Research Article

Design Model of Urban Leisure Sports Public Facilities Based on Big Data and Machine Vision

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Sports facilities are the material basis for people to participate in physical exercise. The construction of facilities is conducive to improving people’s health and their expectations for a happy life. Sports facilities are part of the infrastructure. The reasonable layout of sports facilities is conducive to shortening the gap between urban and rural areas, achieving common economic prosperity, and promoting social harmony and unity. Public sports facilities are of great significance to urban construction and people’s daily lives. Based on big data and machine vision, this document constructs a big data model framework for urban public sports and leisure facilities, quantifies the diversity and overall coordination of sports facilities, and conducts simulation experiments on the designed urban leisure and sports public facility model. The experimental results show that compared with the traditional method, this method effectively improves the coverage of urban leisure and sports public facilities, and the space utilization rate is increased by 15.32% compared with the traditional method, which maximizes the use of regional space and makes it more convenient for urban residents. It can carry out physical exercise quickly and improve the quality of life of residents.

1. Introduction

Under the background that the State Council has raised sports to the height of the national strategy, under the slogan of advocating the people as the core of the development of sports, the development of sports facilities that are closely related to the vital interests of the general public should be paid attention to by governments at all levels. Physical exercise, as a part of spiritual needs, brings people spiritual relaxation and enjoyment in the fast-paced modern life. Public sports facilities are the equipment foundation for people’s physical exercise. The quantity, quality, and distribution of public sports facilities affect people’s enthusiasm and efficiency of physical exercise to a large extent and can further affect people’s living conditions and quality of life. At present, the construction of public sports facilities in our country has largely failed to mobilize people to actively participate in physical exercises. How to build and develop on the basis of existing public sports facilities in order to better respond to national policies and fully mobilize people’s fitness, enthusiasm has become an urgent problem for sports workers. Under this circumstance, we must not only learn from the advanced experience of other local governments in the construction of public sports facilities but also need to absorb the outstanding achievements of public sports construction in developed countries in foreign countries, select experiences and results that meet the actual conditions, and guide them in the country’s major policies. Next, the construction of public sports facilities will be completed better, faster, and with higher quality.

In the late 20th century, with the continuous improvement of our country’s economy, the Engel coefficient of urban residents decreased year by year. While enjoying material enrichment and improving living standards, people are also pursuing health and enjoying health. In recent years, our country has gradually entered a period of high-speed development and construction of sports facilities, and while developing, there have also been some problems that need to be improved. As a way of shaping a healthy physique and forming a high spirit, sports activities are becoming more
and more important to people. Public sports facilities are the material basis for sports activities, and they bear a distinctive task. The emphasis on the construction of public sports facilities is of great significance in the decisive stage of building a well-off society in an all-round way. Because if we want to give full play to the economic driving role of the sports industry and seize the opportunities for the development of sports, the construction of public sports facilities is indispensable.

In order to improve the allocation of physical education resources in colleges and universities, Niu and Zhang’s research constructed a data envelopment analysis (DEA) model by analyzing the proportion of public sports service facilities in colleges and universities. This paper selects the input indicators and output indicators of college sports public service facilities and selects 20 colleges and universities as decision-making units, constructs a DEA model, and studies the DEA Tobit 2-stage method for evaluating the efficiency of college public sports service facilities. The results show that in colleges and universities, the pure technical efficiency of sports public service facilities is effective. However, there are still big problems in the proportion of public sports service facilities in our country [1]. Today, the functional concept of sports facilities is no longer limited to sports. Sport is not limited to professional athletes and sports teams; it must be available to everyone in different age groups. There has also been cooperation between sports and entertainment public facilities. The purpose of this work is to determine the typical characteristics of sports facilities, which depend on their location in the population service system of large cities in Syria. Darf’s research is based on the analysis of the main characteristics of 120 sports facilities and buildings, as well as the research of the urban population’s public service hierarchy [2]. Anestos et al. research people’s opinions on the concept of naming rights sale of public sports facilities in Greece and conduct a preliminary investigation to explore the possibility of introducing this kind of sponsorship practice in the future. A total of 410 study participants filled out a questionnaire that focused on acceptance, changes in agreement, and consideration of decision-making result scenarios and other naming power parameters [3]. U.S. taxpayers heavily subsidize professional sports leagues and teams through direct and indirect public funds to build professional stadiums. Alakhendra investigates and records the most commonly used stadium financing methods in recent years, and the historical transition from privately constructed stadiums to publicly funded stadiums in 65 years. This article also briefly reviews the literature that assesses the impact of public expenditures on professional sports venues. A large amount of literature on this subject shows that economists and urban planners agree that perceived economic development cannot be used as a reason to provide public subsidies for the construction of expensive professional sports stadiums [4]. In order to explore the spatial layout theory of urban sports facilities, Yuan et al. started with theoretical knowledge analysis, analyzed the status quo of public sports facilities in downtown Jinan, discussed various factors affecting the planning layout, and summarized the strategies and methods for the layout planning of public sports facilities in Jinan. The results show that the layout planning of public sports facilities should follow corresponding models and principles [5]. Kim and Kim’s study investigated and analyzed the actual use of public sports facilities and the characteristics of facility users and used the gravitational potential model to measure the spatial imbalance of existing public sports facilities. This research also proposes evaluation criteria that can be considered for effective location selection by examining changes in the accessibility of facilities that meet user needs in the future. As a result of the questionnaire survey, different from the current use, users wish to perform badminton, weight training, and swimming. And we can confirm the expansion of the demand for multifunctional indoor gyms that can carry out such activities in the area. As a result of the analysis of the difference in the accessibility of public sports facilities, there are big differences in various regions. It turns out that, in terms of fairness, a balanced supply of facilities is needed. Particularly when analyzing the population estimates in 2025, it is analyzed that accessibility will decrease [6]. The Xie study is aimed at empirically proving the relationship between consumer choice factors and satisfaction in public sports facilities in Hunan Province, China. To this end, from March to April 2016, a questionnaire survey was conducted among 486 users of public sports facilities in 4 cities in Hunan Province, and based on the collected data, confirmatory factor analysis, reliability testing, frequency analysis, and correlation analysis were carried out and use Win SAS Ver. to perform multiple linear regression analysis. First of all, in the selection factors of public sports facilities, facilities, projects, coaches, user costs, and satisfaction have a significant impact on the satisfaction of coaches. Secondly, among the selection factors of public sports facilities, facilities, projects, coaches, user costs, and satisfaction have a significant impact on facility satisfaction. Third, in the selection factors of public sports facilities, facilities, projects, instructors, and accessibility factors have a significant impact on project satisfaction [7].

The innovation of this article lies in the application of big data to quantitatively study public service facilities in new urban areas. The era of big data has brought a breakthrough in urban cognition, which can not only overlook the whole area but also focus on the behavioral activities of microindividuals. This research uses big data as the breakthrough point. In addition to visually expressing the spatial relationship between public service facilities and residents, it uses a combination of quantitative analysis and spatial analysis to carry out a multidimensional quantitative analysis of the relationship between public service facilities and residents. Evaluate the level of deployment, convenience, and accessibility of public service facilities in terms of population coverage within the service radius of public service facilities, the number of nearby sports public facilities available for residents to choose from, and the transportation distance of residents to public service facilities. In graph theory, reachability refers to how easy it is to go from one vertex to another in a graph. In an undirected graph, the reachability between all pairs of vertices can be determined by identifying the connected components of the graph. It not only
enriches the research methods of public service application and makes the research more scientific and reasonable but also demonstrates the application and operability of big data in public service application research.

2. Model Design of Urban Leisure and Sports Public Facilities Based on Big Data and Machine Vision

2.1. Urban Leisure and Sports Public Facilities. Sports public facilities are regarded as the basic material equipment to show the function of urban integration, which plays a very important role in the construction and layout of a city. The role of public sports facilities is mainly reflected in two aspects. First of all, it has a wide range of applicability and can meet the physical exercise needs of the local people. It can be applied to young people and the elderly to improve their physical fitness and living standards, thereby reducing the occurrence of diseases. Secondly, from a macro perspective, the role of public sports facilities in strengthening the physical quality and improving the mental state of the Chinese nation can not be underestimated. Public sports facilities play an important role in promoting the development of sports masses. It can fully contribute to the benefits of the city in the process of urban renewal and provide the necessary impetus for the comprehensive collective development of social civilization and material civilization in the new stage of social development [8, 9].

However, there are still shortcomings and shortcomings in the construction of public sports facilities, which mainly include the following: the distribution of public sports facilities is different, the types are not rich enough, the utilization rate of facilities is low, the inability to meet the needs of residents, the management is not in place, and the facility supervision is insufficient. Through investigation and research on the construction and use of community public sports facilities, school sports facilities, and rural public sports facilities, we hope to be able to come up with the actual situation of public sports facility construction. There are countermeasures to promote the continuous improvement of the construction of urban public sports facilities. The following conclusions were initially reached:

(1) There are differences in the distribution of urban public sports facilities. Taking residential communities as an example, among the four communities investigated in this article, some of the four communities have complete types of sports facilities and a large number of fitness equipment, while others lack the construction of sports facilities. Looking at the leopard, there is a lack of unified planning in the construction of public sports facilities [10, 11]

(2) The types of public sports facilities are not rich enough. Although increasing investment in urban public sports facilities, it mainly focuses on the construction of large-scale stadiums and sports parks, and insufficient investment in small public sports facilities that are closely related to residents’ daily physical exercise, resulting in insufficient public sports facilities. It is mainly reflected in the two aspects of the insecurity of residents’ physical exercise land and the shortage of indoor sports venues [12, 13]

(3) Low utilization rate is another shortcoming of urban leisure public sports facilities. Through various investigations and analyses, the concept of “National Fitness” and the knowledge of life sports have not been widely promoted and popularized, and the attention of residents participating in sports activities is not strong enough. In addition, due to the lack of groups specializing in scientific physical exercises, many groups in society have very limited opportunities to participate in physical exercises. At the same time, the age structure of the physical exercise population is dominated by the elderly, and the young and middle-aged people lack exercise due to academic and work pressure, resulting in insufficient utilization of sports facilities such as basketball courts and badminton courts that are more popular among young people. Residents’ lack of fitness awareness, inadequate government publicity, and the aging trend of the exercise population have led to underutilization of urban leisure and sports public facilities [14, 15]. Although the utilization rate of urban leisure public sports facilities is low, it does not mean to give up its construction, because as long as the publicity of physical exercise is in place, its utilization rate can be increased, and sports facilities are of great significance to strengthening the physical fitness of the people

(4) The construction of urban leisure and sports public facilities has not yet met the needs of residents. Residents’ needs for public sports facilities are diversified and changeable, and due to the rapid development of the local economy and the rapid dissemination of information, this trend has continued to strengthen. The existing public sports facilities cannot well meet the diverse fitness needs of residents, especially for sports cultural squares and indoor sports venues [16]

(5) The management of urban leisure and sports public facilities is not in place. The construction of public sports facilities lacks supporting surrounding services, and the government lacks investment in public sports facility instructors and public sports facility administrators, making public sports facilities have safety hazards, and residents who do not understand the role of relevant public sports facilities can not give full play to them, fitness utility of public sports facilities [17]. For such problems, the government can increase the investment of facility managers and at the same time strengthen the construction of sports culture, so that people understand the importance of physical exercise
(6) The supervision of public sports facilities is insufficient. There is no supervision on the construction of public sports facilities [18], and no unified standards and scales for the construction of public sports facilities have been formulated, so that in the actual construction of public sports facilities, it is often impossible to follow the original plan.

2.2. Sports Public Facilities Based on Big Data. Although the application of big data in the domestic urban planning industry has been explored for several years, there are few examples of using big data to conduct research on public service facilities. Take big data and public participation as new ideas for the design and preparation of public service facilities in new areas, and use big data as support to grasp the influencing factors such as population structure, future population distribution trends, and house-buying crowd characteristics. Based on this, flattening differentiated public service facility system [19–21]. Use big data to evaluate the layout of basic sports facilities, provide a reference for the planning of basic sports facilities, and propose that the layout of public service facilities based on population activity data and public service facility usage data is a new direction for future public service facility planning.

The era of big data is not only as powerful as a bamboo but also silently descending; it is both powerful and growing. After several years of foreshadowing and deliberation, the wave of big data has gradually penetrated into all walks of life, and at the same time, it has penetrated into urban planning and related fields by means of spring rain. The translation and introduction of big data not only mean new data and new methods for the urban planning industry, but it is more likely to bring about changes in thinking and research paradigms. In recent years, big data has shown broad application prospects in urban research. The rise of big data and its application in urban research can not only discover problems in urban development in time but also collect, mine, and refine data. It can provide new ideas for solving urban problems and create a win-win situation of "people-city-environment" [22–24]. The digitization of urban infrastructure and the advancement of Internet of Things technology have allowed various sensors to spread all over the city. Through the data received by these sensors, buildings, roads, and other facilities can be simulated and digitally reconstructed in the virtual city [25].

At present, scholars in urban planning, transportation, time geography, and other disciplines have tentatively carried out urban research based on big data, such as using bus IC card swiping data, mobile phone positioning data, and taxi trajectory data to carry out urban traffic research and visual expression. The spatial distribution of occupation and residence, and the characteristics of commuting travel, through the crawling of location service data and point of interest data, research on urban functions and urban social space is carried out. The arrival of big data makes urban planning and research support from "things" to "people," and it is gradually spreading in the field of urban research, enriching and expanding the depth and breadth of urban research [26–28]. The structure diagram of the big data model of urban leisure and sports public facilities designed in this paper is shown in Figure 1.

Figure 1 is a structure diagram of the big data model of urban leisure and sports public facilities. It shows that the use of big data for image data processing can extract key urban leisure data to facilitate the construction of urban leisure public facilities, combined with the characteristics of urban leisure sports; it can be quantitatively expressed from three aspects. The three aspects include the naturalness of facilities, the openness of vision, and the diversity of sports public facilities [29].

(1) The naturalness of materials refers to the distribution of urban sports materials. The coverage of facilities mainly refers to the proportion of the area covered by sports facilities to the total area of the city. This mainly reflects the density of urban entertainment and sports facilities, indicating a high coverage of facilities [30]. Sports facilities are more natural, and the types of facility coverage are

\[ G_s = \frac{t_x}{a} \times 10\%. \]  

In formula (1), \( G_s \) represents the coverage rate of facilities, \( t_x \) represents the total area of sports facilities, and \( a \) represents the total area of urban leisure sports facilities.

(2) The opening of urban sports facilities essentially means that some small buildings have an impact on the area of local sports facilities and bring bad visual effects to people [31]. Sports facilities and congestion density are used to measure the openness of urban leisure and sports facilities

\[ G_y = \frac{\sum_{i=1}^{m} t_{yi}}{a} \times 10\%. \]  

In formula (2), \( G_y \) represents the density of urban sports facilities, \( t_{yi} \) represents the bottom area of the \( i \)th sports facility, and \( m \) represents the total number of leisure sports areas in the city.

The density of sports facilities is mainly to look at the site of the facility from the overall point of view and calculate the distribution density of sports facilities in the building area. The higher the distribution density index value, the higher the degree of congestion and the smaller the aperture [32]. It can be expressed as

\[ TG_y = \frac{\sum_{i=1}^{m} S_{iy}}{\max \{ K_y \times a \}} \times 100\%. \]  

In formula (3), \( TG_y \) represents the congestion degree of the sports facility space, \( S_{iy} \) represents the area of the \( i \)th sports facility, and \( \max \{ K_y \times a \} \) represents the maximum height value of the urban sports facility.
The many elements of urban public holidays and amusement facilities can enhance people’s visual and fresh experience and meet the needs of different levels [33]. This paper proposes to adopt the color and composition of urban sports facilities and use the complexity of the components of sports facilities to express different public sports facilities. Its type can be expressed as

\[ R = GQ \times PB \]  \hspace{1cm} (4)

In formula (4), \( R \) represents the complexity of the components of sports facilities, \( GQ \) represents the type of facility color, and \( PB \) represents the type of facility.

\[ RD_y = \frac{1}{m} \sum_{i=1}^{m} \frac{2 \ln (P_{yi})}{\ln T_{yi}}. \]  \hspace{1cm} (5)

In formula (5), \( RD_y \) represents the average fractal dimension of the sports facility, \( P_{yi} \) represents the perimeter of the bottom area of the sports facility \( i \), and \( T_{yi} \) represents the bottom area of the sports facility \( i \).

The peculiar characteristics of public sports facilities mainly affect the attractiveness of public sports facilities to people [34]. Urban sports facilities are mainly composed of a large number of architectural teams, which can easily form the same style.

\[ D_y = K_{max} \sum_{i=1}^{m} (P_{yi}) \ln (P_{yi}). \]  \hspace{1cm} (6)

In formula (6), \( H \) represents the index of diversity, and \( P_{yi} \) represents the proportion of the volume of sports facility \( i \) to the total volume of sports facilities.

The adjustment of urban sports facilities mainly refers to the adjustment of the elements of public sports facilities, including the correlation between sports facilities and natural vegetation, expressed by the volume ratio of sports facilities and man-made facilities

\[ GO = \frac{X_x}{X_y} \times 100\%. \]  \hspace{1cm} (7)

Establish a fairness index model for urban leisure and sports public facilities

Based on the above-mentioned facility ecology theory, combined with the construction characteristics of public sports facilities, 3D simulation space simulation technology is used to create a public facility fairness model for the design of public sports facilities. The fairness index refers to a common index used internationally to measure the income gap of a country or region. It can be used here to reflect the fairness distribution of public sports facilities. The power index and the degree of separation are expressed by equation (8), and the standards for public facilities and site impact are

\[ H_i = \sum_j k(M_j, N_{ij}). \]  \hspace{1cm} (8)

\[ P_{ij(t)} = H_{jt} \times \frac{N_{ij}}{t}. \]  \hspace{1cm} (9)

\( P_{ij(t)} \) represents the fairness index of urban leisure and sports public facilities \( t(k) \) in architectural space \( i, i = 1, 2, \ldots \).
\[ P_{j(t)} = H_{j(t)} \times N_{j(t)}^{-2}. \] 

(10)

Therefore, the total value of urban sports facilities public facilities equity index in the \( i \) of sports facilities space is

\[ S_i = \sum_{t=1}^{T} \sum_{j(t)=1}^{j} N_{j(t)}. \] 

(11)

\( T_i \) represents the sum of the fairness index of urban leisure and sports public facilities, thus completing the design research on urban leisure and sports public facilities.

2.3. Machine Vision Algorithm. Machine vision is a rapidly developing field of artificial intelligence. The working principle diagram of machine vision is shown in Figure 2.

(1) Image denoising

Common image denoising has mean filtering, median filtering, and wavelet denoising. The mean filtering algorithm is

\[ D(a, b) = \frac{1}{N} \sum_{(i,j) \in C} k(i, j), \] 

(12)

\[ D(a, b) = \text{median}\{f(a - r, b - s), (r, s \in Q)\}. \] 

(13)

Among them, \( k(i, j) \) is the original image, \( D(a, b) \) is the image after mean filtering, and \( M \) is the number of template pixels.

The signal-to-noise ratio is one of the important bases for measuring the effect of image denoising processing. The signal-to-noise ratio of the image is the ratio of the signal power to the noise power. Because the image power is difficult to calculate, the ratio of the signal variance to the noise variance is equivalent to the signal-to-noise ratio. The image signal-to-noise ratio formula is shown in

\[ \text{SNR} = 10 \times \log \frac{\sum(a(x,y) - a)^2}{\sum(a(x,y) - A(x,y))^2}. \] 

(14)

Image denoising was performed using three methods, and the peak signal-to-noise ratio is compared in Table 1. It can be seen from Table 1 that the three methods have improved the sexual-to-noise ratio of the image. The signal-to-noise ratio of the image obtained after the median filter is the largest, so the median filter has the best denoising effect for this system. The SNR of the image obtained by the mean filtering algorithm and the wavelet denoising algorithm is similar. The median filter algorithm is simple, and the time complexity is low, so the median filter algorithm is used to denoise the infrared image.

(2) Infrared target detection result

This paper compares the detection effect of the center distance method, least-squares fitting method, and random Hough transform.

(1) Center distance method

The center distance method is a common spot detection method. The center distance method is used to obtain the beacon center formula.

\[
\begin{align*}
    a_0 &= \frac{\sum_{m=1}^{x} \sum_{n=1}^{y} np(m,n)}{\sum_{m=1}^{x} \sum_{n=1}^{y} p(m,n)}, \\
    b_0 &= \frac{\sum_{m=1}^{x} \sum_{n=1}^{y} mp(m,n)}{\sum_{m=1}^{x} \sum_{n=1}^{y} p(m,n)}. 
\end{align*}
\] 

(17)

(2) The essence of the least-squares fitting method to detect the beacon image is to calculate the center coordinates of the light spot by using the principle of the minimum sum of squares of the residuals. The formula for calculating the spot parameters by least squares is as

\[ \text{psnr} = 10 \times \log_{10} \left( \frac{255 \times 255}{\text{mse}} \right). \] 

(16)
Table 1: Signal-to-noise ratio comparison.

| Methods                  | Signal-to-noise ratio |
|--------------------------|-----------------------|
| Original image to noise ratio | 2.4315             |
| Mean filter              | 12.7486              |
| Median filter            | 15.3148              |
| Wavelet denoising        | 13.0361              |

\[
x = \frac{(a^2a + ab^2 - a^3 - ab^3) (b^2 - b^2)}{2(a^2-a^2)(b^2-b^2) - 2(ab-ab)^2},
\]

\[
y = \frac{(a^2b + b^2b - a^2b - b^2b) (a^2 - a^2)}{2(a^2-a^2)(b^2-b^2) - 2(ab-ab)^2},
\]

\[
z = \sqrt{x^2 - 2ax + y^2 - 2by + a^2 + b^2}.
\]

(3) Improved random Hough transform

Random Hough transform has certain defects, and it takes a long time to detect, so the random Hough transform method is improved, and a random Hough transform method based on gradient information is studied. In order to reduce the invalid accumulation of random Hough transform when detecting the target, this method can reduce the amount of calculation and the search time of the linked list. Next, the specific implementation of the improved random Hough transform is introduced. The pixel value of 5A is (a5, b5), and X5 is one of the three randomly selected edge points. Figure 3 is the pixel distribution map of X5 and 8 neighborhoods.

Calculated gradient:

\[
D_a = (X_3 + 2X_6 + X_9) - (X_1 + 2X_4 + X_7),
\]

\[
D_b = (X_7 + 2X_8 + X_9) - (X_1 + 2X_2 + X_3).
\]

The gradient of the pixel point X5 in the a and b directions is \(D_a\) and \(D_b\), the gradient direction angle is \(\eta\), and the straight line equation that the slope of the pixel point X5 is the gradient direction is

\[
b - b_5 = \eta(a - a_5),
\]

\[
G = \frac{|SA - B + Y|}{\sqrt{1 + S^2}} < \gamma.
\]

Beacons were monitored by the center distance method, least-squares fitting method, Hough transformation method, and improved Hough transformation method. The detection results are shown in Table 2.

Compare and analyze the central moment method, least-square fitting method, Hough transform method, and improved Hough transform method to measure time and test results. It can be seen from Table 2 that several algorithms with the smallest central moment can detect the target image. Among them, the central moment method can only detect the center of the target but cannot determine the size of the target. The central moment method has the characteristics of fast calculation speed and simple algorithm, but the disadvantage is that it cannot detect the spot radius. The least-square method can accurately fit the target image, but it takes a long time in the image processing process, which is not suitable for practical applications and cannot meet the real-time requirements of engineering applications. Similarly, the Hough transform method takes a long time to detect and is not suitable for practical applications. By improving the random Hough transform method, the improved random Hough transform method can detect the target image more accurately and, at the same time, the speed is faster. Therefore, the improved Hough transform method can achieve both accuracy and speed and can be applied in actual engineering. The article uses these algorithms to evaluate the construction of urban leisure and sports public facilities. The common spot detection method in the center distance method, the image detection in the least-square fitting method, and the random Hough transform method based on gradient information are used to study the sports public facilities.

3. Construction of Urban Leisure and Sports Public Facilities Based on Big Data and Machine Vision

3.1. Construction of Urban Leisure and Sports Public Facilities. Developed countries have complete facilities for sports facilities and a reasonable layout. What our country needs to consider is to meet the different sports needs of residents. The research on the compound function of stadiums is the main trend abroad. Its production is closely related to the construction method. By comprehensively considering the location, scale, and content of the facility, it not only serves the game but also takes into account the healthy lifestyle, leisure, and young people’s participation in the community, forming a social fitness network centered on sports facilities to activate the community life and drive the demand for related facilities.

Among them, facility sensitivity is an important factor affecting the construction of urban leisure and sports public
facilities. It can be used to evaluate citizens’ attention to a certain facility area. The more people there are in the district means that the district has a stronger sensitivity. According to the sensitivity of facilities, the appearance of urban leisure sports public facilities and the facility area of sports area can be divided into low, medium, and high sensitive areas. According to the different sensitivity of facilities, targeted facility construction should be carried out in different areas, and the impact of pedestrian flow on the area should be reasonably considered. For example, the multifunctional square in the leisure and sports area in the urban sports park belongs to a highly sensitive area due to its strong functionality and a large number of people. Through the reasonable control of the surrounding environment, different pavement division methods should be used to form the invisible effect of the road, so as to control the amount of pedestrian flow, so as to avoid unnecessary impact on the public facilities, in the static leisure fish hole area of leisure sports in the urban sports park, due to the moderate pedestrian flow used in this area. And they all do some static sports, such as traditional health care sports, so we can build sports facilities according to this characteristic.

3.2. Distribution of Sports Facilities. When studying the planning of public sports facilities, take the public sports facilities as the destination and the residents’ starting point as the starting point. In order to make the results more realistic, it is necessary to determine a suitable quantitative method. First, we must understand the entire behavior process and then formulate the principles of choosing quantitative methods.

In modern urban life, people pay more and more attention to their physical condition and take physical exercises after work. With the increase of urban population, urban land is becoming more and more tense, resulting in less and less land that can be used as sports land, and people’s growing demand for sports facilities cannot be met. Due to the limited rest time, people have to make compromises when choosing sports service points. People often choose “will be.”

All classes of society have demands for physical fitness, and there is no need to use factors such as education, income, personal preferences, gender, and other factors to divide them into different groups for research and regard citizens as those who need physical exercise. It is difficult for researchers to verify the conditions of sports facilities themselves, so they regard them as the same level. In the previous paragraph, it was mentioned that when people choose sports facilities, their position is the primary consideration. May make the research results more in line with reality.

3.3. Simulation Experiment. In order to verify the model of urban public leisure sports facilities, we conducted simulation experiments to analyze them. The experimental data is based on big data and machine vision algorithms. The experimental sample data is taken from a specific urban area.

3.4. Questionnaire Survey. In order to more fully grasp the distribution and existing problems of urban public sports facilities, some venues and facilities were selected for field investigation, focusing on their building usage, facility perfection, residents’ usage, sports atmosphere, and the availability of surrounding road traffic. Investigations were conducted on the status of arrivals and residents' satisfaction.

It can be seen from Table 3 that the questionnaire in this article is relatively reasonable in terms of overall, content, and design, conforms to the relevant elements required by the questionnaire, and can provide reliable data for the study of this article.

4. Model Analysis of Urban Leisure and Sports Public Facilities Based on Big Data and Machine Vision

4.1. Simulation Experiment Analysis. Table 4 is an analysis of the diversity of urban leisure and sports public facilities.

According to Table 4, the proposed methods have significantly higher diversity in urban recreational sports public facilities than the other two methods. Figure 4 is the comparison of the coverage rate and the spatial share of the urban leisure and sports public facilities.

Analyzing Figure 4, we can see that the space occupancy rate of urban public leisure and sports facility design using the 3D simulation of the space analysis technology proposed in this paper is higher than that of conventional methods. The method proposed in this paper also fluctuates with the development of facilities, and the occupancy rate of this area also fluctuates, but the overall occupancy rate is on the rise, and the occupancy rate is increased by 15.32% compared with the conventional method. This shows that the use of 3D simulation space simulation technology in the design of public commercial landscape facilities can effectively improve people’s quality of life and maximize the use of surrounding space. Using machine vision algorithms to analyze the urban leisure sports public facility model can effectively reduce the difficulty and fault tolerance rate of artificial algorithms, increase its accuracy, and provide effective help for the construction of urban leisure sports public facilities.
4.2. Questionnaire Survey Analysis

4.2.1. Basic Situation

(1) Type of sports crowd

According to the survey and statistics, the number of women is more than that of men, including 92 men and 90 women; among the age groups of the respondents, 20 are less than or equal to 20 years old, 60 are 21-30 years old, 41 are 31-40 years old, 26 are 41-50 years old, and 35 are over 50 years old.

(2) Exercise frequency

In the frequency of exercise, the number of respondents who exercise 2-3 times a week is the largest, with 86 people, accounting for nearly 60% of the surveyed population; followed by 63 people with a frequency of 4-7 times a week; almost no exercise, the minimum number of people is 33. It shows that the respondents are more aware of exercise, and the detailed information is shown in Figure 5.

(3) Popular types of sports

In terms of facility type preference among the interviewees, the number of people who choose to walk is the most, and the most popular sports are walking and badminton. 68 people chose to walk (22.52%), 21 people used badminton (6.95%), 34 people used aerobics and square dancing (11.26%), 9 people used bicycles (2.98%), and 66 people went jogging (21.85%), 32 basketball players (accounting for 10.60%), 36 table tennis players (accounting for 11.92%), 12 dancers (accounting for 3.97%), 8 Taijiquan players (accounting for 2.65%), and 16 bodybuilders (accounting for 5.30%). The information is shown in Figure 6.

(4) Exercise locations and facilities

In terms of places and facilities for exercise, 75 people chose parks as the most; 30 chose to exercise at home; 28 people in the community square; municipal gymnasium for 17; 12 people in health clubs and 11 people in primary and secondary school sports facilities; and sports facilities of enterprises and institutions for 9 people.

(5) Exercise period

In terms of exercise time, 68 people chose the evening as the most; 55 in the morning; 33 on weekends; 25 in the morning; and 10 people in the afternoon. As shown in Figure 7, nearly half of the interviewees concentrated their exercise time in the evening.

The results of the survey are shown in Figure 7. The respondents are most willing to go to the park for physical exercise, and the proportion is as high as 40%. A relatively high percentage of people choose to exercise at home or community squares, but a relatively low percentage of people choose to go to self-employed fitness clubs, municipal stadiums, or corporate sports facilities. In addition, the number of school sports facilities opened is relatively small. When designing public sports facilities, more attention should be paid to large-scale gymnasiums to create public sports facilities that are close to residents and easy to use.

(6) Exercise intention

In terms of exercise intentions, respondents who exercise regularly and infrequently choose to exercise the most physically, accounting for 49% and 16%; stress reduction and emotional adjustment accounted for 30% and 25%; entertainment and pastime accounted for 33% and 14%; improvement of sports skills accounted for 5% and 4%; increased social interaction accounted for 18% and 2%; participation in competitions accounted for 3% and 1%. The survey results show that the respondents’ exercise intention is highly correlated with their physical health.

(7) Reasons for hardly exercise

Among the reasons why the interviewees hardly exercise, the number of people who do not exercise due to lack of time is the largest. Subjective reasons have become the main reason why the interviewees do not exercise; the second is that they do not exercise regularly because there is no suitable venue nearby. The subjects have a certain demand for sports facilities; they have no interest in exercise and do not exercise regularly due to weather and economic conditions. The detailed results are shown in Figure 8.

(8) Public intentions

Through research, it is understood that residents have a diversified demand for public sports facilities, including badminton courts, indoor activity rooms, basketball courts, swimming pools, track and field courts, table tennis tables, and fitness equipment. Among them, the demand for the

| Method                          | Composition | Abundance of facilities |
|---------------------------------|-------------|-------------------------|
| Characteristic creation method  | 8           | 53.33%                  |
| Inclusive design approach       | 9           | 60%                     |
| Method of this article          | 13          | 86.66%                  |
Figure 4: Comparison of space coverage and occupancy rate of sports facilities.

Figure 5: Gender and age composition of questionnaire subjects and a survey of exercise frequency.
construction of the cultural and sports square is the largest, and the swimming pool is the least. During the questionnaire distribution process, I talked with people who exercised in public sports facilities and learned that most of the users who demanded the cultural and sports plaza were middle-aged and elderly people or retired people. Due to factors such as ideology and economic conditions, these groups generally choose free parks or community open spaces for exercise, so there is a great demand for cultural and sports squares. There is also a great demand for indoor activity rooms and fitness equipment, which is closely behind the cultural and sports plaza. The indoor activity rooms are mainly used as a supplement to the outdoor physical exercise venues under bad weather conditions, while fitness equipment is mainly used. It is the choice for residents who do not have a fixed exercise pattern to exercise. The groups with more demand for badminton and basketball are mainly young people.

It can be seen from Figure 9 that there is a certain degree of mismatch in the types of public sports facilities, which cannot fully meet the physical exercise needs of residents. In the questionnaire survey, 9.24% of residents want to add cultural and sports squares and 34.78% of residents want to add community fitness facilities. The main reason is that a large part of the residents is rural residents who cooperated with the government to demolish during the construction of the new district. Their ideologies are more traditional and are not willing to pay for physical exercise. They often choose the open space of the square for physical exercise. At the same time, they do not have a fixed fitness program,
so they tend to use the nearby community fitness facilities for physical exercise. And 20.65% of residents expect to buy indoor activity rooms. This is mainly because with the improvement of the economic level, the people pay more and more attention to spiritual needs. The cold outdoor climate in winter reflects the citizens. There is a greater demand for physical exercise. At the same time, residents also have a greater demand for public sports facilities including basketball courts, tennis courts, and badminton courts, which reflects the level of mismatch in the distribution of public sports facilities to a certain extent. Residents’ current physical exercise needs usually have a diversified trend. There will be 6 to 7 groups of different groups exercising in the same square, and the age difference will also be relatively large, which leads to the type of sports facilities on the square. Cultural and sports plazas are places for residents to perform leisure and exercise exercises. They are often built near residential areas with a large flow of people. In summer, the square can attract more than 500 people to the square. However, the distribution of sports facilities in the square is relatively scattered, which leads to the same exercise group to be divided and exercised in distant places, and the distribution of public sports facilities is not optimized and scaled. In short, it can be seen that public sports facilities do not fully consider residents’ fitness needs or do not fully understand residents’ fitness needs. The distribution of fitness income is relatively sparse, and there is no clustering scale effect.

It can be seen from Figure 10 that 7.07% of the total number of public sports facilities fully meet the fitness needs of residents, basically meet 21.2%, generally meet 52.72%, and can not meet or completely can not meet only 19.02% of the total number. It can be seen that although the public sports facilities are under development and construction, the quantity and quality are limited, but the residents’ sports needs match and can basically meet the residents’ fitness needs.
Conflicts of Interest

The authors declare that there is no conflict of interest with any financial organizations regarding the material reported in this manuscript.
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