k = n, n-1, \ldots 3, 2$ of the importance degree of the index element $x_{i,k-1}, x_{ik}$ when n is larger, namely, $r_{in} = 1$, can be determined from Formula (1).

If the rational assignment of r_{ik} is obtained that satisfies the relation $\frac{r_{i,k-1}>1}{r_{ik}} k = n, n-1, \ldots, 3, 2,$, then we have the following:

$$w_{in} = (1 + \sum_{k=2}^{n} \prod_{i=k}^{n} r_{ij})^{-1} \tag{2}$$

Then, in $\frac{w_{i,k-1}}{w_{ik}} k = n, n-1, \ldots, 3, 2,$, one-to-one correspondence is made between the calculated results and the healthy ecological greening indices of each highway, and the weights of the target layers corresponding to each index are obtained.

4) DETERMINATION OF MEMBERSHIP FUNCTION

Through the pretreatment of input knowledge and the post-processing of the output structure, the FNN can dissolve fuzzy concepts into the expression of knowledge input [31]. Commonly used function forms include normal distribution, rectangular distribution, trapezoidal distribution, triangular distribution, and S distribution. Of course, the selected distribution function should conform to the essential characteristics of fuzzy sets as much as possible. We can choose the distribution function as the membership function according to the actual situation of the problem. In this paper, the Gaussian function is selected as the membership function.By selecting the Gaussian function as the membership function, a more accurate description of the relationship between the questionnaire indicators and satisfaction of residents in the historical urban area of Lhasa can be achieved. This helps planners to analyze the degree of influence of indicator values on satisfaction and determine which indicators are of importance to residents' satisfaction. Based on these analytical results, planners can formulate corresponding urban planning and community development strategies, optimize the community environment, and enhance residents' satisfaction and quality of life.And its definition is as follows:

$$\mu(x) = \exp(-(\frac{x-a}{(\sigma)^2})^2) \tag{3}$$

5) REASONING CALCULATION PROCESS OF THE NEURAL NETWORK MODEL

First, the experimental samples are input to the input layer; that is, the first layer is $x = (x_1, x_2, \ldots x_n)^T$, where x_i represents the value of i, the input parameter. In this paper,

the length, width and depth of the crack are taken as input parameters; thus, the node is $N_1 = 3$.

In the second fuzzy layer, each node x_i of the first layer corresponds to i, the group of nodes of the second layer; furthermore, each group of nodes represents the corresponding relative membership degree, and the membership function is calculated by the Gaussian function:

$$\mu_{A_i^k} = \exp(-(\frac{x_i - a_i^k}{\sigma_i^k})^2) \tag{4}$$

α_i^k, σ_i^k represents the center and width of the membership function, respectively, and the number of nodes in the second layer is 10 nodes.

The third layer is the rule layer, in which each node represents a rule, which is used to match the antecedents of fuzzy rules and calculate the applicability of each rule as follows:

$$\alpha_j = (\mu^{i1}, \mu^{i2}, \ldots, \mu^{in}) \tag{5}$$

The number of nodes in Layer 4 is the same as that in Layer 3; that is, $N_4 = N_3 = 36$, which realizes normalized calculation as follows:

$$\bar{\alpha}_j = \frac{\alpha_j}{\sum_{j=1}^{m} \alpha_j}, j = 1, 2, \ldots, r \tag{6}$$

The fifth layer is the output layer, which realizes clear calculation as follows:

$$y_i = \sum_{i=1}^{M} w_{ij}\bar{\alpha}_j, i = 1, 2, \ldots, r \tag{7}$$

where w_{ij} is equivalent to the weight of the membership function of the j linguistic value of y_i.

B. RESULT ANALYSIS

Through the above analysis, the following conclusions can be drawn. Firstly, the article utilizes the factor analysis method to preprocess the original information of the constructed evaluation indicators. This ensures the integrity of both the original and calculated information, while avoiding information overlap and achieving dimension reduction. Consequently, the learning efficiency and convergence speed of the model are effectively improved.Secondly, the factor analysis evaluation results serve as the expected output values of the FNN neural network. This eliminates the influence of subjective factors and leverages the self-learning, self-organization, and strong self-adaptive capabilities of the FNN neural network. By doing so, it mitigates the randomness present in traditional comprehensive evaluation processes, significantly enhancing the accuracy and scientificity of the public space service quality evaluation in the Lhasa Barkhor Historic District.Lastly, based on survey data regarding the public space service quality in the Lhasa Barkhor Historic District, the evaluation results align closely with the actual implementation of the district's protection planning. This improvement in the accuracy and scientificity of the public service quality evaluation provides a new perspective and evaluation method for research on public space in historical blocks.

In conclusion, the proposal of the FNN evaluation model offers an effective approach for determining community satisfaction evaluation indicators and evaluation results. It enables the comprehensive analysis of multiple indicators, eliminates the interference of subjective factors, and provides important references for the formulation of update strategies. By utilizing the FNN model, community satisfaction can be assessed more accurately, offering a scientific basis for enhancing public space service quality.

III. ANALYSIS OF THE CAUSES

Influenced by the natural environment of the plateau, religions and ethnic culture, the public spaces in the historic districts of Lhasa are complex and diverse with distinct regional characteristics. For this reason, this paper starts by identifying internal causes of why public spaces were formed in the historic districts of Lhasa. It then identifies the related performance characteristics and establishes a logical relationship (as shown in Figure 2).

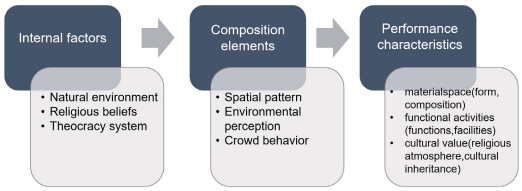

FIGURE 2. A logical illustration of the formation of features.

A. INTRODUCTION TO THE HISTORIC DISTRICT OF LHASA

Located in the Chengguan district, the historic districts of Lhasa are enclosed districts, including west of Linkup East Road, east of Duosenge Road, north of Jiangsu Road, and south of Linkup North Road (as shown in Figure 3). With the Jokhang Temple as the core, the Barkhor block covers an area of approximately 5.3 h square meters, and its buffer area is approximately 128.6 h square meters, including the four subdistrict offices of Ji Beng Gang, Barkhor Street, Chong Sai Kang, and Ji Ri and the 15 community neighborhood committees under their jurisdiction [32].

The population is mainly composed of local residents and tourists. The local residents are mainly older inhabitants of the region. A small part of these individuals are Muslims and Nepalese people who have lived in Lhasa for more than ten generations. In the peak season (from June to September), tourists are mainly from different places both at home and abroad, while in the off-season (from September to May), the majority of tourists are religious pilgrims [15].

B. FORMATION OF INTERNAL CAUSES

1) NATURAL ENVIRONMENT

The historic districts of Lhasa are located in the valley plain of the lower reaches of the Lhasa River, which is a tributary

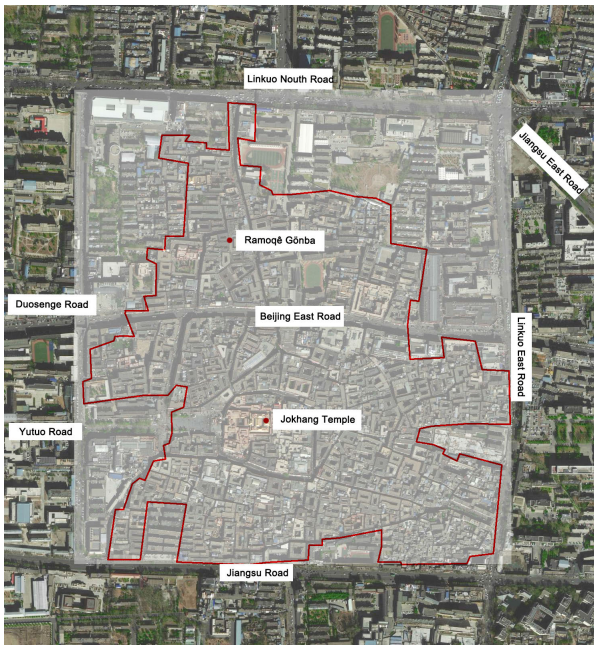

FIGURE 3. Scope of old historic districts of lhasa (painted by the author).

of the Yarlung Zangbo River. The terrain slopes gently, and the soil is fertile. Influenced by the Gangdise-Nienqentangula and Himalayas in an east-west direction, the climate is mild and semiarid. With sufficient sunlight, the annual sunshine time is approximately 3000 h; thus, the solar radiation is strong. The temperature varies greatly between day and night. The land, with its arid climate and few natural disasters, provides a suitable space for the formation of the historic districts of Lhasa.

2) RELIGIOUS BELIEFS

Directly influenced by Buddhism, the public spaces in the historic districts of Lhasa are not only the daily living spaces of residents but also the ritual spaces of Tibetan Buddhism. With the Jokhang Temple as the center, there are three layers of roads for turning scripture, namely, Nunkhor, Barkhor and Linkhor [33]. They highlight the cognitive expression that Indian Buddhism understands the cosmic order through the Mandala pattern. Under the influence of Tibetan Buddhism, religious disciples walked around the spinning scripture wheels clockwise to express their sincere faith. It was through such activities that the spatial form and road network structure of the historic districts of Lhasa were formed, with Jokhang Temple as the core [34].

3) THEOCRACY SYSTEM

From the introduction of Buddhism in the 7th century to the time when the Gelug school was in power, the politics and religion in Tibet developed into a theocratic system. Religious power reflected the social hierarchy of Tibet through institutional influence, which was then projected into an urban spatial form and order [35]. With the Jokhang Temple as the core, the public space of Lhasa serves as the center of religious activities and directly influences the urban spatial form of Lhasa [14]. The spatial form and spatial construction of the public space are also reflections of the theocracy system present in the historic districts of Lhasa.

C. COMPOSITION ELEMENTS

1) SPATIAL PATTERN

The original spatial form of the traditional Tibetan city has been completely preserved in the spatial pattern of the historic districts of Lhasa to a certain extent. In the historic districts of Lhasa, temples, the Lama's residence, dratsangs (schools), mansions, residences and trade markets are determined by the hierarchy of buildings, and the spatial density of buildings decreases based on how far they are from religious buildings [36]. Barkhor, a place for reciting Buddhist scriptures, unifies the urban traffic function and religion functions perfectly. It also plays a decisive role in the spatial form and the road network structure of the historic districts of Lhasa. With the Jokhang Temple as the core, buildings and religious activities naturally develop outward into the spatial pattern of the historic districts of Lhasa. Meanwhile, the distinct spatial format reflects the strong awareness of religion, politics and customs.

2) ENVIRONMENTAL PERCEPTION

Lhasa is located on the Tibetan plateau. Influenced by the natural and geographical environment, Tibetan residents have achieved the unification of space and environment, as well as the wisdom of harmonious coexistence after cumulative experience over a long period of time. Under the influence of Buddhism, the spatial pattern has naturally formed with the Jokhang Temple as the core, which has affected the development of Lhasa and conveys the unique psychological quality and cultural atmosphere of the Tibetans. A rich religious atmosphere is constituted by temples, prayer flags, incense burners, pagodas, etc., in the historic districts of Lhasa. Since residents share the same beliefs, folk customs and living habits there, they have formed an emotional resonance with a sense of belonging. In addition, the atmosphere also affects tourists' feelings toward national and regional culture.

3) CROWD BEHAVIOR

The religious activity space formed by religious buildings is a main component of the public spaces in the historic districts of Lhasa. At present, 23 religious buildings are preserved in the old urban district of Lhasa, including the representative Jokhang Temple, Ramoche Temple, Gyümé Temple, and Tengyeling Temple. The public space with the Jokhang Temple as the center is an important place to hold religious ritual activities. Pilgrims kowtow in the Jokhang Temple and disciples recite Buddhist scriptures around Barkhor Street. They recite six-word mantras and spin prayer wheels of different colors while walking hurriedly. They are totally

absorbed in their rituals without distractions and hide their firm beliefs in their hearts.

Along with the demands of the new era, some changes have already taken place in the traditional urban spatial form of the historic districts of Lhasa. For example, some streets and lanes are disorganized, and the expansion of the outer boundary has weakened the spatial form there. The characteristics of the traditional public space with the Jokhang Temple as the center are disappearing gradually. Factors including the aging of the social structural form, population flow, and high commercial density directly affect the community structure stability in the historic districts of Lhasa. Since the ethnic culture value is underestimated, the cultural atmosphere also weakens, and the cultural inheritance fails in the historic districts of Lhasa. In conclusion, respecting the regional cultural characteristics is the core issue of public space renewal in the historic districts of Lhasa with regard to coordinating contradictions and meeting residents' needs. Therefore, this paper adopts the perspective of community governance innovation and explores the public space renewal methods in the historic districts of Lhasa from the six aspects of space renewal, structure improvement, life reorganization, diversified construction, and innovative ways and system construction (as shown in Figure 4).

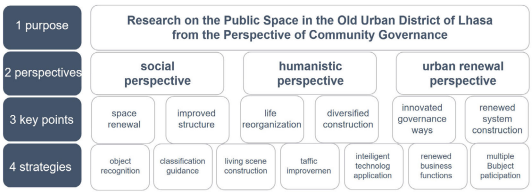

FIGURE 4. Research thoughts of public space renewal in historic districts of lhasa.

IV. RELATIONSHIPS BETWEEN COMMUNITY GOVERNANCE INNOVATIONS AND PUBLIC SPACE RENEWAL IN THE HISTORIC DISTRICTS OF LHASA IN THE NEW DEVELOPMENT STAGE

A. TIME COGNITION OF COMMUNITY GOVERNANCE

Community governance is the means by which to solve the complex contradictions and meet the needs of residents arising from the rapid development of urbanization; it is also the main way to promote community planning. Community planning not only provides residents with aspects of daily life but also serves as the main battlefield of future urban planning in the new development stage. The shortcomings of basic space units have been profoundly realized, especially after the recent epidemic [37]. Therefore, it is important to correctly understand the era-specific characteristics of community governance in the new development stage of China. Community governance has shifted from spatial planning to spatial renewal and from government domination to multiconsultation and coconstruction. Moreover, emerging technology is used to satisfy residents' specific needs for living a healthy life. These factors will become the objectives of future community governance innovation [38].

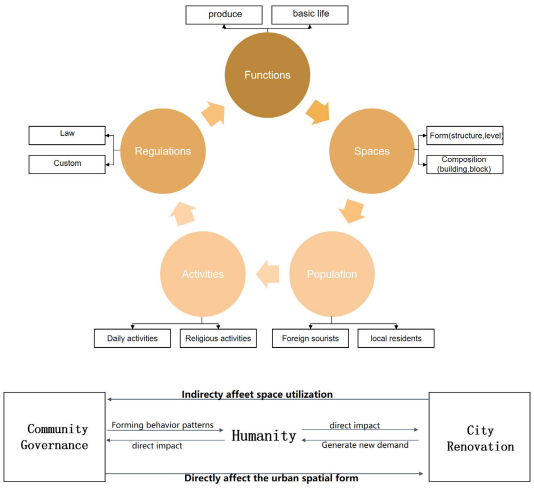

FIGURE 5. Action mechanism of the public space renewal of historic districts of lhasa.

B. ACTION MECHANISM OF THE PUBLIC SPACE RENEWAL OF THE HISTORIC DISTRICTS OF LHASA FROM THE PERSPECTIVE OF COMMUNITY GOVERNANCE INNOVATIONS

Communities are the cells of the city, and organic renewal is a process of urban metabolism [39]. Space governance is carried out to protect historic districts, while social governance is achieved mainly through community governance innovations. There is a coupling-driven relationship between space governance and social governance. Community development focuses on people; thus, residents should play a leading role in community planning and construction to promote the effective protection of historic districts. Meanwhile, the effectiveness of community governance is improved in organic urban renewal to achieve a positive cycle for urban development and renewal, as well as community governance innovations [40].

This paper first sorts out the space, functions, activities, crowds, and regulations of the historic districts of Lhasa and then clarifies the logical relationship between community governance and historic district renewal. The logical relationship is manifested in material form as basically preserving the traditional spatial pattern of the historic districts.

The traditional lifestyles of local residents and the space for religious activities should be preserved for local residents. The culture of the historic districts of Lhasa is inherited based on the tourism industry. This paper proposes public space renewal strategies for the historic districts of Lhasa from a humanistic perspective, social perspective, and urban renewal perspective (as shown in Figure 5).

V. PUBLIC SPACE RENEWAL STRATEGIES OF HISTORIC DISTRICTS OF LHASA FROM THE PERSPECTIVE OF COMMUNITY GOVERNANCE INNOVATIONS

In the new development stage, the construction of a comprehensive, accurate and dynamic renewal system of public space in the historic districts is an important reflection

of community development and governance, as well as an inevitable requirement to promote high-quality urban development [33]. Taking the public space of Barkhor Historic District in Lhasa as an example, this paper constructs a strategy for the protection and renewal of public space in Barkhor Historic District based on research on the distribution of public space, the evaluation of public service facilities and community residents' satisfaction in Barkhor Historic District in Lhasa.

A. RENEW COMMUNITY SPACE AND IMPROVE THE SPATIAL STRUCTURE OF THE HISTORIC DISTRICTS OF LHASA

The spatial structure of the historic districts of Lhasa is mainly formed by temples, the Lama's residence, dratsangs, former aristocratic mansions and ordinary dwellings. The public space centers on the Jokhang Temple, and it presents the level and form of the public spaces in the historic districts based on the use and status of buildings. The goal of protection at all levels should be determined by means of space type screening and classification guidance. The multisource data fusion method, which includes GIS, big data, and questionnaires, is used to comprehensively judge the spatial renewal methods and construct the renewal strategies at different levels. Regarding the hierarchical public space centered on the Jokhang Temple, it is necessary to establish a system of historical and cultural protection and inheritance in the historic districts, restore its traditional pattern and protect the spatial scale and architectural style of the blocks in the historic districts so that historical heritage with cultural value can be inherited and activated in urban renewal.

Naturally, Buddhism is the main factor that influences the spatial pattern of the roads for reciting Buddhist scriptures in the historic districts of Lhasa. Spatial renewal needs to incorporate characteristic elements such as nature, humanity and society to highlight local characteristics. To create good public space in the historic districts, the hierarchical dwelling space needs to configure facilities accurately and improve the complex utilization of the space. In this way, both nearby residents and tourists will be attracted to the historic districts, which effectively reduces the living cost for community residents and improves the happiness index of the inhabitants [41].

B. REORGANIZATION OF COMMUNITY LIFE AND OPTIMIZATION OF SPACE ENVIRONMENT QUALITY

Through the exploration of behaviors such as "walking and exploration" and "daily communication activities" of residents in the old city, a complete unit that is safe, healthy, well-equipped, and managed in an orderly manner to meet the daily needs of the people is created. Considering the space management of community planning and the nature of social action, we can start from community planning to shape, reconstruct and enhance the value of community public space.

1) First is the conservation and utilization of existing public spaces, including public open spaces and street and lane space scales. New public spaces should be actively created through land replacement, and the Chongsaikang and Saixin market plots should be adjusted into new public open spaces (as shown in Figure 6).
2) Second is the use of existing conditions to expand the coverage of public space services in the block. Forty-one open spaces within the block range are based on the accessibility of people within the ranges of 100 m, 300 m and 500 m to measure the coverage of its public space service area. The 41 vacant lots are small in area and do not form a large-scale public space. They are concentrated on the south side of Beijing East Road, with a total of 33 sites, with an additional 8 sites on the north side. They have wider coverage and meet the living needs of residents. (As shown in Figure 7)

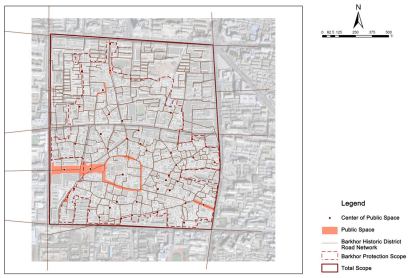

FIGURE 6. Status of public space.

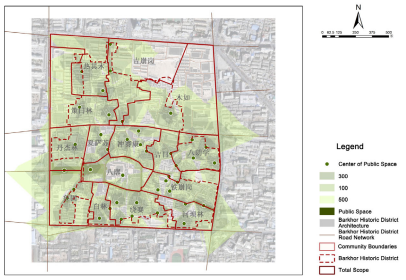

FIGURE 7. Scope of public space services after planning.

C. DO A GOOD JOB IN DYNAMIC ASSET ASSESSMENT TO ACHIEVE SUSTAINABLE DEVELOPMENT OF HISTORIC DISTRICTS

1) It is necessary to pay special attention to the dynamic assessment (characteristics, distribution, status, potential) and database construction of the stock assets of communities and cities and to use appropriate community audit tools to regularly diagnose the mismatch between people, space, and services in the community and misalignment.
2) We should also pay attention to the internal growth and external connectivity of the community's public structure. Through local mechanism innovation, planning leadership and value realization are guaranteed. We should strengthen the guidance of planning results,

redefine the rules, and reserve flexible space for public participation in collaborative governance.

D. TOURIST ATTENTION INDEX OF FAMOUS HISTORICAL AND CULTURAL STREETS

Through accurate policy guidance and the implementation of detection and early warning of the flow of people, big data can reasonably formulate the proportion of business formats, maintain the continuity of the function of historical and cultural blocks and the inheritance of historical culture, optimize the relationship between historical and cultural protection and mass consumption, and avoid excessive tourism. Commercial exploitation leads to the loss of ''authenticity'' [42].

In addition, the promotion of big data applications will promote the establishment of institutional mechanisms for government guidance, social participation, common protection, and common benefit. Through a variety of internet data platforms, a public participation mechanism in the protection planning of historical and cultural streets should be established, including publicity related to protection planning and consultation, the supervision and management of cultural heritage, the analysis of relevant public opinions, etc. The protection of rights and interests and the acceptance of public opinion are also important. With the in-depth mining of internet data and the application of Internet of Things data and public participation data in historical and cultural streets, the evaluation system will be further improved. Through the network layout of integrated sensing equipment, such tools can realize the real-time monitoring of urban environment perception data such as temperature and humidity, illuminance, noise, PM2.5, PM10, etc. This information can be used to promote refined management.

E. STRENGTHEN THE GOVERNMENT's MACROGUIDANCE FOR FOR HISTORIC DISTRICTS

The government bears significant responsibility in the governance of historic districts. On one hand, we emphasize the government-led model for the current governance of historic districts; on the other hand, we must strive to avoid numerous issues arising from government organizations' involvement in historic district governance. This may appear to be a challenging paradox, but that is not the case. The key lies not in whether the government should intervene in the governance of historic districts but rather in how the government positions itself and effectively intervenes.

For the governance of historic districts, the government should primarily focus on macro-control and macro-management. This entails formulating policies, implementing regulations, and utilizing higher-level instruments such as policies and laws to promote the development of historic districts. To ensure effective management, systematic organization, and comprehensive oversight of Barkhor Street's renewal and revitalization, we need to define the relevant aspects and undertake ''comprehensive research, scientific deployment, planning first, and detailed design.'' The goals, strategies, and content of Barkhor Street's renewal should be studied holistically, and scientifically formulated short-term, medium-term, and long-term renewal plans. Detailed renewal plans and guidelines should be developed, with precise design for key areas. Simultaneously, it is important to establish a planning feedback mechanism to facilitate timely input during the renewal process and continuously improve the process. Additionally, the urban renewal of Barkhor Street requires the establishment of a robust policy system to ensure the smooth progress of the renewal efforts. This policy system may encompass comprehensive management policies, land policies, planning policies, cultural preservation policies, demolition compensation policies, as well as aspects related to population resettlement, land (including idle housing) redevelopment, housing rights confirmation, planning technical guidelines, approval measures, and a negative list.

F. ESTABLISH AESTHETIC EVALUATION STANDARDS AND ATTACH IMPORTANCE TO NATIONAL AESTHETIC VALUE

The aesthetic evaluation standard of the community space environment should be constructed. In domestic practice, the urban design guidelines at the regulatory level are mainly responsible for controlling the spatial appearance of cities and communities. At present, they are compiled from individual technical indicators and superficial control guidance to ensure the effect of community environment construction. Thus, they meet the aesthetic requirements of the benchmark or above.

1) The color used should be in harmony with the traditional architecture so that the whole image is pure and low-key, and the historical architecture and the traditional Tibetan characteristics are highlighted. For an incongruous modern architectural style, the color should be extracted from the traditional Tibetan architectural color, and the auxiliary color and the embellishment color should use a color with lower level of brightness than the traditional architectural color.
2) In addition to adopting qualitative methods such as subjective experience evaluation of residents, parametric design in the field of architecture can be used to quantify aesthetic evaluation indicators, thereby improving the scientificity and effectiveness of standard formulation.

G. BUILD A PUBLIC INFORMATION PLATFORM AND IMPROVE THE GOALS OF COCONSTRUCTION, SHARING, AND MAINTENANCE

A community public information platform that combines online and offline approaches should be constructed. In addition to the application of corresponding technologies and the construction of network infrastructure, it is advisable to focus on the establishment and improvement of the participation mechanism of various subjects.

1) The online communication function of residents should be improved, the channels for virtual communication and community participation should be expanded, and the expansion of residents' social capital and the integration of neighborhood relationships should be promoted.

2) A sound platform for communication, interaction and feedback mechanisms should be established to ensure effective dialog between the government, community organizations, community residents, planners, etc., and implement people-oriented community construction. The information platform can be applied to demand surveys, with particular attention given to residents living in core areas, rental housing, young and middle-aged, undergraduates, and middle-income residents. For these ''vulnerable groups'', in terms of housing opportunities, we should carefully understand their actual needs and implement differences in the public domain. The fairness of housing and business opportunities should also be improved.
3) The construction of smart towers and other urban perception bases that can comprehensively carry a variety of equipment and sensors and advance the layout of new infrastructure for the next construction of historic districts should be promoted.

H. FUTURE WORK

Regarding the data ecosystem and cross-border innovation, at present, there are no mature data ecological products for recording, disseminating, interacting and innovating in the field of urban historical and cultural heritage. The time and space behavior data of people is the biggest future asset of the historic district. With data cooperation and sharing as the core, through multiple cooperation channels, a data ecosystem with multiparty participation and collaboration can be cultivated. In this data ecosystem, the management agencies of famous historical and cultural streets could use big data to realize the refined management of famous streets and promote the sustainable development of streets at different levels of society, economy, environment and culture. Urban planning and design units could use the accumulation of urban big data to better realize the protection planning and design of historical and cultural streets and actively participate in the subsequent development of cultural tourism and commercial operations. Internet companies could strengthen cooperation through institutions in related fields, facilitate the connection of business fields, and realize data-oriented product development and industrial chain layout [43], [44]. Developers and travel companies could use data to achieve precise marketing and refined commercial use in famous streets. The public could use the data platform and new media platform to achieve two-way interactive communication with the famous street management department, and the use of big data could provide empowerment support for public participation. The use of big data brings mutual benefits to participants and contributes to cross-border collaborative innovation in the field of historical and cultural protection.

I. HIERARCHICAL ANALYSIS OF RELATIONAL ANALYSIS STRUCTURE

According to the weight calculation method described in the previous article, the weight value of the heating potential evaluation index system is calculated by using the order relation analysis method. According to the total score of each index, the relationship is sorted, and the weight of each index of case engineering is obtained by using the sequential relationship analysis method. Details of the evaluation results are shown in Figure 8, and those of the construction and operation stage are shown in Figure 9.

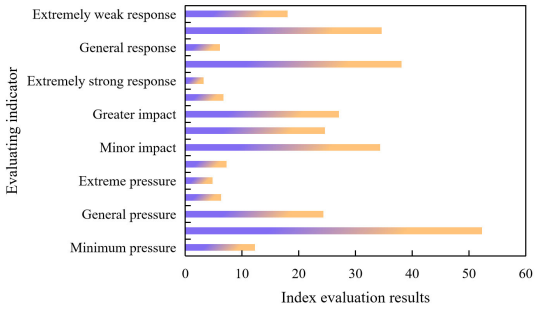

FIGURE 8. Evaluation results in planning and design stage.

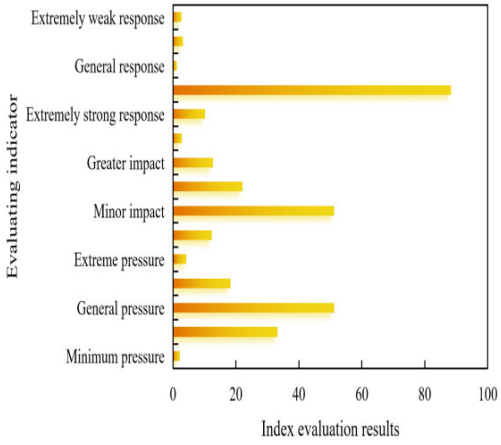

FIGURE 9. Evaluation results of operation stage.

Then, the degree of membership corresponding to the comprehensive evaluation of heating potential, namely, dark green, green, fresh green, light green and yellow, is 0, 0.341, 0, 0.656, and 0), respectively, which shows that the case project of the planning and design stage is considered green at 33.4% and light green at 65.6%. According to the evaluation results, the heating potential of the project in the planning and design stage is light green.

In addition, the corresponding membership degree of the comprehensive evaluation of heating potential, namely, dark green, green, bright green, light green, yellow, in the construction and operation stage is 0, 0.646, 0.337, 0, 0), which shows that the ratio of the project in the construction and operation stage is considered green at 64.6% and bright green at 33.7%. According to the evaluation results, the greenness of the project in the construction and operation stage is green.

VI. CONCLUSION

This research on public space renewal in the historical districts of Lhasa, from the perspective of community

governance innovation, marks a significant transformation of urban renewal from extensiveness to refinement. The study integrates community space, focusing on the needs of older inhabitants, and utilizes a neural network evaluation model. By improving community space and establishing community living circles, the public space structure of the historical districts is updated, promoting diversified construction. Additionally, a refined public space renewal system is proposed, characterized by spatial living circles within 15 minutes, business function transformation, and intelligent technology application. The findings of this research not only address the issue of public space renewal in Lhasa's historical districts but also offer valuable insights for other historical districts facing similar challenges in public space renewal.

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