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Research Article

Research on Digital Application of Lighting Design in Public Space Based on Cloud Computing and Data Mining

Yan Huang and Yongfeng Zhang

Sichuan Fine Arts Institute, Chongqing 400053, China

Correspondence should be addressed to Yan Huang; 2019024@scfai.edu.cn

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Light comes along with everything in the world, which makes the world full of vigor and vitality. The appearance and development of urban landscape art lighting have added a surprise to human beings and have also increased their desire and pursuit for life. This paper describes the characteristics and functions of intelligent lighting control system in landscape public space based on cloud computing and big data, and how to use remote measurement and control technology. The system is composed of intelligent sensing layer, network transport layer, and big data processing application layer, which can collect the location and running status information of urban lighting equipment in real time. The application mode, management mode, and service mode of traditional lighting were changed through a remote platform, and the sustainable development mode of energy saving and environmental protection in the future was realized. The importance of humanized lighting design in landscape public space and the scientificalness of humanized lighting design in landscape public space lighting design are further clarified. This paper hopes to have certain reference value and guiding significance in landscape public space lighting design.

1. Introduction

With the rapid development of artificial lighting technology, human beings are presented with a colorful light and magical world. Artificial light source is more important in human life, and the application of artificial light source in architectural space has become an important topic in contemporary architectural design. With the construction of cultural buildings and the improvement of public aesthetic quality, higher requirements are put forward for the lighting of cultural buildings [1]. At present, the construction of smart cities in many developed cities abroad started earlier, the concept of smart cities is more mature, and it has made great progress and been widely recognized in the specific implementation and construction [2]. An excellent landscape public space lighting design is not only for people's lighting needs and functional design but also for people to show a comfortable and beautiful landscape public environment through a complete lighting design scheme, and to increase the enjoyment and interest of urban public space environment.

With the improvement of white light technology, its application in the field of general lighting shows great potential. In order to take the lead in the field of semiconductor lighting, countries all over the world rush to launch their own semiconductor lighting plans [3–4]. How to provide visitors with a better visual experience, how to make visitors deeply understand the designer's design intention by using light, and how to study light by means of display have become important issues faced by designers. At present, the lighting perception of landscape public space in China is monotonous, and the old color is the general feeling of visitors [5]. The designers of landscape public space lighting still stay at the stage of technical indicators, ignoring the visual quality of landscape public space lighting. The difference between Chinese and foreign landscape public space lighting is not only reflected in lighting equipment and

funds, but more importantly, there is a big distance between ideas and technologies.

The most prominent application of information age development in smart city construction is the application of information technology in urban infrastructure construction [6]. We need to evaluate and predict the effect of landscape public space lighting in the early stage with the help of digital technology, so as to check the working performance more conveniently and intuitively. The application of digital technology in architectural space lighting design will also have far-reaching significance. In order to strengthen the research on lighting and lighting system of landscape public space, this paper hopes to make a deeper and more comprehensive research on lighting and lighting system of landscape public space from practice to theory and summarize some methods and theories of lighting and lighting design of landscape public space. It is very gratifying to provide some useful basic information and professional knowledge for the practitioners of lighting design in landscape public space.

2. Research Purpose and Innovation

With the continuous improvement of urbanization level, the urban lighting system is expanding, especially in the current energy shortage environment, lighting energy saving has become a common concern of the society. How to save energy and improve the lighting design level of public space is an urgent problem to be solved. Based on this topic, this paper puts forward the research of digital application of public space lighting design based on cloud computing and data mining.

The innovation of this research is to build an intelligent lighting control system for landscape public space based on cloud computing and big data. The system is composed of intelligent sensing layer, network transport layer, and big data processing application layer, which can collect the location and running status information of urban lighting equipment in real time, thereby realizing the digital design of public space lighting.

3. Research Status at Home and Abroad

3.1. Overseas. The lighting design of landscape public space in foreign countries was earlier. For example, landscape lighting, a relatively advanced lighting method, appeared in Louis XIV cities from 1643 to 1715. Although the development of this kind of landscape lighting is far behind the future lighting means, it provides a strong reference for the future lighting. Entering the 20th century, thanks to the advancement of the second scientific and technological revolution, the lighting industry has also made considerable progress [7]. The design of residential landscape lighting environment is not only to illuminate the environment in the traditional sense but also a derivative and recreation of the existing landscape art. If the design is unreasonable, it will often lead to excessive lighting or abuse of lighting, which will lead to problems such as too tacky and dazzling lighting, unobtrusive scenery, lack of stereoscopic impression, and even more serious light pollution [8]. Alla et al. [9] did not use a lot of light to beautify the plant landscape by using LED light source but made the plant landscape more beautiful than before. Sybilski et al. [10] focused on creating artistic conception of design. Through the use of light, the artistic conception of landscape lighting can be created, and the light and shadow of plant lighting can be handled skillfully to achieve a more poetic atmosphere. The top of the exhibition hall of London Art Museum is designed with diamond hollowing out, and visitors can look up to the blue sky when standing in the middle. The efforts made by foreign designers in saving energy, preventing glare, providing a clear and comfortable angle, avoiding vision disorder or causing fatigue, etc. are worth learning and learning from our designers.

3.2. Domestic. Data show that there are some problems in the lighting of landscape public space in China. For example, most of the light sources are lamps for general use in the market, the light source shielding effect is not very good, the light reflection phenomenon is serious, and the display lighting lacks professional design. In contemporary residential landscape design, the beautification function of lighting art is obvious to all. Reasonable lighting design not only meets people's basic needs functionally but also enables people to enjoy visually and makes the residential environment achieve ideal artistic conception [11]. Wong [12] brings a good visual impression by harmonizing with the landscape of the big environment, which makes people have a strong sense of belonging to the living environment and admire the beautiful environment. Wei [13] thinks "Only landscape plant lighting with outstanding style and characteristics can be regarded as excellent works." According to the understanding of plant landscape design style, it puts forward "the logical analysis diagram of plant lighting design thinking." Yanguo et al. [14], combined with the design lighting design project, measured the internal light environment of Tibetan architecture and combined the quantitative analysis of traditional light environment with modern lighting design strategy, so that the final design results not only met the functional illumination requirements of landscape public space but also realized the higher requirements of expressing Tibetan traditional light environment.

3.3. Lighting Design Level of Landscape Public Space. The lighting design of landscape public space belongs to a part of landscape lighting in terms of large content. Usually, the design of landscape lighting is actually the realization of functional lighting design. In residential areas, if the plant lighting design is to achieve the light environment effect with functionality, comfort, and artistry, it is necessary to consider and understand the level of lighting design.

3.4. Lighting Planning of Landscape Public Space. The description of plant landscape by light is actually a way to express design ideas by using three-dimensional light forms. For living space, the expression of light form should be rigorous. The planning of landscape public space lighting is a detailed technical analysis of living space, and the analysis should be sufficient. According to different plant growth and morphological characteristics, the corresponding plant

lighting methods should be determined to meet the needs of lighting design [15], have a relatively correct grasp of the overall space, outline the lighting layout, and then take the overall space as the basic point, gradually and orderly refine to different functional areas, and refine the plant landscape in the functional areas. Only in this way can we ensure the orderly and unified lighting effect at night, thus forming a good visual impression.

The area is a whole composed of function and environmental landscape. Defining the lighting area is a clear understanding of the design function of humanized lighting and the content elements of the whole environment. In the design and understanding of lighting nodes, we should also pay attention to the fact that lighting nodes are the main landscape center in lighting design. As the key and important content of regional analysis, lighting nodes should have a clear design method for the design of lighting nodes. Lighting structure analysis refers to the design and organization of various elements in the lighting environment. Through the design and organization, the lighting elements are coordinated and unified, and then the lighting space architecture in the lighting space is optimized.

3.5. Lighting Design of Landscape Public Space. Lighting design is an extension of lighting planning, which is the early stage planning and pattern division of lighting schemes. Lighting design is aimed at the content established by lighting planning and carries out corresponding analysis and refinement. In a sense, it is also the lighting design scheme that meets the needs of humanized design to the utmost extent. Everyday lighting effect is commonly used, and it is also the most common and common description of landscape public space lighting in residential lighting environment most of the time.

The lighting design of landscape public space focuses on the landscape center and main landscape axis of residential area, and the lighting design of landscape center and main landscape axis of residential area are often the most intuitive and explicit expression of the general characteristics of plant landscape in residential area [16–17], mainly through the contrast of light in illumination. In the lighting design, in order to create different lighting features for the plant landscape of the large living environment, the use of contrast technique is the most effective means to highlight the lighting effect [18]. For example, in order to form an affiliation and set the contrast between subject and individual, the landscape center is the main body of lighting design, and other landscape lighting is the subsidiary part of this main body. In this way, the differences between subject and individual in landscape environment can be effectively displayed through lighting design.

3.6. Program of Humanized Lighting Design for Plant Landscape in Residential Area. The design of landscape public space lighting scheme is a combination of various activities. In the specific scheme design, it should be carried out in turn according to reasonable steps and procedures to complete the design task more scientifically [19–20]. After receiving the design task, it is necessary to comprehensively, systematically, and carefully analyze the design task book and various materials provided by the design entrusting party, so as to better carry out the next design work and have more exact requirements and design specifications for the design content.

4. Research Technique

To sum up, it is possible to establish intelligent lighting monitoring and management system based on the Internet of Things technology, such as big data processing, cloud computing, platform management, and mobile application mode. Therefore, building a lighting monitoring and management system based on the combination of Internet of Things, big data, and cloud services has become one of the inevitable measures for urban ecological and economic transformation. In this chapter, Apriori association rule algorithm based on cloud computing platform and spatial distribution descriptive analysis method are used to design landscape public space lighting digitally. The method flow is shown in Figure 1.

4.1. Algorithm Design of Apriori Association Rules Based on Cloud Computing Platform. Based on the idea of dividing distributed database, the database D is divided into $D_1, D_2, \cdots D_m$, among $D_1 \cup D_2 \cup \cdots \cup D_m = D, D_1 \cap D_2 \cap \cdots \cap D_m = \phi$; after division, each data block is sent to the corresponding server node, and each data node processes one block, so that multiple nodes can work in parallel.

Apriori algorithm solves the frequent k-item sets for each node and obtains the local frequent item sets contained in the corresponding data. Apriori uses the iterative method layer by layer, that is, searching $(k+1)$-item sets with k-item sets. $L_k - 1$ is used as a connection to generate a set C_k of candidate k-item sets and get k-item sets L_k. This step is completed by each task independently. Finally, the global end performs the threshold operation of L_k obtained by C_k. Finally, the global control end uses the following formula [21]:

$$\text{Confidence}(A \Rightarrow B) = \frac{\text{support\_count}(A \cup B)}{\text{support\_count}(A)}. \quad (1)$$

The confidence of association rules is calculated, where $\text{support\_count}(A \cup B)$ is the number of things containing item sets $(A \cup B)$, and its value is the support count of frequent item sets obtained by the global controller. $\text{support\_count}(A)$ is the number of things containing item set A, and its value should be the accumulation of the number of things containing A in each server node.

4.2. Descriptive Analysis Method of Spatial Distribution. Descriptive analysis of spatial distribution is a global description of the spatial distribution characteristics of a group of discrete points from the macro level, based on the spatial position and nonspatial attributes of the discrete points, using specific spatial statistical indicators to find a certain rule [22–23]. Statistical indicators of descriptive analysis of spatial distribution are mainly divided into two categories: concentrated trend statistical indicators and discrete trend statistical indicators.

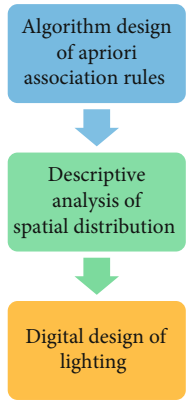

Figure 1: Method flow chart.

The concentrated trend statistical index mainly refers to various center positions of a set of point sets, among which the mean center index in spatial distribution description analysis refers to the average value of x coordinate value and y coordinate value of a set of discrete points, which is the center position or average position of the set of discrete point sets. In some cases, this index is called the center of gravity, which indicates the distribution state of discrete points.

We assume that there are n cases of urban management problems in the study area in a certain time period, in which the plane coordinate point of the ith case can be expressed as (x_i, y_i); then, the mean center position (x, y) in this area in this time period is the arithmetic mean value of the coordinates of n cases [24], and its definition is expressed by the following formula [25]:

$$(x, y) = \left(\sum_{i=1}^{n} x_i/n, \sum_{i=1}^{n} y_i/n \right), \tag{2}$$

where n represents the total number of case points in this area in this time period.

Among them, the standard distance refers to the deviation of the actual occurrence position of the case from the central position, and its expression is shown in the following formula:

$$d = \left(\sum_{i=1}^{n} (x_i - x)^2 + \left(\sum_{i=1}^{n} (y_i - y) \right) \right) /n. \tag{3}$$

The standard distance sd actually reflects the average deviation of each point position relative to the center position of the spatial mean. In the actual research process, we can compare and analyze the average distance of the same type of cases in different case types or different time periods, so as to investigate the dispersion degree of the spatial distribution of relevant cases relative to the mean center position.

The standard deviation ellipse index is described by the center position, ellipse major and minor axes, and ellipse orientation. Among them, the center position can be any center index that gathers trend statistics, such as mean center or median center. In the research, the mean center is used for aggregation trend statistics, and the standard deviation of (x, y) coordinate value is calculated first, as shown in the following formula:

$$\begin{aligned} sdx &= \left(\sum_{i=1}^{n} (x_i - x)^2 \right) /n, \\ sdy &= \left(\sum_{i=1}^{n} (y_i - y)^2 \right) /n. \end{aligned} \tag{4}$$

Then, the orientation of the standard deviation ellipse is calculated, which is an angle rotated relative to the true north direction, so that the sum of the distances from all the points in the point set to the major and minor axes of the ellipse is the shortest.

Rotation angle is $\tan\theta = (A + B)/C$, where A, B, and C are shown in the following formula:

$$\begin{aligned} A &= \left(\sum_{i=1}^{n} sdx_i^2 - \sum_{i=1}^{n} sdy_i^2 \right) = \left(\sum_{i=1}^{n} sdx_i^2 - \sum_{i=1}^{n} sdy_i^2 \right)^2 + 4 \left(\sum_{i=1}^{n} sdx_i sdy_i \right)^2, \\ C &= 2 \sum_{i=1}^{n} sdx_i sdy_i. \end{aligned} \tag{5}$$

Finally, the standard deviation along the x axis and y axis is calculated, as shown in the following formula:

$$\begin{aligned} \sigma_x &= \left(\sum_{i=1}^{n} (sdx_i \cos\theta - sdy_i \sin\theta)^2 \right) /n, \\ \sigma_y &= \left(\sum_{i=1}^{n} (sdx_i \sin\theta - sdy_i \cos\theta)^2 \right) /n. \end{aligned} \tag{6}$$

To sum up, by using the statistics such as the mean center of concentrated trend indicators, standard distance, and standard deviation ellipse of discrete trend indicators, we can quantitatively analyze the data of digital urban management cases from a macro perspective and preliminarily grasp the overall spatial distribution pattern of cases.

4.3. Digital Design of Public Space Lighting

4.3.1. Selection of Light Source and Lighting Fixture. In the practical process of outdoor lighting setting, we use a lot of lights for artistic treatment of night scenes in buildings, which will inevitably form some dazzling lights. If these dazzling lights are not properly handled, a new kind of pollution may occur. If dazzling lights affect motor vehicle drivers, potential safety hazards may arise. Therefore, we should choose the lamp position, projection angle, and projection direction reasonably. It is the first principle to determine the lamp position according to the lamp efficiency. We also require the lamp position on the facade to be concealed, so as not to destroy the day-to-day effect of the building. In

addition, the hidden light source gives people a sense of trance and has special effects.

All kinds of lighting sources and lamps have become the most basic and core carrier of landscape public space lighting, and they are also one of the contents that we need to pay special attention to in the process of landscape lighting design. Therefore, when designing space lighting, we should fully consider the system attribute and importance of each element, pay attention to the influence degree between lighting elements, and coordinate the relationship between each element. The landscape of residential area is Chinese or Western, natural or regular, and the lighting design should show tranquility or style, elegance or magnificence. Different types of residential area landscape need different types of waterscape lighting design to cooperate with it. When designing the interior lighting environment of the civic center, we should start from the public's psychology, avoid the high-brightness and complex changing space, tap the spiritual needs of the citizens, extract the unique space atmosphere of each space, and cooperate with the changes of architectural space and indoor materials and colors to create a comfortable and harmonious indoor lighting environment.

MapReduce is a new parallel programming system invented by Google Inc. in recent years. It puts parallelization, fault tolerance, data distribution, load balancing, etc. in one database, and all data operations of the system are summarized into two steps: Map stage and Reduce stage. Map function and Reduce function only need to be defined in all operation processing job programs submitted by programmers to MapReduce, and the MapReduce system can automatically initialize the job into multiple same Map tasks and Reduce tasks, read different input data blocks, and call the Map functions and Reduce functions for processing according to information such as the size of input data and the configuration of the job.

The working mode of MapReduce is as follows, Map is responsible for decomposing tasks and Reduce is responsible for merging decomposed tasks. The work flow of MapReduce is shown in Figure 2.

By determining the brightness contrast, the lighting relationship between the plant itself and its environment is made clear, that is, the rationality of the selection and arrangement of lamps and light sources is made clear. In terms of actual lighting effect, the visual feeling produced by reflection to our eyes is also different. In order to verify the rationality of this inference, the author conducted an experiment with lighting software (Figure 3).

With the emergence of light projection technology, LCD liquid crystal projector, optical-processing DLP digital projector, and CRT cathode ray tube projector are developed. The projection technology of LCD projector is more mature. The chip of DLP digital light processing projector completes the visual digital information display technology. There is rapid development of DLP digital light processing projector, through the lighting design activities to meet the needs of people's visual viewing, while taking into account people's psychological perception of the lighting environment. Expression of local characteristics, highlights the natural and cultural characteristics of the regional scope, highlights

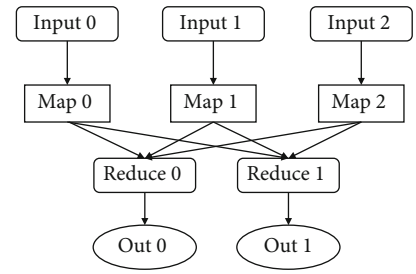

Figure 2: Work flow of MapReduce.

the landscape content and specific landscape intention, and gives artistic conception to the humanistic atmosphere. With lighting design as the medium, we can better coordinate the relationship between natural environment and humanistic environment and create a more humane lighting atmosphere.

4.3.2. Spatial Characteristics Analysis and Atmosphere Refinement. Landscape lighting environment design is an important means to decorate and beautify the environment and create artistic atmosphere. In order to decorate the residential landscape, increase the spatial level, and render the environmental atmosphere, it is very important to use decorative lighting and decorative lamps. The same lighting effect can be embodied in different technical ways. For example, the spectrum with the same intensity that people feel may be composed of light with different wavelengths. Contour lighting, floodlight lighting, and interior transparent lighting all belong to the landscape lighting modes of modern urban waterfront space. In the design process of landscape lighting scheme, it is necessary to take the factors such as lighting source, lighting environment, and lighting function zoning as reference and select and apply these lighting modes reasonably.

The GFS (Google File System) is composed of a Master and a large number of block servers. Master stores all metadata of the file system, including namespace, access control, file block information, and file block location information. The files in GFS are divided into 6 MB blocks for storage, as shown in Figure 4. After obtaining the write authorization from Master, the client transmits the data to all the data copies, and only after all the data copies receive the modified data does the client send out the write request control signal. After all data copies update the data, the master copy sends a write operation completion control signal to the client.

In order to achieve the core design concept of maximum humanization, the layout and features of landscape elements should be followed, and the functionality of lighting design should be met; the road system of the park is analyzed in landscape design (Figure 5), hoping to cover the content requirements of humanized lighting design more comprehensively.

The function of light and color is to render the space environment and reflect the theme characteristics of public places. When designing light and color, the influence of light and color on surrounding plants should be fully considered to avoid interference with the growth of plants. There are three kinds of light shapes: point, line, and plane. Point light source can be used for local illumination to attract people's

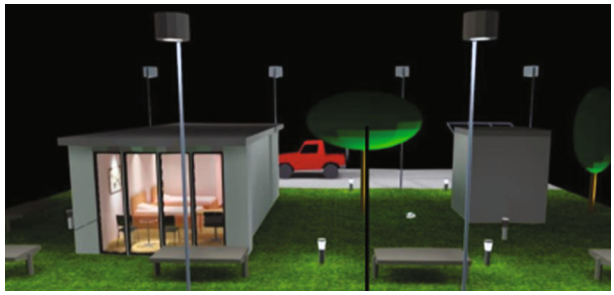

Figure 3: Lighting environment.

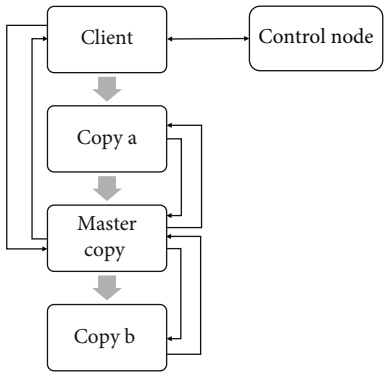

Figure 4: The write control signal of GFS is separated from the data stream.

attention. Among them, the garden lamp not only plays a role in ensuring lighting but also pays great attention to its shape, material, color, proportion, and scale. The garden lamp has become an indispensable ornament in residential landscape. In the lighting design, obviously, we should emphasize this sense of depth and, at the same time, let the public enter the building from the urban space. Emotions are gradually moved to control the different dimming modes of the panel, adjust the brightness and illumination of light and shadow, and create a three-dimensional and layered sense with abundant light, so that the landscape public space can show the best side.

4.3.3. Design of Intelligent Lighting Control System for Landscape Public Space Based on Big Data. Combined with big data technology, this project puts forward the architecture of intelligent lighting control system in landscape public space. By transforming the existing street lamps, a variety of sensors, controllers, and communication modules are used to build a smart city information perception network with high intelligence. This project collects the location and running status information of urban lighting equipment in real time, which can not only provide all-round street lamp and operation and maintenance of information technology service for the city but also provide personalized decision support for road sections under different environmental parameters by using big data platform and also provide effective support for urban intelligent transportation and intelligent security.

This project focuses on the intelligent lighting management of landscape public space based on big data technology and proposes a framework of intelligent lighting control system of landscape public space including multiple sensors, central controller, and communication module. On this basis, a big data platform for urban public lighting management is constructed. The system is divided into intelligence perception layer, network transport layer, and big data processing application layer. The system structure diagram is shown in Figure 6.

Intelligent sensing layer is the sensory organ of urban lighting intelligent energy-saving system, which captures all kinds of information in the area covered by lighting lines in real time through various intelligent sensors. The collected information includes various information of lighting equipment, such as current, voltage, and fault information. Lighting use related information, such as the flow of people passing through per unit time and the number of vehicles. Environmental parameters include illuminance, temperature, humidity, air pollutant monitoring, and noise monitoring.

The application layer of big data processing is the "brain" of urban lighting system, and the intelligent lighting control strategy reflects the intelligence degree of the whole system. Comprehensive utilization of all kinds of collected data information and related information of environmental parameters can realize big data analysis, and at the same time, it can assist to realize real-time monitoring of street lamp working conditions and provide functions such as alarm of street lamp fault type and notification of fault location. The functional structure of the system is shown in Figure 7.

Big data processing center includes five modules: data source, data collection, data storage, data processing, and data display. All kinds of data collected from the intelligent sensing layer are transmitted to the big data processing center as data sources through the network layer. Through the analysis and processing of the data, the intelligent lighting control schemes in different environments are obtained, which makes the lighting control scheme break the traditional unified control mode and analyzes the characteristic lighting control schemes according to the different situations of the actual lighting scene, thus improving the energy-saving efficiency. The structural diagram of the big data processing center is shown in Figure 8.

4.3.4. Lighting Control and Energy Saving. The lighting control is mainly based on the automatic lighting controller of the branch circuit, supplemented by manual control. Intelligent lighting controller is used to switch the power supply with different functions in each partition, which can be used for overall control, partition control, and timed scene control. The green courtyard is divided into active area and quiet area, and the active area is designed with high illumination according to the requirements of the lighting code. Lighting design should be people-oriented, starting from people's physiological and psychological needs, select the light source and color suitable for garden scenic spots, and determine the reasonable light consumption and illumination, which can not only fully show the night viewing of

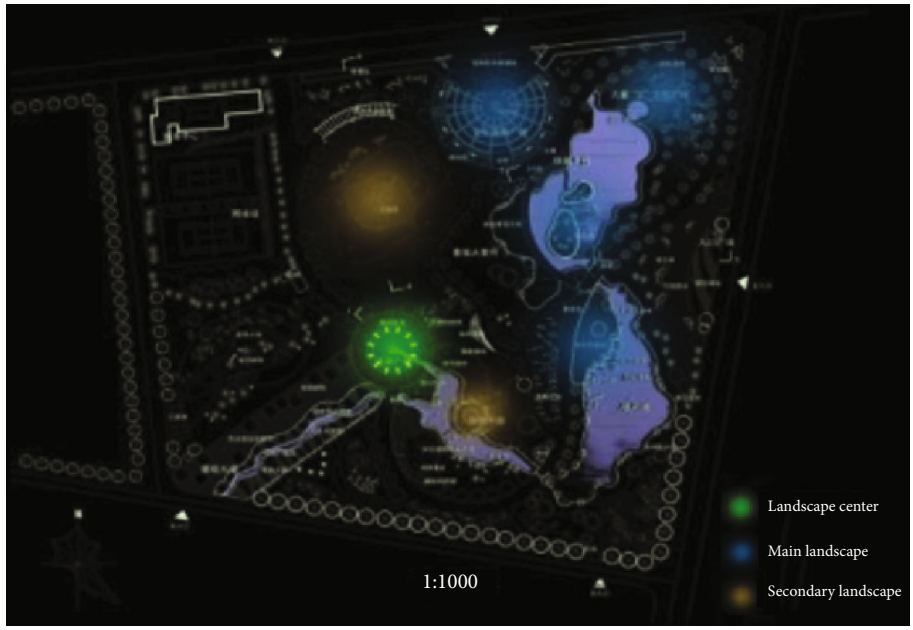

Figure 5: Landscape structure analysis diagram.

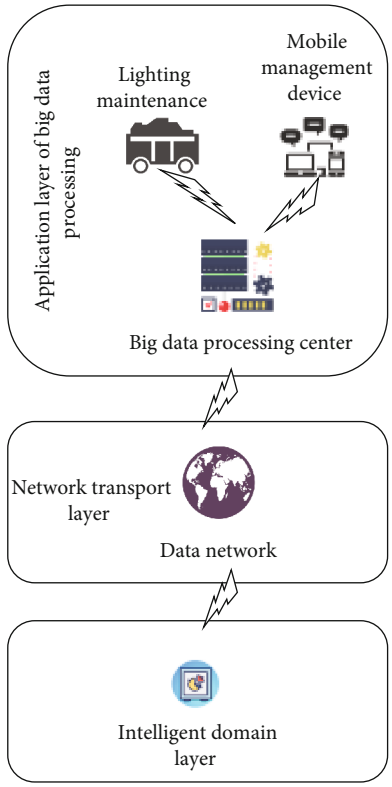

Figure 6: System structure diagram.

residential landscape and the interaction with residents but also avoid designing excessive night lighting to meet the effect of landscape as the key decorative lighting of nodes.

Sphere adopts the flow processing calculation mode [26]. In the stream processing mode, each element of the input array is independently processed by the same processing function using multiple computing units. Assume that a sector data set consists of one or more physical files. In Sphere, a data stream is actually an abstraction, which represents either a data set or a part of a data set.

The data processing process of Sphere is shown in Figure 9.

Figure 8 shows the specific process of Sphere processing data segments in a stream. Generally speaking, the number of data segments is larger than the number of SPEs. Sphere provides a simple mechanism to deal with the load balancing problem. Because the slower SPEs will process fewer data segments, they will be allocated one more data segment to the faster SPEs accordingly. Each SPE obtains a data segment from the stream as an input and generates a segment from the stream as an output. In turn, these output segments can be used as inputs for other Sphere processing processes.

According to the requirements of illumination index, the number of lamps and lanterns and the power of selected lamps and lanterns should be reasonably configured. Energy-saving and environment-friendly lamps were chosen. The selection of lamps and lanterns should comply with the national standard for lamps and lanterns (GB7000), power saving should be considered, and timing control should be carried out (timing control in different seasons in summer and winter) [27]. Different from the lighting modes of commercial streets and buildings, there is less flow of people at night in residential areas, and many lighting fixtures are directly accessible by human hands. Flooding lighting has a large demand for electric energy, and the only effective way is to control the demand for landscape lighting by illumination value [28]. High-pole lighting can be adopted, so that the light intensity can be distributed to a farther space as far as possible. Diffuse lamps and lampshades made of diffuse materials can be used to determine

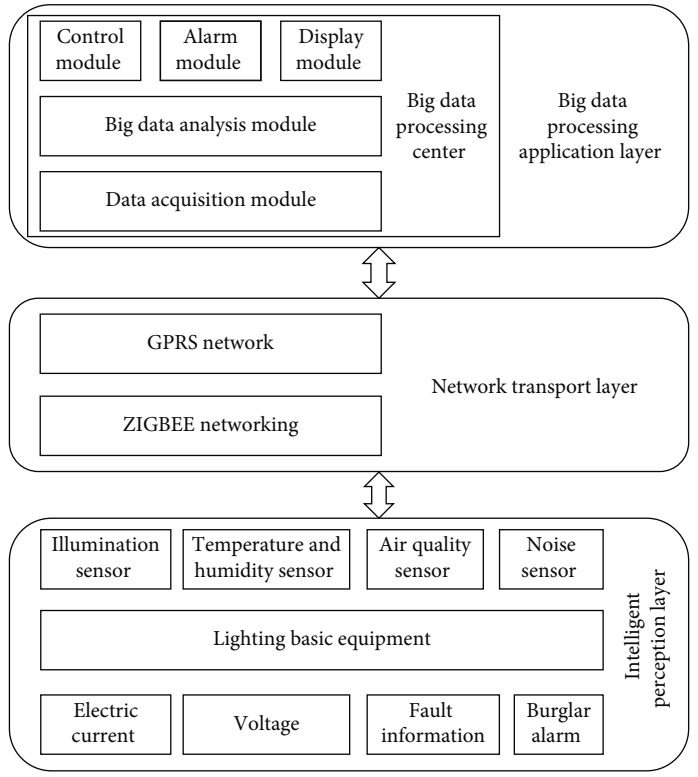

Figure 7: System functional structure diagram.

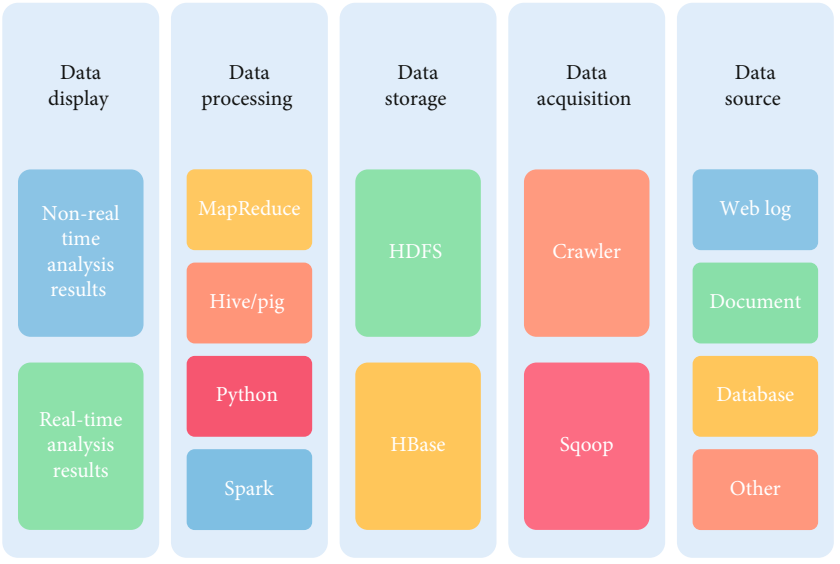

Figure 8: Structure diagram of big data processing center.

the appropriate lamp spacing and meet the requirements of uniform lighting.

Considering the safety of electrical equipment, the metal shell of lighting fixture should be equipotentially connected with the metal part of the building. Metal bases of lamps and lanterns and PE lines from terminals to lamp holders (cross sections with power lines, etc.) shall be reliably connected with PE lines of loop cables. A set of repeated grounding shall be made at the entrance of lighting distribution power supply of control box, and the grounding resistance shall not exceed 4 ohms. Considering personal safety, TN grounding system is adopted in the design. The grounding

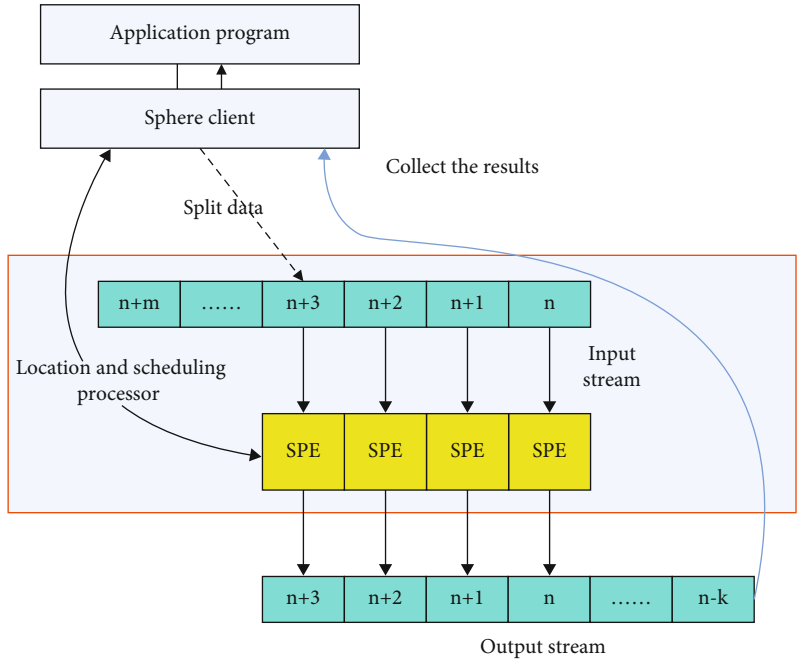

Figure 9: Sphere stream data processing process diagram.

resistance of PE line should be controlled within a reasonable range, and the resistance should be no more than 4 ohms.

5. Analysis and Discussion

Self-made data are used to collect the experimental information, in which the training sample set contains 1000 samples and 100 categories. The test data sets are 300 M and 580 M, respectively, containing tens of millions of test samples. The dimension of the algorithm is open (the highest test dimension in the experiment is 20 dimensions), but in order to make the data most representative, this experiment uses 10-dimensional samples.

Through a series of experiments on OptimDM in cluster environment, this paper collected the data of the relationship between the number of computing nodes and the running time of OptimDM algorithm in the edge cluster environment of Graph G, as shown in Table 1. The number of edges in the table is millions, and the number of nodes is 10, 20, and 30, respectively. The unit of running time is hours.

It can be seen from Figure 10 that there is a linear relationship between the number of edges in Graph G and the running time of the algorithm, which is consistent with the analysis of the time complexity of the algorithm in section 4. It can be seen that using the OptimDM algorithm, with the increase of the number of edges in the graph, the running time of the algorithm is within an acceptable range, and the performance of the algorithm remains stable all the time. By comparing the experimental results with the experimental results based on the traditional breadth-first search algorithm, it can be found that the optimal algorithm has better time performance when processing large-scale graph data, which is obviously improved compared with the traditional single-node solution.

Table 1: The relationship between the number of edges of Graph G, the number of nodes in cluster and the running time of OptimDM.

The number of edges of G	10	20	30
0	0	0	0
100	0.36	0.62	0.21
205	2.14	1.78	0.88
330	3.38	2.66	1.28
418	4.24	3.19	1.96

Then, the influence of the number of computing nodes on the running time of OptimDM algorithm is verified under the premise that the scale of the graph data is unchanged. The experimental data are from Table 1. When processing the graph data with 992×10^6 edges, the relationship between the number of computing nodes in the cluster and the running time of OptimDM algorithm is shown in Figure 11.

It can be seen from Figure 7 that increasing the number of computing nodes in the cluster can greatly shorten the running time of OptimDM algorithm and improve the algorithm performance on the premise that the number of edges in the graph is unchanged. Experimental results directly prove that the performance of the OptimDM algorithm is scalable and depends on the size of cluster. That is, the OptimDM algorithm can make full use of distributed computing resources and reduce the time cost of algorithm operation. Comparing this experiment with the traditional single-node environment experiment, we can find that the algorithm based on cloud computing distributed environment has advantages in performance scalability. As long as computing devices are added, the computing power can be

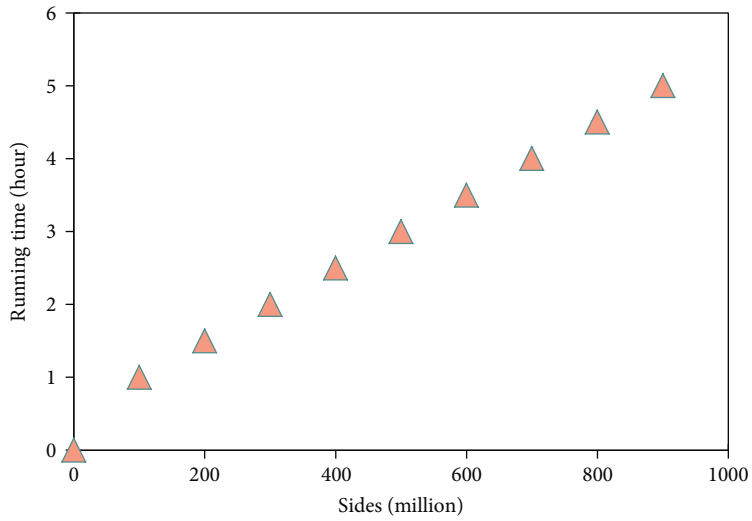

Figure 10: Relationship between the number of edges and running time in the cluster of nodes.

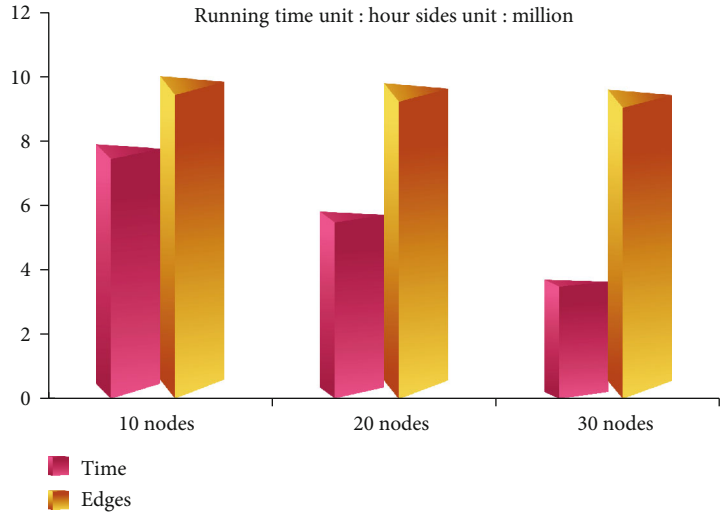

Figure 11: Relationship between cluster size and running time when dealing with the graph with fixed scale.

continuously enhanced. Therefore, this experiment also indirectly proves the powerful computing power brought by cloud computing cluster.

In order to detect the influence of the number of nodes in the Hadoop cluster on cluster performance, this experiment will kill off different numbers of data nodes in the cluster, and let the Hadoop clusters with different numbers of nodes process the same batch of input data (100,000 web pages and 10,000,000 web browsing records) and then analyze the performance changes between clusters with different numbers of machines, so as to obtain the performance acceleration of Chinese hotspot extraction algorithm MapReduce on the Hadoop cluster with the number of machines changing. In this experiment, the relative acceleration ratio coefficient is taken as an important measure, which is defined as follows: relative acceleration ratio = single data node cluster running time/multi – data node cluster running time.

After starting the Hadoop cluster, a certain number of data nodes is killed every time, then the MapReduce Chinese hotspot extraction algorithm is run, the running time of each cluster is recorded, and finally the acceleration ratio of each cluster experiment is calculated according to the definition of the above relative acceleration ratio formula, and we get Figure 12.

The data in Figure 12 shows that after Map/Reduce, the algorithm has received a good speedup effect when running on the Hadoop cluster. With the increase of data nodes in the cluster, the running speed of the cluster shows a nearly linear growth trend.

In structured data, entities appear in the form of tables, and the relationships among various entities are embodied by keys and constraints. The structure of structured data is similar to that of XML to a certain extent. The work of structure mapping is to map the tree graph of structured data

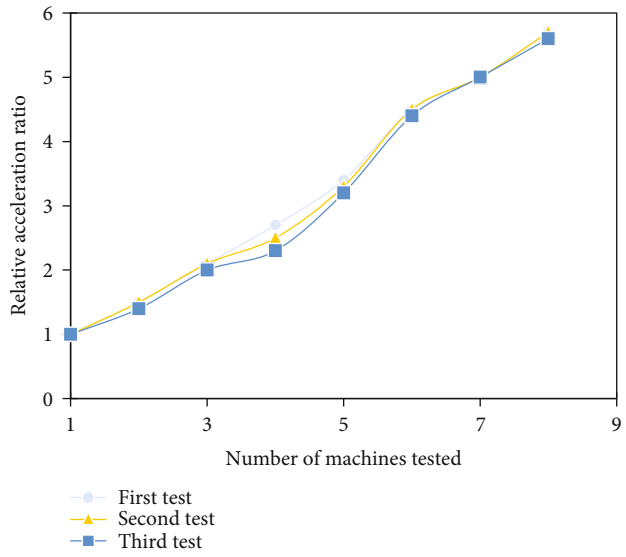

Figure 12: Hadoop cluster performance acceleration chart.

with edges as labels to the tag tree of XML with nodes as labels. However, the mapping of this structure does not contain semantic information in structured data. Once the domain structure is determined, the corresponding relationship between structured data and XML data can be determined, and the mapping from structured data to XML data can be automatically realized by the program through the field/domain interval comparison table.

Unstructured data is difficult to retrieve because of its various formats and large amount of data, and it lacks good organization strategy and mechanism when it is stored. If the unstructured data storage management system only provides simple data storage and maintenance functions, it is only a container for data, and it is impossible to mine valuable information in data on this basis. When adding or modifying the path field to the data table, the query system should find the source file. Only when the source file exists can the path and other information be recorded or modified in the data table. At the same time, the monitoring system updates the monitoring list and brings the newly added or modified data file into (or re-into) the monitoring range. Similarly, to delete a source file, we first remove the monitoring and then realize the consistent deletion of the source file and attribute data through the monitoring system.

6. Conclusion

Urban landscape public space lighting is a comprehensive landscape image composed of the city's natural landscape, humanistic elements, and lighting language. With the rapid development of science and technology, people's aesthetic ability is improving day by day, and the pace of social development is accelerating. People are no longer satisfied with the traditional municipal lighting. In the current cloud computing environment, the architecture of data mining platform is becoming more and more perfect, and its functions are becoming more and more powerful and diversified. In this paper, in the design and implementation of landscape public space lighting system, wireless sensor technology, embedded technology, and cloud computing framework are comprehensively used to form a series of complete systems in hardware and software. The wireless sensor technology is used to collect different parameter data of lamps, the embedded technology is used to forward different parameter data, and the server node is used to analyze and filter the data. Finally, the large-scale website is built to display the effect and realize data processing and real-time monitoring. Through practical exploration, a set of operation modes are condensed, and the perceptual design concept is combined with the rational operation mode, which enriches the lighting design method of landscape public space.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no competing interest.

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