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APPLICATION OF ENVIRONMENTAL PSYCHOLOGY IN SUSTAINABLE OPTIMIZATION OF URBAN PARK LANDSCAPE PLANNING BASED ON CLUSTER COMPUTING

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Abstract: In order to realize the sustainable optimization of urban park landscape planning, the sustainable optimization method of landscape optimization is proposed by applying environmental psychology in cluster computing mode. Determine the cluster computing mode of urban park environment simulation, and balance the cluster load of urban park landscape planning sustainability optimization. From two aspects of visual perception and space-time perception, this paper analyzes the landscape cognition of environmental psychology and the psychological needs of urban residents for urban park landscape, and introduces the analysis results into the cluster computing model. After cluster calculation, the results of functional area division and landscape elements planning of urban park landscape planning are obtained, and the sustainable optimization of urban park landscape planning is realized. Through the experimental analysis of the application effect test, it is concluded that the application of environmental psychology in landscape planning can effectively improve the satisfaction of tourists, and has a positive effect on the sustainable optimization of landscape planning.

Key word : cluster computing mode ; environmental psychology ; urban park landscape ; landscape planning ; continuous optimization ;

0 Introduction

Urban park is a green space to meet the leisure needs of urban residents, provide rest and entertainment, and hold a variety of collective cultural activities. It is a green infrastructure of the city. As an important public open space of the city, it not only provides the main rest and entertainment places for the urban public, but also provides a place for the development and dissemination of cultural activities. In recent years, due to the increasing function of urban park, its own value is also improving, including use value, aesthetic value, tourism value, cultural entertainment value, ecological protection value and social economic value [1]. The function of national parks is becoming more and more important with the development of cities. In a word, the role of urban function can be divided into: reflecting the city style, ecological function, urban culture display, inheritance function, organizing urban landscape function, spiritual civilization construction and scientific research and education base and other types. The main components of urban parks include plants, topography, Waterscape, architecture, roads and other landscape elements. Among them, only plants are growing elements. Seasonal changes, rich color changes and beautiful posture jointly create a colorful urban park landscape.

Due to the improvement of economic and aesthetic level of urban residents, the requirements of urban park landscape are also improved. In order to meet the requirements of urban residents

and realize the sustainable development of urban park, environmental psychology needs to be applied to the landscape planning. Environmental psychology studies the overall science of the relationship between human behavior, experience and artificial and natural environment. It uses psychological methods to analyze the interaction of human activities, experience and all aspects of society and environment, especially the interaction and relationship of physical environment, and explores the law of human psychological change and development under different environmental conditions, Its research scope includes people's perception, understanding and attitude towards the environment, people's spatial behavior in the environment, including privacy, domain, personal space, etc., as well as the physiological and psychological pressure on people in the environment, involving psychology, cultural anthropology, sociology, urban planning, architecture and other disciplines. The application of environmental psychology can help designers to think about what aspects should be paid attention to when creating artificial environment, and how to help people use the clues in the environment to achieve their goals and needs.

However, from the perspective of psychology, the psychology and artistic aesthetics of urban residents will change with the changes of the times, so the planning of urban park landscape needs to meet the requirements of sustainability, that is, to adjust the landscape planning mode in combination with the psychological changes of the audience. Because the planning and implementation of urban park landscape need to consume a lot of human and material resources, in order to reduce the cost to the greatest extent, the cluster computing mode is introduced by using computer technology. Cluster is a kind of parallel or distributed processing system, which is composed of many independent computers connected together, making it work together like a single integrated computing resource. A cluster contains many computers, each computer runs an operating system, has one or more IP addresses, has one or more processors, has independent memory and I / O [2]. These computers can be located in the same location, or can be physically dispersed and connected together through the network. These connected computer groups have strong processing performance. Cluster connects a group of loosely integrated computer software or hardware to complete the computing work closely. In a sense, he is regarded as a computer. A single computer in a cluster system is usually called a node, which is usually connected through a LAN, but there are other possible connection modes [3]. Cluster computers are usually used to improve the computing speed and / or reliability of a single computer. In the cluster computing mode, environmental psychology is applied to the sustainable optimization of urban park landscape planning, in order to provide good and aesthetic urban park landscape for urban residents, and improve the utilization rate and economic benefits of urban park landscape resources.

1 Sustainable optimization method design of urban park landscape planning

In order to better complete the landscape planning of urban park, we need to take sustainable development and wetland protection and restoration as the concept of landscape planning and design, so as to effectively complete the integrity of wetland ecological planning, combined with advanced wetland landscape planning methods. For example, the use of remote sensing and GIS technology for field survey, and the use of advanced equipment such as UAV to complete the

overall layout of the city park to understand the details, and provide important data parameter support for landscape design [4]. And through the use of the connection between each part and different, so as to determine the corresponding functional area and landscape, these have mature design scheme for reference, designers have to do is to adapt to local conditions will be appropriate design scheme for effective planning, and combined with the different characteristics of each region, complete the preliminary plan of Landscape Planning [5]. On this basis, the cluster computing model and environmental psychology are integrated to optimize and update the landscape planning primary plan continuously.

1.1 Determine the cluster computing mode of urban park environment simulation

Cluster computing mode based on distributed parallel computing framework in big data technology belongs to multi instance and multi task decomposition parallel computing, that is, each instance corresponds to a computing task. This mode is suitable for large-scale model computing and has a wider range of applications. Its core is parallel distributed storage and computing [6]. Location aware moving computing to the location of data is a significant progress, that is, data localization can reduce data migration, save network bandwidth and achieve efficient computing performance. Distributed storage stores data to multiple nodes, and saves multiple copies of the same data on different nodes, which not only realizes data localization, but also realizes data redundancy backup, and ensures data security. Distributed computing distributes algorithms / models and other computing resources to the location of data through location awareness, so as to achieve the purpose of "computing localization optimization". The cluster computing mode of landscape environment simulation fully uses the ideas of "data localization" and "computing localization" for reference, distributes the simulation scene model configuration files to each computing node to realize "configuration file localization", and the model computing program realizes "computing program localization" by perceiving and locating and distributing the program to the node where the model configuration files are located [7]. Figure 1 describes the cluster operation mode of landscape environment simulation. The redundant backup mechanism of distributed storage of configuration file shortens the addressing aware time of computing program.

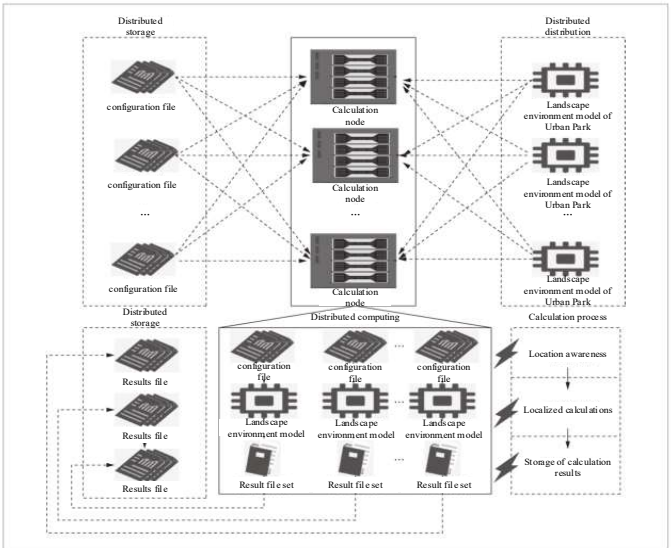

Fig.1 Cluster operation mode of urban park landscape environment simulation

The distributed computing of landscape environment model includes three processes: location aware, localization computing and distributed storage of computing results. The distributed distribution mechanism can quickly locate the computing node where the configuration file is located. The execution file of the landscape environment model is automatically downloaded to the computing node, and the running space is created. The model is started to read the configuration file, and the localized calculation of the model is performed. Finally, the calculation results are written into the distributed storage [8]. Taking Delft3D model operation in HadoopMapReduce environment as an example, the feasibility of cluster operation mode is verified. It is used to calculate the hydrodynamics and water ecology of free surface landscape environment such as rivers, lakes, reservoirs, estuaries and coasts. Delft3D consists of seven modules, including hydrodynamic module, wave module, water quality module, particle tracking module, ecological module, sediment transport module and dynamic geomorphology module. The functions of these modules are independent and interrelated, and each module can be implemented separately or combined with one or more other modules, which can simulate two-dimensional and three-dimensional flow, wave, water quality, ecology, sediment transport and bed topography, as well as the interaction between various processes [9]. In Figure 3, the core of cluster operation mode design for landscape environment simulation is to distribute each parameter set file of Delft3D model to each data node through the cluster distribution mechanism. The cluster locates the computing program to the data node through the location aware mechanism. On the node, by reading the parameter set file, the model configuration file is reconstructed, and the model calculation process is completed.

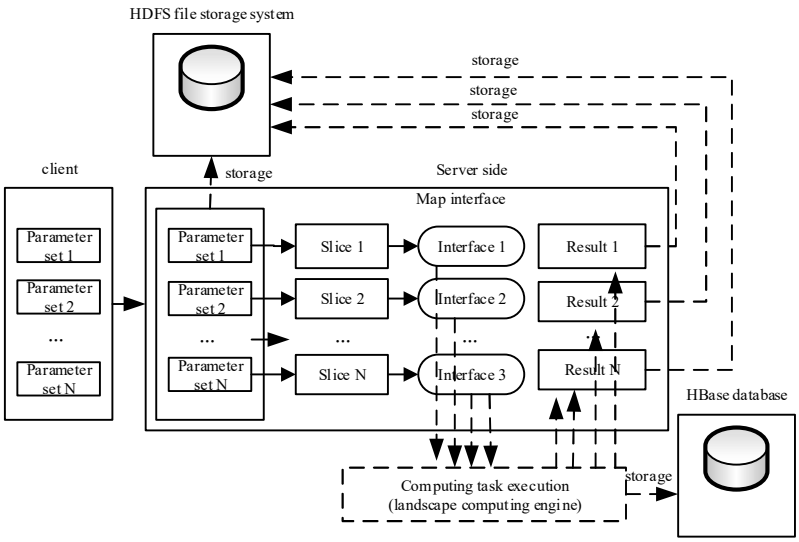

Fig.2 Core flow chart of cluster operation for urban landscape environment simulation

1.2 Balance the sustainability of urban park landscape planning and optimize cluster load

From submitting the task of urban park landscape planning to the end of the task and calculating the valuable execution results, the basic scheduling of cluster tasks can be divided into seven stages: task submission, task splitting, computing resource detection, computing resource selection, task scheduling, task execution, and result summary and integration [10]. The user uploads the execution task to the service cluster through the client, which is the total task that each computing node needs to cooperate to complete. At the same time, the task is attached with the description information of the task in the form of script and submitted to the grid management system. After receiving the task uploaded by the user, the grid scheduler analyzes the type of the task according to the description information of the task. According to a certain disassembly mechanism, the task is divided into a series of small-scale executable tasks suitable for the current performance of the processor. There can be no interdependence between subtasks. The purpose of computing resource detection is to find the computing nodes with matching performance in the current network cluster. In the detection phase of computing resources, the system may scan multiple grid resources that meet the requirements of tasks submitted by users. The purpose of resource selection is to screen the detected resource nodes again to make the resource nodes matched by each task more adaptive [11]. Task scheduling includes two processes: task mapping and task scheduling. Task mapping means that the scheduling system takes the pre-processing time matrix as the input information according to the current availability, network bandwidth and task attributes of the computing resource nodes, and the grid uses heuristic allocation algorithm to match the sub tasks and the computing resource nodes and generate a scheduling strategy matrix. Task scheduling is to analyze the results of task mapping, and according to the analysis of the scheduling strategy information, assign tasks to the corresponding computing resource execution queue one by one according to the rules. Each computing resource node maintains its own task queue, and the queue does not affect other nodes. The computing resource node will take out the low priority from the local task queue and start execution according to the principle of not affecting

the normal operation of the local node. After the task execution, it will return the execution result to the user server and release the computing resource node occupied by the user [12]. The grid scheduler will monitor the execution of the whole resource node, and the user can also query the execution status of the sub task. If the sub task fails or the computing resource node fails for other reasons, the grid will fault tolerance the task. When all the computing resource nodes complete their tasks, they delete the queues they maintain and enter the idle state, and then feedback all the execution results of the subtasks to the user server. In the sustainable optimization of urban park landscape planning, the load balancing factor of cluster computing network can be expressed as:

$$F_r = f_h - f_l \quad (1)$$

In the formula, F_r is the load balance degree, f_h is the maximum load of nodes in the grid, f_l is the minimum load of nodes in the grid. Suppose the urban park landscape planning project is divided into *n* independent and non communication tasks by cluster task scheduler. There are *m* computing resource nodes in the grid system, and the execution efficiency between nodes is in line with the real network situation. Set *J* represents *n* independent subtasks, and set *R* represents mm computing resource nodes [13]. According to the sub task set and computing resource node set, the cluster task allocation results can form a matrix $P_{m\times n}$ with the size of $m\times n$. Each task has and can only match one node resource, while a node can match multiple tasks and form a local task execution queue. The cluster task allocation results will also form an expected time matrix $T_{m\times n}$ with the size of $m\times n$, and T_{ij} shows the expected time for node *i* to execute task *j* [14]. Then the objective function of cluster task scheduling is the total time spent after processing all tasks, which can be described in the following form:

$$makespan = \max\left\{\sum_{j=1}^{n} P_{ij}T_{ij}\right\} \quad (1)$$

The constraints of cluster task allocation are as follows:

$$\begin{cases} P_{ij} = 0 or 1 \\ \sum_{j=1}^{n} P_{ij} \geq 0 \quad (2) \\ \sum_{j=1}^{m} P_{ij} = 1 \end{cases}$$

In the cluster task scheduling calculation, the scheduling algorithm should make the makespan of all tasks as minimum as possible, that is, the optimal span. At the same time, it should also maximize the load balance between the resource nodes of the whole system.

1.3Analysis of landscape cognition in environmental psychology based on cluster computing

1.3.1 Visual perception

According to the characteristics of visual perception, it can be divided into depth perception, color perception and figure perception. Applying these characteristics of visual perception to plant

landscape design, the plant landscape will be a pleasant beauty with good sense of picture and art. Depth perception, also known as distance perception, refers to people's perception of the distance of objects, that is, depth. Its accuracy is a comprehensive measurement of the sensitivity of depth clues. The external space takes 20-25m as the unit, and forms a sense of series and rhythm with the change of material mechanism or elevation difference, so as to break the monotony of open space and make the site full of vigor and vitality, which provides a design basis for large-scale plant design in Urban Parks [15]. According to the Enlightenment of depth perception, plant landscape should be divided into different depth of plant scene, combined with the path, to create a park plant landscape with changing space, strong sense of plant rhythm, high and low levels and rich levels. People's eyes are more sensitive to color than to texture, texture and shape. Different levels of color perception will lead to different physiological projection, which will affect people's mood and mental state. Stimulated by the warm tone, the pupil dilates, and the pulse will accelerate, especially the red, yellow, orange and other colors with higher saturation and brightness will make people excited. The more gorgeous the color is, the greater the stimulation to people will be [16]. Cold colors can calm people's anxious mood and eliminate mental pressure. People are calm and relaxed in the blue and green environment.

1.3.2 Spatiotemporal perception

People's perception of the environment is mainly based on vision. Through the joint action of various senses, space perception is formed, and the position, orientation, shape and size of the environment are recognized by space sense and cognitive ability. People's psychological changes and time changes have an impact on space perception. People recognize the space environment with the movement of position and the change of time. When time and space are connected, they form a four-dimensional space [17]. According to the enclosed state, space can be divided into two forms: open and closed. The space and enclosed height are defined as D and H respectively. When $\frac{D}{H}$ is less than 1, the space is too closed and prone to depression; when $1 < \frac{D}{H} < 2$ is less than 1, the space makes people have a sense of cohesion and stability; when $\frac{D}{H} > 2$, the enclosed entities repel each other and the space has a sense of dispersion.

The diversity and complexity of landscape is reflected in the diversity of spatial form change, and the organic change of spatial form is spatial sequence. Through the stacking of plants and rocks, retraction, opening and closing, a variety of spatial sequences are formed. Modern plant landscape design does not need to design such a rich space, but there should still be some changes in space, such as the road turning, the boundary of different functional areas, the treatment of intersections and so on. In the process of plant landscaping, spatial sequence can be formed by means of spatial curvature, spatial opening and closing changes, and node retraction.

1.4 Analyzing the psychological needs of urban residents for urban park landscape

People will produce different physiological and psychological reactions under different environmental stimuli, and then produce different behaviors. The real environment provides a place for the occurrence of behaviors. While the environment affects people's behaviors, people

also have an impact on the environment, constantly improving the surrounding environment. The design goal of urban park is to create a comfortable and humanized environment, which requires observation and Research on the main body of activities, especially the analysis of the factors related to people's psychological needs and behavior activities in the park, and puts forward countermeasures to achieve this goal. At present, the single greening can not meet the aesthetic standards of modern people. What people need is a natural landscape full of changes, rich colors, changeable spatial forms, dynamic canopy lines, and dynamic landscape full of seasonal changes. The more diversified the landscape is, the closer people feel to nature and the more comfortable they feel in the park, which is conducive to improving the quality of life, Improve the level of the whole city [18]. When visitors play in the park, there are two main meanings to the landscape security requirements. One is that the plants that constitute the landscape are safe and should not cause people's uneasiness. The other is the security requirements of the site. People should have a corresponding sense of control over their own fields in the various spaces surrounded by plants. Once they lose the sense of control, the sense of security will be reduced. In addition, the accessibility of park landscape refers to the degree of difficulty from any point in the space to the scenic spot, which reflects the landscape resistance of urban park landscape to the horizontal movement process of space. The horizontal movement process of visitors arriving at the urban park landscape is the process of overcoming the spatial resistance. If the accessibility of the park landscape is good, it means that the park landscape has great potential to serve people, and the value of landscape realization is greater. If the accessibility of the park landscape is poor, it means that the service potential of the park landscape is small, and the value of its realization is also small. In order to make the landscape of the park appreciable, the first thing is to let people get close to the landscape, but to let people walk in it, so that the landscape can play its maximum value. In the same way, we can get the audience's requirements for the identifiability, comfort, sense of domain and privacy of the landscape, and make continuous adjustment to the urban park landscape planning based on the results of real-time psychological needs analysis.

1.5 Sustainable optimization of urban park landscape planning

In the cluster computing mode, the results of psychological needs analysis are imported into the computing environment, and the landscape planning results of sustainable optimization are obtained through cluster computing and iteration from two aspects of functional zoning and landscape elements.

1.5.1 Continuous division of urban park landscape function area

From the nature of park use, it can be divided into three parts: public area, semi public area and private area. Public area refers to the public area commonly used. Such as park entrance, square, sports facilities area, entertainment area and activity area. Semi public area refers to the overlapping common area between public area and private area. Such as promenade, waterfront platform, entertainment and rest area [19]. As the name suggests, private area refers to the area that a few people can use alone. Such as park management area, lovers leisure area, private garden rest area, etc.

1.5.2 Sustainable optimization of urban park landscape elements planning

As an important part of connecting the inside and outside of the park and between the various functional areas, the road system needs to be properly graded in the process of design, so as to better complete the design of the road. For example, the functional area and the functional area should be connected to the main road, the design width needs to meet the needs of a large number of tourists, and also form a certain loop design, so as to form a road Scientific tour route. In addition, there are many secondary roads, footpaths and so on, which are designed to meet the specific needs of tourists. For example, some tourists want to take sightseeing vehicles, which puts forward certain requirements for the road level between various scenic spots [20-21]. In addition, if some places with beautiful environment can not be directly reached, some sightseeing Cableways can also be developed, so as to make the scene of the Wetland Park fully catch the eyes of tourists, and also form a good protection for the Wetland Park, so as to avoid too many road designs affecting the ecological environment of the wetland, and provide mature solutions for the sustainability of development.

The distribution structure of plant landscape in urban park landscape is shown in Figure 3.

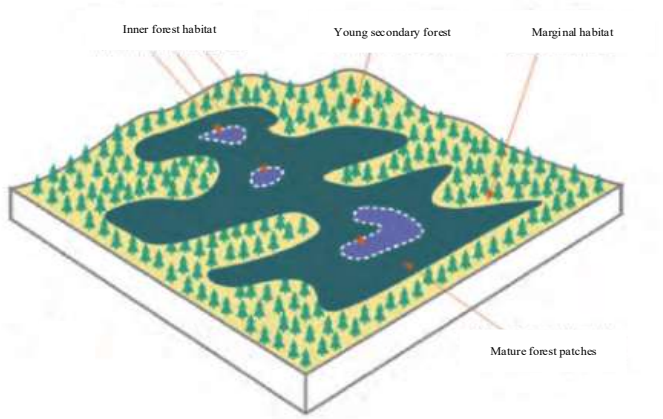

Fig.3 Distribution map of urban plant landscape planning

n the process of sustainable planning of plant landscape, the canopy density, ornamental characteristics and sight distance are controlled respectively. Canopy density refers to the degree of sheltering relationship between tree crown and canopy. If the maximum canopy density of trees is set to 1, the ground will be covered completely0.9, 0.8, etc. In the planting planning, the canopy density (P) of background dense forest is greater than 0.8; the P value of sparse shrub is less than 0.8 and greater than 0.6; the p value of shade wood grassland is less than 0.8 and greater than 0.4; the p value of grassland is greater than 0.2; the p value of tree shade square is less than 0.8 and greater than 0.6. For the isolated trees and clumps, the specification, height and posture of the isolated trees should be strictly controlled, the trees with strong ornamental characteristics should be selected, the spatial distance from the surrounding trees should be maintained, and special maintenance and management methods should be adopted to ensure their ornamental characteristics and value. There are strict regulations on plant density. Solitary trees, clumps and groups of trees must have ornamental points. The width of sight distance determines the quality of ornamental points, which is better than 1.5 times of the width of clumps. The sight distance of

ornamental forest must be 2 times larger than that of Lingao. The height of hedgerows and fence plants is generally not higher than that of people, and the ground cover plants are only about 0.5 meters. Plant spacing requirements should generally comply with the provisions in Table 1.

Table 1 Planting spacing of greening plants

name	minimum spacing（m）	maximum spacing（m）
A line of street trees	4.00	6.00
Two line street trees (chessboard planting)	3.00	5.00
Arbor group planting	2.00	/
Trees and shrubs	0.50	/
Shrub group planting (large	1.00	3.00
shrub)	0.75	1.50.
(middle Bush)	0.30	0.80
(Bush)		

In addition, when choosing plants, we should also pay attention to the selection of large-scale green plants in areas with tourist activities, and it is not suitable to choose poisonous plants, thorny plants, or plants secreting slurry. In children's recreation areas, we should choose plants with a clearance of more than 1.8 meters under the branches of trees. In the adult area, the plants with the clearance under the branches of trees greater than 2.2m should be selected. On this basis, traffic safety factors, seasonal changes in spring, summer, autumn and winter should also be considered. For example, in summer, we should choose the shade tree species with luxuriant branches and leaves, whose shade range reaches 50%. In addition to the above landscape elements, on the basis of the initial landscape planning plan, the road landscape, washing landscape, architectural landscape and other parts can be continuously optimized, and the results of urban park landscape planning at different time stages can be obtained.

2 Experimental analysis of application effect

In order to test the application effect of environmental psychology in the sustainable optimization method of urban park landscape planning under the cluster computing mode, the application effect test experiment is designed, and the selected urban park samples and their landscape planning status are shown in Figure 4.

Fig.4 Preliminary planning of sample landscape of Urban Park

The total area of the selected urban park is about 5000 square meters, and the service radius is between 0.7-1.3 hectares. The main problems of the base site are as follows: the greening function is relatively single, the plant configuration is lack of regularity, the drainage system of the green space is poor, and the integration of the overall space and the surrounding environment is not close enough. On the basis of the present situation, the park should be transformed, and the facilities such as pavement, Garden Road and landscape wall should be added to enrich its functions, so as to avoid the "appreciation of green space". In the design process, the pavement with good water permeability is used, and the terrain is properly raised in low-lying areas. Anfeng Road Park will be built into a set of ornamental, ecological, recreational, cultural in one of the multi-functional park.

Because the sustainable optimization method of urban park landscape planning is run in the cluster computing mode, it is necessary to build the corresponding experimental environment for this mode. The experimental cluster is composed of three sub nodes and one master node. The sub nodes are responsible for the tasks assigned by the master node. The hardware configuration of the sub nodes is the same. They are all Centosv6.0 operating system + 1G memory + 8G external memory. As the center of the cluster, the master node is responsible for the resource management and job allocation of the whole cluster, and manages the file storage system of the whole cluster. Compared with the sub node, the configuration of the master node is slightly higher, which is the operating system of V6.0 + 2G memory + + 16g external memory. The master and child nodes run NameNode, ResourceManager, master and Datanode, NodeManager and Worker processes respectively. Namenode and Datanode manage storage files, ResourceManager and NodeManager manage cluster resources, Master and worker are processes opened by Spark and execute submitted Spark jobs. There are many software involved in the experimental environment, and the specific software configuration information is shown in Table 2.

Table 2 Software configuration information of cluster nodes

software	name	edition
operating system	Centos	V6.0
SDK	Jdk	1.8.031
programming language	Scala	2.11.5
file storage system	HDFS	Hadoop-2.5.2
resource manager	Yarn	Hadoop-2.5.2
computing framework	Spark	1.2.0
programming tools	IntelliJIDEA	14.0.3

In Hadoop_HOME execute start in home directory- dfs.sh and start- yarn.sh directly execute start- all.sh To start Hadoop. Directly execute start under SBIN- all.sh Or start step by step- master.sh And start- slaves.sh . After successful startup, you can use Submit tool. You can also execute "spark shell" in bin directory to program Scala directly. Through the application of environmental psychology, the results of urban park landscape planning are obtained. The planning results of leisure and entertainment areas are shown in Figure 5.

Fig.5 Landscape planning results of leisure and entertainment area

In order to test the sustainable optimization results of urban park landscape planning, the research samples are updated in real time. When the environmental psychology and needs of the audience are detected to change, the landscape of urban park is rectified immediately through cluster computing mode, and the time of the two landscape rectification is controlled as much as possible for more than half a year, so as to reduce the cost of landscape planning and transformation. The number of audience samples is 20000, and the satisfaction degree of tourists to the urban park landscape is obtained through questionnaire survey, and the application effect of environmental psychology in the sustainable optimization method of urban park landscape planning under the cluster computing mode is obtained, as shown in Table 3.

Table 3 Application effect of environmental psychology in sustainable optimization method of urban park landscape planning

Name of urban park functional area	Landscape planning results without applying environmental psychology		Landscape planning results of applied environmental psychology	
	Number of satisfied tourists / person	Number of dissatisfied tourists / person	Number of satisfied tourists / person	Number of dissatisfied tourists / person
quiet area	19615	385	19875	125
recreation area	18732	1268	19926	74
elderly activity area	19431	569	19848	152
children's activity area	18488	1512	19762	238
sports area	19505	495	19845	155

park	18922		19726	
management area		1078		274
water play area	19317	683	19771	229

It can be seen from table 3 that before and after the application of environmental psychology, the tourist satisfaction of urban landscape planning results is 95.7% and 99.1% respectively. Similarly, after one year's operation and renovation of urban parks, the satisfaction rate of tourists is 94.3% and 99.5% respectively. It can be seen that the application of environmental psychology can effectively improve the satisfaction of tourists to the urban park landscape. Through time comparison, it can be seen that the satisfaction of tourists has been improved after the application of environmental psychology, which proves that under the cluster computing mode, environmental psychology has a positive role in the sustainable optimization of urban park landscape planning.

3 Conclusion

With the deep understanding and knowledge accumulation of urban park landscape functionalization, especially the establishment of the relationship between spatial pattern and landscape function. Some cases of application of design principles emerge as the times require. Through the application of cluster computing mode and environmental psychology, the real-time optimization and updating of landscape are realized, and new discoveries are sought from the actual situation and problems. This method makes a significant contribution to the sustainable development science and the sustainability of landscape planning.

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