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Research Article

Construction of 3D Design Model of Urban Public Space Based on ArcGIS Water System Terrain Visualization Data

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On the premise of being familiar with ArcGIS Server technology, we build the architecture of the entire platform, including the basic support layer, data layer, service platform layer, and application layer, and build the entire environment of the platform. We make electronic maps through Arc Map, and collect, organize, and improve spatial data and attribute data, so as to achieve satisfactory accuracy and visual comfort. This study implements various map services under the Dojo framework, including basic map operations, information display and query, marker points, eagle eye diagrams, measurement, printing, and other functions, and uses JavaScript technology to improve user experience. We publish various services through ArcGIS Server, and realize fast and error-free invocation of each service. Based on the theory of runoff and runoff, ArcGIS software was used to study the hydrological information of the watershed, and to determine the catchment area threshold and hydrological response unit. Combined with the GIS spatial analysis method, the numerical simulation of rainfall and runoff in the study case area was carried out, and the variation of the annual rainfall-runoff coefficient was obtained. This study selects an area where stock planning was first proposed as the object of this research. Briefly, we introduce the construction of three-dimensional public space in a certain area, select thirteen typical three-dimensional public spaces as representatives for public evaluation, and explore their existing problems, mainly including the lack of adaptability of space functions and the lack of diversity in space design, privatization of operation management, low level of public perception, etc. Since then, in response to the public problems of the three-dimensional public space in a certain area, a targeted three-dimensional public space optimization strategy is proposed from the four levels of planning policy, urban design, management subject, and user subject.

1. Introduction

At present, the research and application of GIS mainly focus on describing the plane with reference to the two-dimensional space [1]. However, with the continuous improvement of computer hardware performance, the rapid development of computer software technology, and the gradual improvement of 3D GIS theory and technology, geographic information systems represented by 3D GIS continue to emerge [2]. Compared with the traditional two-dimensional plane GIS, the three-dimensional GIS system gives people a more real, natural, and intuitive feeling. Many mature commercial GIS systems have added 3D modules to meet the increasingly complex functional analysis needs of various industries, such as ArcGIS 3D Analyst, Map Info Engage3D, and Skyline Globe. These 3D GIS modules can provide functions such as terrain analysis, spatial query, 3D roaming, and flight animation in a 3D spatial reference environment by creating 3D terrain data and overlaying and processing satellite remote sensing image data [3]. At the same time, in order to improve the three-dimensional sense and visual effect of 3D scenes, many 3D modules of GIS software have added support for 3D models, so that GIS can not only display a wide range of 3D terrain data but also add houses, 3D models of roads, dams, bridges, etc., thus making the 3D scene more realistic.

Cities continue to carry out single-dimensional high-density development or urban renewal, while ignoring the low efficiency of the original urban public space, resulting in the further deepening of the contradiction in land use [4].

The lack of public space limits the occurrence of residents' public activities, and residents' resistance to this contradiction is manifested in informal behaviors that are increasingly common in urban public spaces [5]. From the "informal" perspective of the city, the form of informal urban public space and the rich and diverse social behaviors of different groups of users are observed and recorded, and the informal intangible logic is analyzed. Through the theoretical research on informality and the observation and research on the informality of public space, this study puts forward the design goals and principles of urban public space from the perspective of urban "informality" and proposes specific design strategies as a supplement to the construction of formal urban public space. From a new perspective, it studies the informal phenomenon of urban public space, pays attention to different groups and different lifestyles in the city, respects the diversity of the city, and reflects the spirit of humanistic care. Through the observation and analysis of the informal phenomenon of public space, the internal organizational logic and elastic adjustment mechanism are summarized, and the urban public space design strategy from the perspective of urban "informality" is proposed as a beneficial supplement to the formal urban public space design. It has practical significance for the renewal of urban public space and the optimization of stock space.

This study mainly describes the realization process of the mobile public GIS service platform based on ArcGIS Server systematically, which focuses on the production of electronic maps, the release of map services, the specific realization of map functions, and the modules of the whole system. With the help of the hydrological analysis tool of the spatial analysis technology of geographic information system, the water system information of the basin is extracted. Based on the extracted watershed water system, the subwatershed is cut and the selected case area is exported using ArcGIS. Based on the three-dimensional public space publicity evaluation model, this section evaluates the publicity of the three-dimensional public space in a certain area and summarizes the publicity problems of the three-dimensional public space in a certain area due to the lack of adaptability of spatial functions and the lack of diversity in space design. There are six specific aspects as follows: privatization of operation and management, low level of public perception, obvious sense of distance between spatial boundaries, poor spatial information disclosure, and unoptimistic use of space.

2. Related Work

The development of GIS in foreign countries has entered a mature stage, and a large number of commercial GIS software have been successfully applied in water conservancy, electric power, petroleum, transportation, land, and other industries [6]. Especially in the past ten years, with the gradual improvement of 3D GIS theory and 3D visualization technology, the fields of geology, ocean, minerals, and urban planning have successfully entered the 3D era [7]. ESRI's ArcGIS series software not only provides mature industry solutions in 2D GIS but also has a full-featured 3D Analyst extended analysis module and a 3D GIS visualization environment based on Scene and Globe in 3D GIS. Skyline proposed a 3D GIS solution from the perspective of Globe, displaying massive spatial data in a three-dimensional interactive way and providing true three-dimensional GIS application analysis functions not only in a large-scale scene but also in a small-scale high-precision sand table environment [8].

Erdas' 3D GIS visualization analysis tool can realize the interactive operation of virtual scenes and query spatial information such as 3D terrain surface coordinates and height, and view 3D object attributes and geometric information [9]. Stereo Analyst analysis software can acquire 2D and 3D geographic information data from a variety of different data sources without going through DEM. CC-GIS is a three-dimensional modeling software based on photogrammetric data developed by ETH Zurich University in Switzerland. The software uses consistent symbols to construct surface models of complex objects and manages three-dimensional data in relational databases through V3D data structures based on 3DFDS models. MapInfo is a desktop geographic information system software solution for data visualization and information mapping [10]. The 3D GIS tool Engage3D has grid surface creation, grid display control, 3D analysis and query, terrain image browsing, real-time interactive navigation, 3D Walkthrough animation, and other functions. Cult3D is a web-based 3D software based on streaming 3D technology, which provides basic operations such as rotation, zoom in, and zoom out to view 3D models from different angles [11].

The city of Faro and New York have established a WebGIS urban tree management system to achieve tree loss assessment and postdisaster tree cleanup after a snowstorm [12]. Major League Baseball pioneered the use of spatial analysis and a spatial approach to sports-related problems by using GIS to analyze the distribution of radio station networks for the Kansas City Royals and St. Louis Cardinals baseball games [13]. Kansas City, Missouri, used GIS to centrally manage the data and business of departments at all levels and realized an enterprise-level 3D GIS city-wide connection platform [14].

Related scholars have used the 3D extension module of ArcGIS to realize the dynamic simulation of the flood inundation evolution process and surrounding scenes in ArcScene [15]. The researchers developed a flood inundation analysis system based on ArcScene, which realized the functions of classification and statistics of submerged area losses, animation simulation of flood inundation, and water depth query at any point [16]. Based on DEM, relevant scholars perform flood inundation analysis and calculation under given water level conditions through computer algorithms such as recursive algorithm and iterative algorithm [17]. The researchers used the feature line method of the Courant format to obtain the temporal and spatial relationships between the water level and discharge of the river channel, and based on this, the GIS-based flood evolution visualization method was studied [18]. Relevant scholars have realized the dynamic simulation of large-scale water

surfaces through dynamic texture technology based on the channel boundary search algorithm based on the section and developed a 3D visualization simulation system that can effectively simulate the flood in the river basin [19].

According to the experience of western developed countries and the development of my country, since the reform and opening-up policies are introduced, the process of rapid urbanization is usually accompanied by the transformation of urban spatial form and the intensification of various conflicts within the society. It has been found that it is quite common for the quality of urban public life to deteriorate due to improperly designed physical spaces [20]. The "urban public space research" is also a hotly discussed topic in the field of architecture today, and the most common part is the design, construction, and development of some generally recognized and typed public spaces such as urban squares, pedestrian streets, and parks. Further research also includes a discussion on the necessity and possibility of the existence of urban public space and involves social issues other than technical issues, human behavior issues, etc. The purpose is to reveal the potential public space needs in the interpersonal environment. Since the service objects of urban public space cover almost all social classes, and its construction and use also involve many aspects of urban operation, various issues related to it must go beyond the scope of the field of architecture. In fact, many groups, including sociologists, urban managers, architectural planners, designers, and theoretical workers, are exploring and practicing urban public space and presenting diverse research perspectives.

3. Method

3.1. Application of ArcGIS Hydrological Analysis Tools. DEM is a simulation of terrain, but the original smooth surface of DEM will appear with some concave areas that do not exist in real terrain due to grid accuracy and interpolation. The existence of concave areas will lead to unreasonable or even unreasonable surface water flow simulation; therefore, when simulating surface water flow, the original DEM data should be processed to eliminate peaks and fill depressions, and then the water flow direction is calculated.

The water flow direction refers to the direction of the water flow, as it leaves each grid cell. Hydrologists have done a lot of research on the influence of terrain factors on hydrological simulation and the divergence of water flow itself and proposed many different algorithms to determine the direction of water flow: mainly single-flow method and multidirection flow distribution method.

The D8 method assumes that there are only 8 possible directions of water flow in a single grid cell, that is, it flows into the 8 adjacent grid cells. Its water flow direction is determined by the steepest slope method through 3×3 DEM grid cells, that is, on the grid cell, the slope between the central grid cell and each adjacent grid cell is calculated. The direction of the grid unit with the largest slope is taken as the outflow direction of the central grid unit, that is, the water flow direction of the central grid unit. If the slope changes within the search range are equal, the search range needs to be expanded outward. Therefore, the processed DEM flow map will eventually have 8 directions due east, southeast, due south, southwest, due west, northwest, due north, and northeast.

In the D8 algorithm, the center point of the grid cell is considered to be the runoff center, the river channel is described by a one-dimensional line, the infinite possibilities of the water flow direction are ignored, and the water flow direction in the natural state is summarized into 8 possibilities. The water flow direction of the grid unit is set according to the principle of the steepest gradient, that is, the direction of the maximum gradient between grid units is the water flow direction.

Catchment analysis is the process of generating a catchment raster from a determined flow direction raster. The value for each grid cell on the catchment grid represents the total number of grid points flowing into that grid cell from the upstream catchment area. Assuming that there is a unit water volume at the regular grid point, then how many grid points flow into the grid is determined according to the regional topographical water flow direction data; it means how many unit water volume flows into the grid unit, so as to obtain the flow through each point. For the calculation of the cumulative value of the catchment for each grid cell on the watershed surface, the order of routing from the highest point of the watershed to the lowest point of the watershed must be followed.

The hydrological analysis is an important aspect of DEM data application. Catchment and flow networks generated using DEM are the main input data for most surface hydrological analysis models. The main content of surface hydrological analysis based on DEM is to extract the water flow direction, confluence accumulation, water flow length, river network, and watershed segmentation of the surface water runoff model by using hydrological analysis tools. In DEM, through the extraction of these basic hydrological factors and basic hydrological analysis, the hydrological analysis process is finally completed, and the flow process of water flow is reproduced. The schematic diagram of hydrological information extraction is shown in Figure 1.

The water flow length refers to the projected length on the horizontal plane of the maximum slope distance from a point on the ground along the water flow direction to the starting point (endpoint) of its flow direction. The length of water flow is the direct cause that affects the velocity of surface runoff; therefore, the extraction and analysis of the length of water flow are very important. At present, there are two main ways to extract the length of water flow, namely, downstream calculation and upstream calculation. The calculation method of calculating the horizontal projection of the maximum ground distance from each point on the ground along the water flow direction to the watershed outlet where the point is located is called downstream calculation. The calculation method is called upstream calculation.

A watershed is the catchment area of a river or water system, from which the river receives its water supply. Various waterways of different sizes combine with each other to form a natural river network. Each waterway that

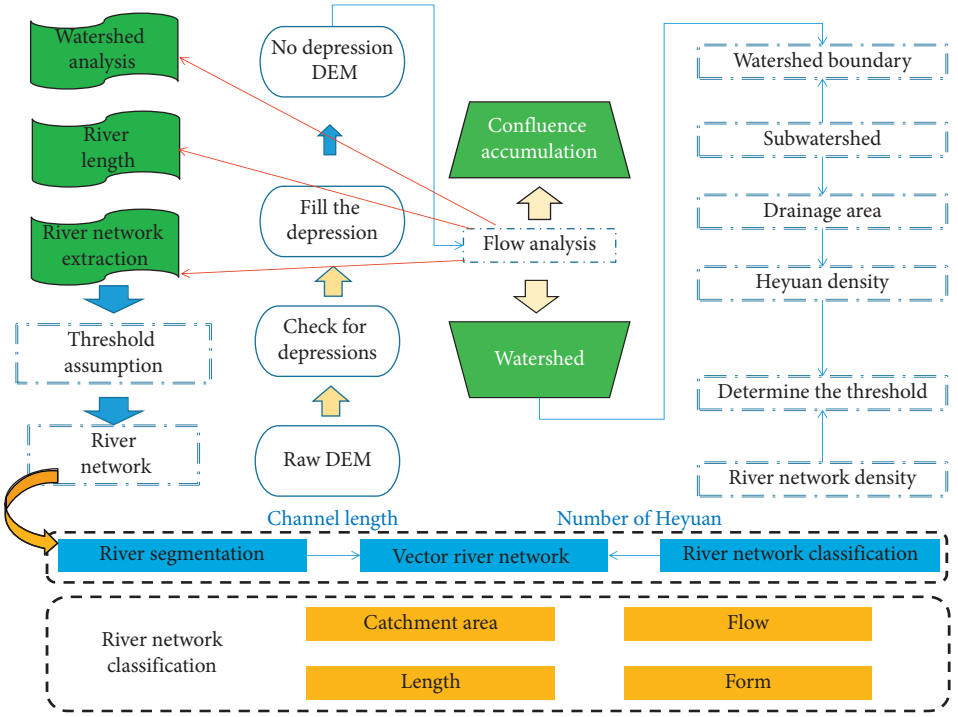

Figure 1: Schematic diagram of hydrological information extraction.

constitutes the river network has its own characteristics, catchment range, and water outlet. Smaller watersheds combine to form larger watersheds. The catchment area refers to the total area of the river flowing from a certain outlet; the outlet is the outlet of the water flow in the basin, which is the lowest point of the whole basin; the dividing line between the basins is called the basin watershed.

3.2. Construction of Urban Public Space Map Service System. Map service is to publish maps to the Web through ArcGIS, but before creating a map service, we need to make a map in Arc Map and then publish the map service on ArcGIS Server, so that users can easily use Web applications or use these map services in other applications.

The server is logged into the computer as an administrator account so the administrator account needs to be given sufficient permissions to manage and control all ArcGIS services. The specific setting method is carried out in the computer management of the server. We find agsadmin in the local group and then add the account, which gives the administrator account permissions to manage ArcGIS services.

The configuration file defines the file source, output path, cache path, and image parameters of the map service. Administrators can achieve the maximum optimization of program performance and server usage by modifying the corresponding parameters.

To use ArcGIS Server Manager to publish map services, the service definition file must be .sd. First, we need to create a service definition file (.sd) through ArcMap and then log in to ArcGIS Server Manager to publish. After successful publishing, we can see the map service in the corresponding service directory of manager.

The basic operations of the map are mainly used to meet the basic requirements of users to browse maps, so that users can quickly find and obtain useful information from large maps according to their own needs, perform other related operations, and also get a list of specific map service resources. Figure 2 shows the process of publishing map services in ArcGIS Server.

In the case of a vector map service, it can be easily combined with other map data due to its transparent background. The user can select the vector map service when loading the page when using the electronic map and then cover the initially loaded map service by loading the image map service. Before performing map switching operations, the system often learns the display range of the map on the interface from the extent property of the map document.

Generally, the lower right corner of the map has maximum values of X, Y, whereas the lower left corner has minimum values of X, Y. After the map is switched, the system needs to set the display range of the new map on the interface. At this time, the setExtent method is used, which is different from the previous one. Since the slicing scheme used in this electronic map system is ArcGIS Online, there is almost no change in the scale of the map, so there will be no map zooming during the switching process, and the switching process is relatively natural.

Based on the entire information query, the system and the server use a no refresh callback technology but exchange data between information queries and perform partial refresh in the search information box, which significantly speeds up the response speed of system.

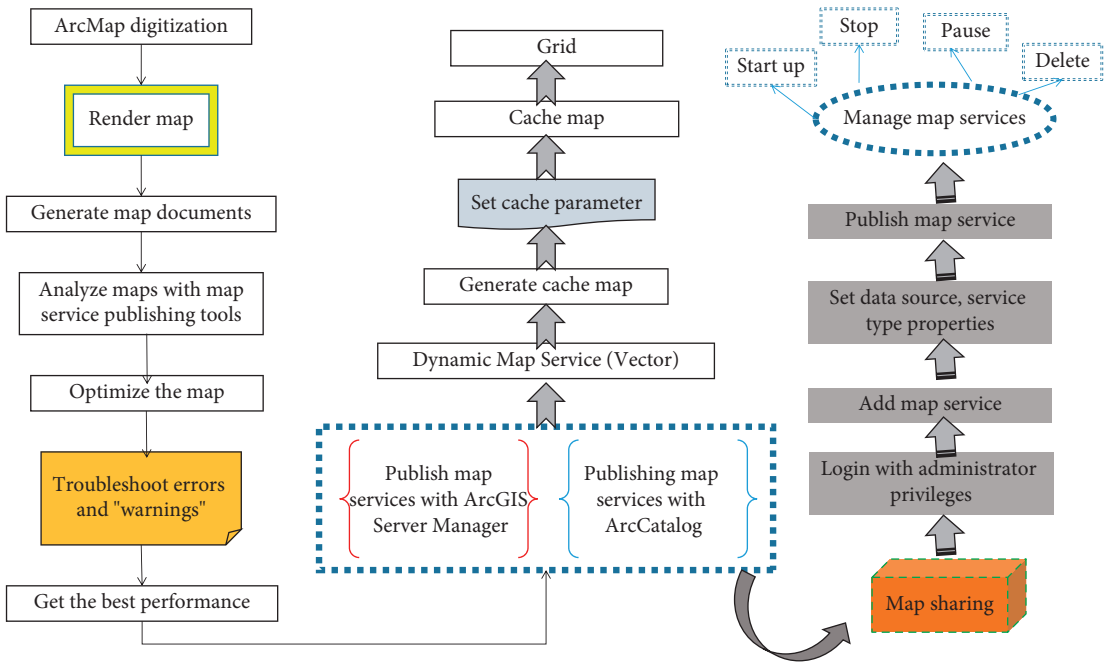

Figure 2: The flow chart of ArcGIS server publishing map service.

3.3. Estimation of River Network Density in Water System Topography and Evaluation of Water System Accuracy. The river network density is the length of the river per unit area or the total length of natural and artificial channels per unit area, which is calculated as follows:

$$D = \prod_{w=1}^{N_w} \frac{\prod_{j=1}^{\Omega} Lwj}{(A \cdot N_w)}, \tag{1}$$

where D is the river network density; Lwj is the length of the jth river in the w-th grade, $j = 1, 2, \ldots, N_w$; N_w is the number of the w-th grade rivers, $w = 1, 2, \ldots, \Omega$; A is the area of the watershed; L is the total length of the channel.

The water system information is extracted according to the best threshold of DEM of different scales, the parallel water system information is extracted by Arc GIS software according to the DEM of different scales, and the length of the water system is counted and then divided by the best threshold value to extract the total length of the water system. Remember to refer to the evaluation formula of water system extraction accuracy in the study area. The formula calculation process is as follows:

$$P = \prod_{i=1}^{n} \frac{\prod_{j=1}^{m} L_{ij} \cdot D}{\prod L}. \tag{2}$$

In the formula, P is the evaluation accuracy of the parallel water system, L_{ij} is the length of the parallel water system in the i-th segment and j, and L is the total length of the extracted water system in the study area. The closer the value of P is to 0, the higher the accuracy of water system extraction, and vice versa.

Horton–Strahler method extracts water system based on 1:50,000 topographic map or 30 m resolution ASTER-GDEM digital elevation data using Arc GIS, then classifies the river network according to Strahler river network classification theory, and finally counts the river channels of each level of river classification. The fractal dimension is calculated as follows:

$$R_b = \frac{(N_i - N_{i-1})}{N_i},$$

$$R_L = \frac{(L_i' - L_{i-1}')}{L_i'}, \tag{3}$$

$$D_b = \text{Min}\left[-1 \ \frac{\lg R_L}{\lg R_b} \ 1 \right],$$

where R_b is the bifurcation ratio, R_L is the river length ratio, N_i is the number of channels at all levels, i is the channel grade, and D_b is the fractal dimension of the Horton–Strahler water system.

The box-counting dimension method is also known as the covering method or the grid method. It takes the square grid with side length r and the water system map to find the intersection, and the number of grids covered by the water system is $N(r)$. When r changes continuously, a series of $N(r)$ values will be obtained corresponding to it, and the relationship between the two is as follows:

$$N(r) \longrightarrow \frac{1}{r^D} \cdot L_{ij}. \tag{4}$$

In the formula, points ($\lg r$, $\lg N(r)$) are taken as the coordinates to make a double logarithmic graph and the least-squares method is used to fit a straight line:

$$\lg N(r) = (D - 1) \cdot \lg r - b. \tag{5}$$

In the formula, r is the side length of the square grid; $N(r)$ is the number of grids covered by the intersection of the grid with the corresponding side length and the water system map; b is the undetermined coefficient; D is the slope value of the double logarithmic curve.

In addition to Horton's theorem method and box-counting dimension method, this study also chooses the method of relief ratio, which is easy to calculate and has reliable results, to study the landform development of karst dam-building areas. The relief ratio method is Pike and Wilson's classical method for estimating the integral value of area elevation derived from a mathematical formula, which is calculated as follows:

$$\mathrm{HI} = H_{\max} - \frac{H}{H_{\max}^{'} - \lg N(r) \cdot H_{\min}}. \tag{6}$$

In the formula, HI is the integral value of the area elevation; H' is the average elevation of the watershed; $H_{\min}$ is the minimum elevation of the watershed; $H_{\max}$ is the maximum elevation of the watershed. According to a large number of studies, it can be known that when $\mathrm{HI} > 0.6$, the geomorphological development stage is juvenile; when $0.35 < \mathrm{HI} < 0.6$, the geomorphic development stage is the prime-age period; when $\mathrm{HI} < 3.5$, the geomorphic development stage is the old age.

4. Results and Analysis

4.1. Overall Assessment of the Publicity of Three-Dimensional Public Space. The survey on the control variables of the perception dimension is mainly conducted through questionnaires. In order to ensure the objectivity of the survey data, the citizens who are using the space and other citizens are surveyed in two ways: on-site distribution and online questionnaire collection. In order to improve the efficiency of online questionnaire distribution, it is classified according to the administrative division of the research site and distributed separately. The questionnaires that have not been to a certain place in the collected questionnaires are recorded as invalid questionnaires for that place. The survey of three-dimensional public space in a certain area is listed in Table 1.

The final results of this research are listed in Table 2. For the basic situation of the 13 three-dimensional public spaces in a certain area, Table 2 provides specific information on various indicators of space publicity. From the general results, the average publicity score of the thirteen three-dimensional public spaces selected in this survey is 71.7 points. The south square of the railway station shows a very low publicity, mainly because it has a very low adaptability to other functions and can only be used as a traffic space and a short stay space. With a certain exclusivity, the user's perception of the square is not ideal, especially at the level of spatial comfort perception. The highest publicity score is the second-floor platform of Nanshan Commercial and Cultural Center, with a score of 83.9 points, showing a relatively high publicity.

By calculating the results of each control variable, the average value of each control variable of thirteen three-dimensional public spaces in a certain area is obtained, so as to understand the specific public quality of the three-dimensional public space in a certain area.

From the results, it can be inferred that these spaces are basically located in densely populated areas in the city (the average estimate of the location is 1.92) and also on the urban base with high publicity (the average estimate of the vertical position of the base is 1.92). As most of these spaces are considered to be open and accessible (publicity estimated at 1.6), there are no obvious prohibition signs in the space (regulation notices estimated at 2) and no shortage of recreational facilities (seats estimated at 1.54).

These spaces are also considered safer (1.25 for a safety estimate) and are visually open to connected streets (1.62 for a viewport integration estimate), and users will not experience motorized traffic in the spaces. However, the same results also reveal why three-dimensional public spaces often have boundaries that make people feel distant (the boundary is estimated to be 1).

The average value of the imageability of the surveyed subjects is only 1.25, indicating that most of the three-dimensional public spaces in a certain area do not have special significance and have good urban intentions that can create a "sense of community." The survey results also show that these three-dimensional public spaces can support a limited range of activities and behaviors (the functional diversity estimate is only 1.08) and are not flexible to the changing needs of users. In addition, the spatial design of these three-dimensional public spaces is not ideal. The average evaluation score of spatial form is only 1.23. Some spaces are limited by functions and have small scales. Although some spaces are large in scale and can accommodate various activities, the spatial form is single. It lacks the shaping of subspaces that can generate personalized experiences and diverse activity choices. The visualization of the average value of each control variable in the three-dimensional public space in a certain area is shown in Figure 3. The 10 control variables represented in the figure are as follows: preset function, functional diversity, spatial form, night lighting, vertical position of the base, physical environment, design elements that hinder the use of space, management organization, target beneficiaries, and publicity perception.

4.2. Publicity Assessment of All Dimensions of Three-Dimensional Public Space. The estimates obtained from the seven common component dimensions of the thirteen survey objects were marked on the corresponding axis positions of the multiaxis coordinates to establish a common seven-axis model. From the seven-axis model of the publicity of thirteen three-dimensional public spaces and the seven-axis model of the average publicity evaluation, it can be seen that the degree of publicity presented by each component dimension of the three-dimensional public space in a certain area is not optimistic.

Under the circumstance that the presupposed dominant function of the space cannot be changed, improving the adaptability of the space to various nonpredetermined functions is the most effective way to improve the publicity

Table 1: Survey of three-dimensional public space in a certain area.

Research site number	On-site distribution	Network collection	Valid questionnaire
1	120	220	315
2	132	109	236
3	100	156	247
4	110	167	270
5	145	180	336
6	116	189	300
7	165	195	347
8	126	200	311
9	114	170	280
10	106	195	294
11	108	206	302
12	115	156	267
13	129	184	298

Table 2: Public control variables of urban three-dimensional public space.

Control variable	Assignment criteria	Weight index	Research method
Preset function	The functional mechanism of action is embodied as a dialogue mechanism	1.1	Observations and interviews
Functional diversity	Can accommodate a variety of other functions	0.6	Data query and interview
Space form	Large-scale space with multiple subspaces	1.3	Questionnaire
Night lighting	Multiple lighting fixtures present and all covered	1.4	Observations and interviews
Vertical position of the base	Near ground area or surface layer	0.7	Observations and interviews
Physical environment	Several different microclimates, extensive overhangs, and trees	1.4	Data query and interview
Design elements that hinder the use of space	No space barriers	0.8	Observations and interviews
Governing body	Government agencies lead operations for public use	0.7	Data query and interview
Target beneficiaries	The beneficiaries are the majority	0.6	Questionnaire
Perception of publicity	Very public	1.3	Observations and interviews

of the space. However, it can be found from the survey results that the three-dimensional public space in a certain area is less inclusive of nonpreset functions. Most of the three-dimensional spaces can only adapt to a certain other function. The comparison of each dimension of the thirteen three-dimensional public spaces is shown in Figure 4.

The diversity of space design is an important factor that directly reflects the degree of publicity and can also have an important impact on other compositional dimensions. Although from the mean point of view, the thirteen three-dimensional public spaces reflect a high degree of publicity in the dimension of space design, but from the point of view of a single control variable, there are still some problems. First, more than half of the thirteen survey objects still have the problem of lack of spatial scale and subspace. The lack of subspace design fails to meet the flexibility of citizens in using the space; second, some spaces confuse subspace and hinder the use of space. In the design of space use elements, although some spaces have considered the shaping of subspaces in the design process, the inappropriate design of subspace boundaries and scales has instead cut off the continuity of space activities. The visualization of the control variable estimates of the spatial design dimension of the three-dimensional public space is shown in Figure 5.

Due to the fact that the selection of the research site has a certain type of equalization, the proportion of private development and construction and postmanagement and operation is equivalent to the proportion of development and management conducted by public institutions. However, looking at all the 13 three-dimensional public spaces in a certain area, companies or private individuals still account for the majority of development, construction, and post-operation management, and this model itself has a certain profit purpose. The management measures taken in more than half of these three-dimensional public spaces are mainly to protect the interests of managers themselves or those who can bring benefits to managers. In terms of management measures, some spaces are even more than a certain number of people. Management personnel will be dispatched to conduct inspections during gathering activities, some three-dimensional public spaces lack management, various service facilities in the space are not well

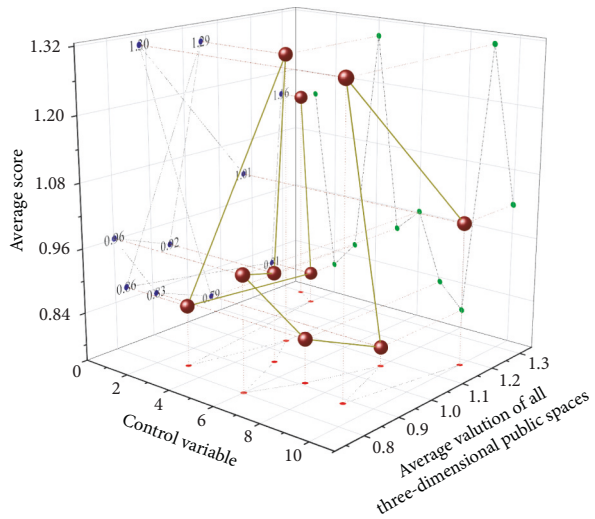

Figure 3: Visualization of the average value of each control variable in a three-dimensional public space in a certain area.

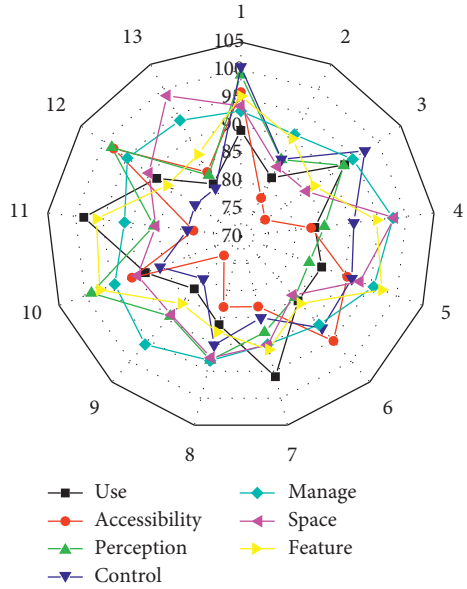

Figure 4: Comparison of dimensions of thirteen three-dimensional public spaces.

maintained, the quality of the space environment is degraded, and eventually the vitality of the space is lost. The proportion of management agency types is shown in Figure 6.

Thirteen three-dimensional public spaces have a high level of publicity in terms of control dimensions, with an average evaluation score of 81.5 points. But there are also parts of the space control that show a certain exclusivity. From the estimation of control variables, the main reason is the lack of intensive monitoring equipment and guidance signs.

4.3. Publicity Evaluation and Analysis of Three-Dimensional Public Spaces with Different Functions. In this study, the three-dimensional public space is divided into three-dimensional public space dominated by traffic, three-dimensional public space dominated by business, three-dimensional public space dominated by office, and three-dimensional public space dominated by recreational landscape. Now, a multidimensional comparative analysis of the publicity of these four different types of three-dimensional public space in a certain area is carried out, and the problems existing in different types of publicity are analyzed. From the comprehensive score of publicity, the commercial-led three-dimensional publicity in a certain area is the highest, with an average score of 77.9; the publicity of the three-dimensional public space dominated by recreational landscapes ranks third, with an average score of 71.0. The least public space is the three-dimensional public space dominated by traffic, with an average score of only 61.5 points.

The spatial design dimensions of the four types of three-dimensional public spaces in this survey also show a special phenomenon—the three-dimensional public space dominated by business and office has a significantly better consideration of space design than the one dominated by traffic and recreational landscapes. In the three-dimensional public space, the evaluation score of three-dimensional public space design dimension dominated by business and office is 87 and 76 points, respectively, while the evaluation score of three-dimensional public space design dimension dominated by transportation and recreational landscape function is 83.6 and 75.9, respectively. Among them, the space design of the commercial-led three-dimensional public space reflects the highest publicity. Although the spatial scale of the commercial-led three-dimensional public space is limited, the design of seats and night lighting is relatively expensive. Compared with the three-dimensional public space dominated by business and office, the three-dimensional public space dominated by traffic and recreational landscapes is slightly monotonous, and there are obvious defects in seating and night lighting, thus reducing the cost and publicity score. The comparison of the publicity of different types of three-dimensional public spaces is shown in Figure 7.

Usually, the three-dimensional public space dominated by business and office is developed by enterprises, groups, and other organizations, and these development units also organize the follow-up space operation and management. When these two types of spaces are managed, the people who have the ability to consume in the adjacent commercial area and work in the office building and can directly or indirectly create benefits for the management organization were often set as target beneficiaries. Outside the center, the remaining space target beneficiary control variables used in these two types of spaces are all undervalued (valued at 1). The three-dimensional public space is dominated by traffic and recreational landscapes. Although most management agencies are state-owned units and government units, and the management benefit target is also the majority of citizens, but in terms of management measures, these two types of spaces have the phenomenon of excessive management and insufficient management, resulting in insufficient space vitality and reduced space popularity. The visualization of different types of three-dimensional public space management dimension estimates is shown in Figure 8.

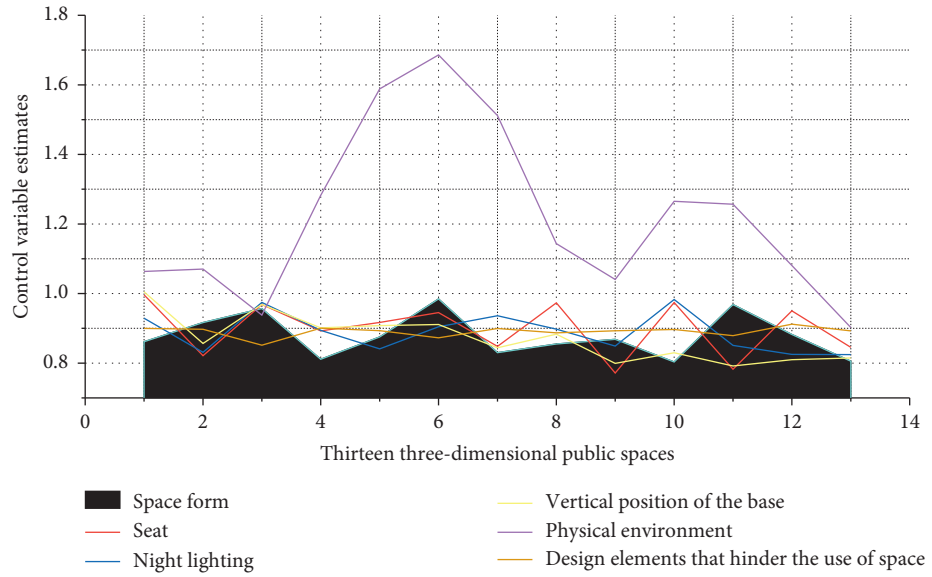

Figure 5: Visualization of control variable estimates for three-dimensional public space design dimensions.

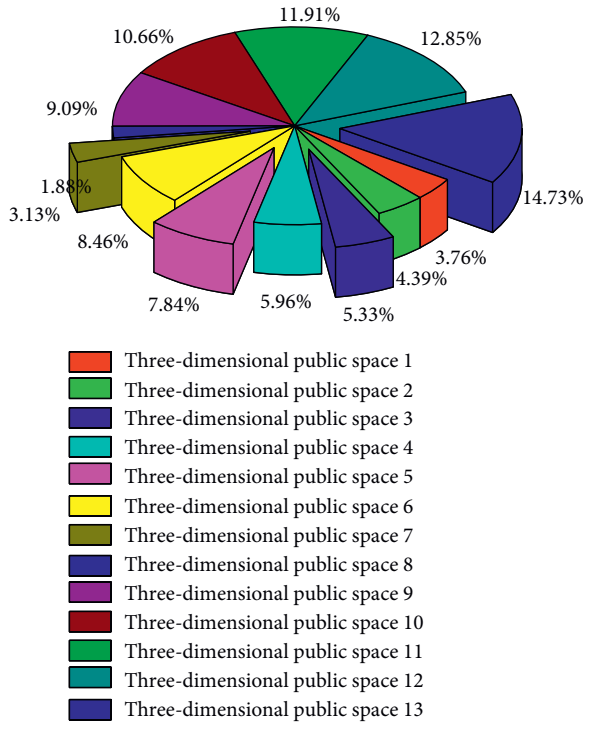

Figure 6: Proportion of the types of management institutions.

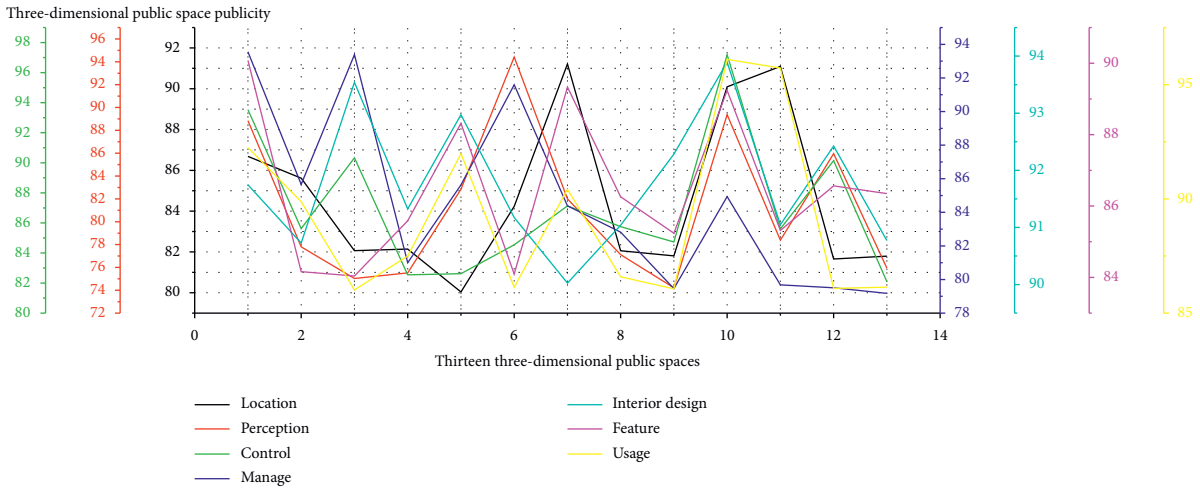

Figure 7: Comparison of publicity of different types of three-dimensional public spaces.

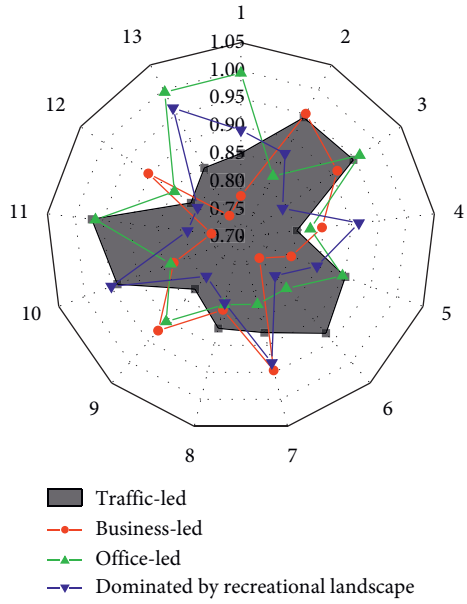

Figure 8: Visualization of dimensional estimation of different types of stereoscopic public space management.

5. Conclusion

The platform of choice is ArcGIS Server. As a powerful enterprise-level GIS system development tool, it can convert resources into services and publish them. The study introduces in detail the implementation of system authority management based on RBAC, which can realize user management, role management, resource management, etc., and introduce the electronic map system implemented by combining JavaScript and nonrefresh callback technologies, including the realization of basic map operation functions, information query and display, mark point labeling, eagle eye map, area measurement, printing, and other functions, as well as basic GIS platform service functions and interface calls realized through REST technology. Through this platform, the data sharing can be realized among multiple departments and regions of the company, and by establishing a web geographic information service system in B/S mode, users can browse and operate map services through web connections anywhere. Based on the basin runoff theory, ArcGIS software was used to analyze the basin hydrological information, and the catchment area threshold and hydrological response unit were determined. On the basis of the theoretical framework, it proposes seven components of the urban space publicity and defines the defining characteristics of "public" and "private." At the same time, it is concluded that the special impact of three-dimensional public space on public life is mainly concentrated on two factors, namely, vertical position and vertical traffic, so that a complete evaluation model for the publicity of three-dimensional public space can be established, including seven public properties. High-speed urbanization has made Shenzhen a pioneer city in various studies of urban planning. In terms of the construction of three-dimensional public space, a certain area, as a typical high-density city, also has a certain perspective. Therefore, this study evaluates the publicity of a three-dimensional public space in a certain area, summarizes its publicity problems, and based on the analysis, proposes a three-dimensional public space publicity improvement strategy with a certain universal value.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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