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Computer-Aided Design AND APPLICATIONS

Art Interactive Design of Public Leisure Space Environment Based on PSO Algorithm

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Abstract. With the continuous growth of urbanization, many cities use public works of art to enhance the image of the city in the form of artistic expression. Environmental art computer aided design (CAD) means that the designer expresses the design intention through human-computer interaction (HCI) technology, and finally informs the customer by image. CAD has been widely used in environmental engineering, and it has become an important means to improve product and engineering design level, shorten product development cycle, improve labor productivity and reduce consumption. This aritcle will interpret public art and urban public space, and summarize the relationship between them. According to the interactive design characteristics of environmental art in public leisure space, a CAD optimization method of public space layout based on particle swarm optimization (PSO) is proposed, and a mathematical model of interactive optimization design of environmental art in urban public leisure space and a parametric description of public leisure space are established. The comprehensive results show that the performance of PSO algorithm and user perception score can achieve relatively ideal results, so the application of PSO algorithm has certain guiding significance for interactive design in urban public leisure space.

Keywords: Public Leisure Space; PSO Algorithm; Man-Machine Interaction; CAD; Layout Optimization
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1 INTRODUCTION

The urban open space is not a simple ornamental function, but is endowed with more social significance. If people want to experience more colorful social life, have more opportunities for social interaction and participation, and the demand for leisure activities is becoming more and more diversified. Balochian and Baloochian's [1] improved grey prediction model is applied to the universality detection of user commuting frequency in the transportation system. The grey prediction model is a prediction method based on grey system theory, which can handle small samples, nonlinear, and non-stationary data. By improving the grey prediction model, the accuracy and reliability of prediction can be improved. This model is a grey prediction method based on exponential accumulation, which can predict future data by constructing grey differential

equations. GM model can be used to predict the number of users in the future. A common method is to introduce seasonal factors, such as using the Seasonal GM Model (S-GM). Considering that the number of users in the public road transportation system is affected by many factors, a multi-level gray prediction model can be established to predict the number of users in the future with multiple factors as inputs. The S-GM model considers the seasonal variation factors and can be used to predict the seasonal variation of the number of users of the public road transportation system in the future. The grey prediction model can be combined with other prediction methods (such as linear regression, neural network, etc.) to synthesize multiple prediction results and improve prediction accuracy. It should be noted that the improved grey prediction model also needs to be selected and applied based on actual situations. At the same time, for the prediction of the number of users of the public road transport system, it is also necessary to consider the impact of other factors (such as policy changes, economic development, etc.). By selecting appropriate models and methods, the accuracy and reliability of prediction can be improved, which provides strong support for the planning and decision-making of public road transportation system. Interactive design is an important means of landscape design and the key to improve the quality of landscape interactive design of urban public leisure space. Landscape interactive design refers to the corresponding combination of different spatial forms and recreational ways in the design process, focusing on changing people's passive appreciation into guiding people's active participation, so that people can actively participate and meet people's needs for recreation, viewing and communication. Gharaibeh et al. [2] analyzed the weighted Scenario analysis of land allocation and utilization rate by genetic algorithm under the compatibility of functional algorithm. By continuously optimizing land use allocation plans, the goals of improving land use efficiency, achieving sustainable development, and promoting urban development can be achieved. In practice, the goals of land use can be clearly defined, such as maximizing commercial land, maximizing residential land, and maximizing public facility land. Based on the characteristics of land use problems, the basic operations of genetic algorithms can be improved, such as selection, crossover, mutation, etc., to improve search efficiency and quality. Add constraints on land use to the optimization process, such as limitations on the area, location, and purpose of land use. Evaluate and validate the optimized land use allocation plan to ensure its feasibility and reliability. Through the above steps, genetic algorithms can be improved to optimize land use allocation, improve land use efficiency and planning quality, and provide effective tools and ideas for urban planning and development. The purpose of public art is to integrate the professional skills, creativity and imagination of artists and arts and crafts artists into the whole process of creating new space and urban renewal. In order to permeate the unique quality into the whole development process, the space is endowed with soul and vitality by creating an environmental visual art with visual impact. Interactive design mainly considers people's emotional experience, taking people as the carrier, the landscape design of the square is people-oriented, and feedback is given in the design to meet people's use needs, while the public's active participation can get experience from the landscape design, forming the interaction between people and landscape, and the interaction between people. With the rapid development of Digital art design information, computer scene synthesis technology based on CAD video network sharing has become an important tool. Guo and Li [3] analyze the scene perspective of compressing computer information scene frame synthesis by creating interactive interface designs. Designers can use CAD software to create digital models and then add interactive elements to them in a digital environment to create interface designs with a good user experience. This tool can be used to create 3D printing designs. Designers can use CAD software to create digital models and then export them to 3D printing format to create highly complex objects. These are just some applications of CAD digital video networks in art and design. In fact, CAD tools have a wide range of applications and can be applied in various fields, including architecture, engineering, manufacturing, and game development.

Filtering and informing design space is a method of moving towards design space thinking, which can help designers better organize and process information when facing complex design problems. Halskov and Lundqvist [4] conducted a comprehensive spatial architecture perspective to dynamically analyze the structure. In designing a space, there are many factors that need to be

considered, such as color, shape, size, materials, functionality, and so on. To help designers better process this information, filtering and screening methods can be used. By filtering out unnecessary information, designers can reduce their Cognitive load and focus more on key design factors. By visualizing the design space, it can help designers better understand and explore the design space. Filtering and informing design space is an important design thinking method that can help designers better organize and process complex design information. By clarifying the design space, filtering and screening information, visualizing the design space and iteratively optimizing design, designers can better solve complex design problems and create unique and innovative design solutions. In the urban public leisure space, various activities take place in the same time and space, which show us the culture and life of the city as the "urban living room", thus condensing an energy full of life breath and urban vitality. From the perspective of its spatial environment, it is not only simply placed in a unique public space to become public art, but more consideration is given to the harmonious and symbiotic relationship between works of art and its surrounding spatial environment. With the maturity of Internet technology and digital media technology, the design idea of interactive experience has been applied to architectural design, planning design, environmental art design and other fields with the help of digital media technology of the Internet. Harbaoui et al. [5] used the PSO algorithm to optimize the multi-site pickup and delivery problem with time windows and multiple vehicles, which is an important logistics planning problem. This issue requires determining the driving route of each vehicle and the time window of each station to meet customer needs and maximize profits. It clarifies the objective function and constraints of the problem. The objective function can be to maximize profits, minimize costs, etc. Constraints can include time windows, number of vehicles, route restrictions, etc. Treat each vehicle and its corresponding task list as a particle. In this problem, the fitness function can include factors such as profit, distance, and time. The position can represent the starting position and target position of the vehicle, and the speed can represent the driving speed of the vehicle. Find the particle with the best fitness among all particles and consider it as the optimal solution. Adjust the parameters of the PSO algorithm based on experimental results, such as inertia weight, acceleration constant, etc. Computer-aided environmental art design means that designers express their design intentions through HCI technology, and finally inform customers by images, the emergence and application of CAD software is changing the design methods and expressions. Focusing on the specialty of environmental design, what modern environmental design needs is not only the traditional design mode, but also the collection of computer design, intelligent design and diversified design.

Jiang [6] analyzed the group management structure of urban public art digitalization. Utilizing cluster computing technology to connect multiple computers together and work together to improve computational efficiency. In Public art and interactive design, cluster computing can be used to process images to improve the expressiveness and effect of Digital art installations and interactive art design. Encourage the public to participate in the process of public art and interactive design, such as providing an interactive design platform, so that the public can create and upload works independently. This can enhance the sense of belonging and participation of the public, and can also promote the diversity and innovation of urban public art. The strategy of urban public art and interactive design based on digital technology aims to use digital technology and cluster computing. By enhancing the artistic value and interactivity of urban public spaces, it enhances the attractiveness and competitiveness of the city. At the same time, this strategy can also promote cultural exchange and innovative development in cities, making contributions to their sustainable development. Due to the economic transition and social transformation, urban social problems and social contradictions have become increasingly prominent, and the research on urban social space has attracted more and more attention from academic circles and government departments. Many problems in urban development have a strong timeliness and the constraints of geographical and spatial distribution, which are manifested in the multidimensional combination of time, space and characteristic quantities. Urban public leisure space is both the noumenon and the carrier of urban culture. As a microscopic element of the city, leisure space is not only the carrier of residents' daily life, but also the crystallization of urban culture. Strengthening the

guidance, adjustment and optimization of public leisure space organization is an urgent task to promote the growth of urban communities. This aritcle discusses the application of PSO algorithm and CAD technology in the interactive design of public leisure space environment art;

(1) This aritcle will interpret public art and urban public space, sum up the relationship between them, and analyze the environmental characteristics of public space in public art design, so as to get the influence of these characteristics on the growth of environmental art CAD.

(2) According to the interactive design characteristics of environmental art in public leisure space, an optimization method of public space layout based on PSO is proposed, and the mathematical model of interactive optimization design of environmental art in urban public leisure space and the parametric description of public leisure space are established.

The first section of the article introduces the basic concept of interactive design of public leisure space environment art and the significance of CAD technology application, and the second section constructs an interactive optimization model of public leisure space. The fourth section is experimental analysis, which verifies the efficiency and effectiveness of PSO in this aritcle. The fifth section summarizes the contribution of this study to the environmental art design of urban public leisure space, and puts forward the direction of future improvement.

2 RELATED WORK

Internet of Things service composition using genetic algorithm and Particle swarm optimization is an important field of open computer science. IoT service combination refers to the combination of multiple IoT services to achieve more complex application scenarios. In this process, it is necessary to optimize the parameters of service composition to achieve better performance and user experience. Genetic algorithm and Particle swarm optimization are two common optimization algorithms, which can be used to optimize the service composition of the Internet of Things. Kashyap et al. [7] transformed optimization objectives into objective functions, such as minimizing service composition time, maximizing resource utilization, and maximizing service quality. Apply the optimal service combination solution to practical scenarios to achieve better performance and user experience. By optimizing the parameters of the service portfolio, better performance and user experience can be achieved, providing support for the development of IoT applications. Li and Fan [8] evaluated the landscape planning scheme of Urban green space based on PSO neural network model. Through the network rating of Urban green space indicators, the influencing factors of the model indicators were analyzed. Collect the relevant data of Urban green space landscape planning scheme, including the area, shape, location, surrounding environment and other factors of green space. Convert these data into digital data, analyze and preprocess them. Based on the collected data, construct a suitable BP neural network model. You can choose a model with multiple hidden layers and neurons to handle complex green landscape planning problems. Train the model using historical data and optimize its parameters and structure to ensure that the predicted results of the model are as close as possible to the actual results. Evaluate the model using a test dataset and calculate the prediction error and accuracy of the model. If there is a significant difference between the predicted results of the model and the actual results, the model can be adjusted and improved. With the change of Urban green space landscape planning and the collection of new data, the model needs to be updated and improved. New data can be used to retrain the model and adjust its parameters and structure to adapt to new planning needs and changes. PSO-BP neural network model can reduce the subjective factors in Urban green space landscape planning and improve the accuracy and objectivity of planning. Through the prediction results of the model, the layout of green spaces can be optimized, and the position, shape, and area of green spaces can be reasonably arranged to achieve better ecological benefits and landscape effects. The use of PSO-BP neural network models can reduce planning time and labor costs, and improve planning efficiency. The PSO-BP neural network model can comprehensively consider the impact of various factors on the landscape design of Urban green space, and enhance the scientificity of the planning. the combination of practical operation and

theoretical learning, and the organization of extracurricular expansion activities. Through the exploration and practice of these methods, art designers with innovative and practical abilities can be better cultivated. Liu and Yang [9] designed a database based innovative teaching model for environmental art. By analyzing the language teaching model architecture of server development, fully leverage students' subjective initiative. By involving students in practical projects, organizing student teams, and conducting classroom discussions, students' interest and creativity in learning can be stimulated. In addition to classroom lectures and exercises, extracurricular expansion activities should also be organized, such as visiting art exhibitions, participating in design lectures, and conducting social practices. These activities can expand students' horizons and knowledge, while also stimulating their interest and enthusiasm. Lubida et al. [10] analyzed the information system of land use planning and urban geographic analysis. Land use planning needs to balance multiple objectives, including economic interests, environmental protection, social needs, and policy requirements. Multi objective optimization can be achieved by comprehensively considering these objectives through mathematical models or artificial intelligence algorithms, and finding the optimal solution. This approach can help decision-makers better balance the needs of different stakeholders and develop more fair and sustainable land use planning. Policy support is the key to the implementation of land use planning. The government can guide the rational distribution and utilization of land use by formulating relevant policies and regulations, while providing financial support and incentive measures to promote the implementation of sustainable land use planning. The land use planning for sustainable urban development needs to comprehensively consider multiple aspects such as spatial planning, multi-objective optimization, public participation, policy support, and ecological protection. By adopting the above methods, more scientific, fair, and sustainable land use planning can be formulated to promote sustainable urban development. Mao et al. [11] developed the rail transit route of Kunshan traffic data based on the PSO-LSTM model. The analysis of road traffic speed in the mountainous areas of the Kunming Plateau is a complex problem that requires consideration of multiple factors, such as road conditions, traffic volume, weather, etc. The LSTM model can be used to predict road traffic speed in the mountainous areas of the Kunming Plateau, and predict future traffic speed by using historical and current data. Marques et al. [12] using random change allocation algorithms to simulate and predict urban land use changes that consider multiple categories and transitions is an effective method. This method can consider multiple types of land use and transitional changes between different land uses. Specifically, a random change allocation algorithm can be used to construct an urban land use change model, which can simulate changes consider transitional changes. The basic idea of the model is to regard urban land use change as a Stochastic process, and the change probability between different land use types can be dynamically adjusted according to the actual situation. Through the above steps, the random change allocation algorithm can be used to simulate and predict urban land use changes that consider multiple categories and transitions, providing effective tools and ideas for urban planning and decision-making. At the same time, it can also provide reference and reference for relevant research. Mingyang et al. [13] conducted a training mechanism under a single view 3D network architecture. Through the deep learning of the background reconstruction of 3D shape, the Iterative reconstruction is based on the training mechanism of the network architecture. The training of deep learning models requires a large amount of data and computational resources, which require a lot of time and computational resources. The reconstruction results may be influenced by factors such as lighting conditions, camera posture, and object posture, which need to be considered in model design. Analyze features through deep learning models to restore the three-dimensional shape and geometric structure of objects. Generative adversarial network (GAN), or point cloud-based methods, such as point cloud library (PCL). For the reconstructed 3D model, it is necessary to evaluate the results, including accuracy, robustness, reliability, and other indicators. The evaluation method can be manual or automatic, such as error measurement based or similarity measurement-based methods. Mohamed and Ali [14] used CAD/CAM to analyze the design of campus leisure areas. Create a design sketch using CAD software. This includes drawing floor plans, elevations, and 3D models of buildings, as well as the layout and facility arrangements of each area. It uses CAM

software to analyze and evaluate design sketches to determine their feasibility, practicality, and safety. Evaluate whether the design meets the requirements of the campus by simulating environmental factors such as wind speed, lighting, and noise. Adjust and optimize the design based on the analysis results of CAM software. For example, adjusting the position and opening direction of buildings based on wind speed simulation. Based on noise simulation, consider whether soundproofing measures need to be taken. After completing the design optimization, use CAD software to create construction drawings. This includes detailed Floor plan, elevation, structural drawing, pipeline drawing, etc., as well as installation drawings of various facilities. Carry out on-site construction according to the construction drawings. During this process, it is necessary to comply with relevant building regulations and safety standards to ensure the smooth progress and completion of the project. Mutlu [15] needs to transform the land use model into a processable form of genetic algorithms. Determine the range of values for each parameter, for example, land use efficiency can be between 0 and 1, and planning flexibility can be between 0 and 10. Based on the parameter range, randomly generate some initial populations, each consisting of multiple genes, each representing a set of parameter values. Evaluate the fitness of each population using a land use model to determine the survival probability of the fittest for each population. Based on the fitness evaluation results of the population, select some operations, such as crossover, mutation, etc., to optimize the population. According to the stopping conditions, output the optimal solution, which is the optimal combination of land use model parameters. Optimizing parameters in land use models through genetic algorithms can achieve the goal of improving land use efficiency and achieving planning flexibility. At the same time, appropriate adjustments and improvements can be made according to the actual situation to adapt to different land use needs and changes. Evaluate and validate the optimized land use model to ensure its feasibility and reliability. Through the above steps, genetic algorithms can be used to optimize multi-objective land use models, achieve elastic design of buildings and planning, improve land use efficiency and sustainability of planning. Niu et al. [16] conducted a gradual coverage evacuation guidance of particle swarm optimization algorithm by conducting analysis of nonlinear change feature guidance. Based on emergency simulation evacuation, it analyzed the time division of spatial configuration optimization and emergency evacuation plan decision-making analysis. By using CAD software for space allocation, the distribution points of evacuation guides can be labeled and drawn in CAD space based on the structure and layout of public spaces. The above are the main steps of the CAD space allocation method for evacuation guides in urban open public spaces. In practical applications, adjustments and optimizations need to be made based on the characteristics and needs of different public spaces to ensure that evacuation guides can better serve the public and improve the level of urban emergency management. Take Binjiang Green Space in Xuhui District of Shanghai as an example. This method can allocate space through CAD software, and label and draw the distribution points of evacuation guides in CAD space based on the structure and layout of public spaces. In emergency situations, it is necessary to provide necessary training and management for evacuation guidance personnel to ensure that they can respond quickly and perform their duties effectively. Regular emergency drills and training are needed for evacuation guidance personnel to improve their response ability and quality. By considering the above factors, a more comprehensive evaluation of the safety status of public spaces can be conducted, and a more scientific and reasonable evacuation guidance personnel allocation plan can be developed. At the same time, it is also necessary to continuously adjust and optimize according to the actual situation to ensure the effectiveness and implementation effect of the plan. Yan et al. [17] constructed a machine learning neighborhood optimization analysis model for Urban green space. It analyzed the support vector optimization learning model of the park green space label dataset. The ocean predator algorithm is an optimization algorithm based on biological evolution theory by applying a mixture of indicators and hyperparameters in the validation set. Optimize the parameters of the machine learning model using the ocean predator algorithm. The marine predator algorithm constantly searches for the optimal solution by simulating the biological evolution process, and continuously optimizes the model parameters to improve the accuracy of Urban green space type classification. Various indicators are used to evaluate the optimized

machine learning model, such as accuracy, recall, F1 value, etc., Consider the parameters in the machine learning model as biological populations in the ocean, and use the ocean predator algorithm to optimize the model. Evaluate the optimized machine learning model using a test dataset and calculate the prediction accuracy and error of the model. Use the optimized machine learning model to classify the types of Urban green space, and output the classification results. Using machine learning optimized by marine predator algorithm can classify the types of Urban green space and improve the accuracy and objectivity of classification. At the same time, appropriate adjustments and improvements can also be made according to the actual situation to adapt to different needs and changes in the classification of Urban green space. Zhang et al. [18] designed an intelligent fuzzy system for interactive Iterative reconstruction. In interactive Iterative reconstruction design, intelligent and fuzzy systems can be used to improve user experience and efficiency. At the same time, fuzzy systems can be used to handle uncertainty and errors, improving the robustness and reliability of the system. Combined with entropy weight method and grey correlation analysis, is a complex problem that requires a comprehensive evaluation of multiple methods. Zhang [19] used the ideal solution similarity ranking preference technique to rank the emotional attachment features of small-scale urban vitality spaces and determine the relative importance of each feature. This technology can construct an ideal solution model, divide the evaluation indicators into positive and negative indicators, standardize them, and then calculate the similarity between each solution and the ideal solution, and sort them based on the similarity. Secondly, combining the entropy weight method, assign weights to each evaluation indicator. Entropy weight method is an objective weight distribution method, which can distribute weights according to the characteristics of data itself to avoid the deviation caused by subjective factors. By calculating the entropy value of each indicator, its weight can be determined. Finally, grey correlation analysis is used to comprehensively evaluate the emotional attachment characteristics of small-scale urban vitality space.

3 THE RELATIONSHIP BETWEEN PUBLIC ART AND PUBLIC SPACE

Urban public space is a window to show the charm of the city and an important part of modern urban life, which can vividly reflect the local culture and characteristics of a city. As an important part in the process of urban construction, public art needs a space formed by a certain public area of the city as a carrier to reflect its publicity. The design of the form and style of modern public art is not only to provide people with a living environment rich in cultural accomplishment and connotation, but also to guide the public to observe and think in various forms in the process of creation by virtue of the two-way interaction between artists and the public. Public art belongs to the category of contemporary art. It makes public space more public, historic and cultural, and at the same time brings people closer to have a good interaction with the public space environment, so that people can feel the psychological fluctuation brought by the space environment where public art is located, thus achieving a spirit and attitude, and making the whole space more place-oriented.

Public art and public space have a close relationship. They influence and promote each other, and together build the cultural atmosphere and public life of the city. First, Public art is an important part of public space. Public art refers to works of art existing in public space, including sculptures, installations, paintings, images and other forms. Public art can not only beautify public space, improve the quality and charm of public space, but also guide the public to know and understand public space, and promote public participation and attention to public affairs. Therefore, Public art plays an important role in public space and is an indispensable part of public space. Secondly, Public art can shape the character and atmosphere of public space. The design and selection of public art works directly affect the character and atmosphere of public space. For example, a serious sculpture can make public spaces more solemn and solemn, while a cheerful installation can make public spaces lively and interesting.

Therefore, Public art is not only an art form, but also a cultural expression and transmission of values, which can shape the character and atmosphere of public space and affect the public's

feelings and behavior. Finally, the public space provides a stage for the display and dissemination of public art. Public space is the place where Public art is displayed and spread, and is the basis for the existence and development of Public art. Public space provides an opportunity for Public art to display and spread, so that the public can better understand and appreciate Public art. It also provides a platform for public artists to display and exchange, and promotes the development and innovation of public art. Therefore, the relationship between public space and public art is interdependent and mutually reinforcing. To sum up, public art and public space interact and promote each other, and jointly build the cultural atmosphere and public life of the city. Public art is an important part of public space, which can shape the character and atmosphere of public space. At the same time, public space provides a stage for public art to display and spread. Therefore, in urban planning and design, we should pay attention to the coordinated development of public art and public space, give full play to their joint efforts, and create a more beautiful, comfortable and dynamic public space for the city.

Nowadays, many landscapes in cities only affect users' cognition through the aesthetic feeling of surface form. For a long time, it has been established as an aesthetic demand, and the behavior law restricts landscape design, ignoring the feelings that users get when they participate in the landscape as the main body. In the process of urban construction and development, public art plays an important symbolic role in it, which presents the vitality of a city's development to the public. Judging from the living environment and quality of the public, public art not only brings the public into a city public space full of artistic atmosphere, but also provides a cultural activity space for the public to communicate with each other. In the process of engineering design and production, many information of objects, such as shape, color, volume, area, center of gravity, moment of inertia, texture and illumination, are often needed. Whether this information can be effectively expressed is directly related to whether the design efficiency and design success rate can be improved.

Urban public art creates public places and public spaces and produces culture derived from them. The core of this culture is citizen culture, which pays attention to sharing and communication in public space. In public leisure space, people's main activity is to have a rest in the environment. In order to make people enjoy comfortable leisure and amusement in the environment, get spiritual pleasure and emotional satisfaction in interaction, subjective feelings and emotional elements can be integrated into public facilities widely used by people's behavior activities, injecting more vitality into facilities and increasing artistic forms to express emotions. The scale has a great influence on the interactivity formed by people in public space, and the lack of interactivity can't attract the public to stop and watch. Public art is in harmony with people and the environment, and the participation of the public is easy to resonate with the public art. The existence of the spirit of place has formed a close relationship between the public and public art.

4 INTERACTIVE OPTIMIZATION MODEL OF PUBLIC LEISURE SPACE

4.1 Optimization Strategy of PSO Algorithm Layout

People's inherent demand for leisure mode puts forward higher requirements for the design of urban public space. In this article, the structural characteristics of urban public leisure space are analyzed, and the mathematical model and parametric description of urban public leisure space environmental art interactive optimization design are established. Combined with PSO, the optimal design of urban public leisure space environmental art layout is realized, which lays the foundation for the CAD of urban public leisure space environmental art.

Because the standard PSO algorithm is easy to fall into local optimum and can only be optimized in one direction, in order to solve this problem, the cloud model theory is introduced into PSO optimization algorithm, and the constraint processing technology of feasibility rules is used to balance the "exploration" and "development" of the algorithm and solve the constrained optimization problem. The flow of PSO algorithm is shown in Figure 1.

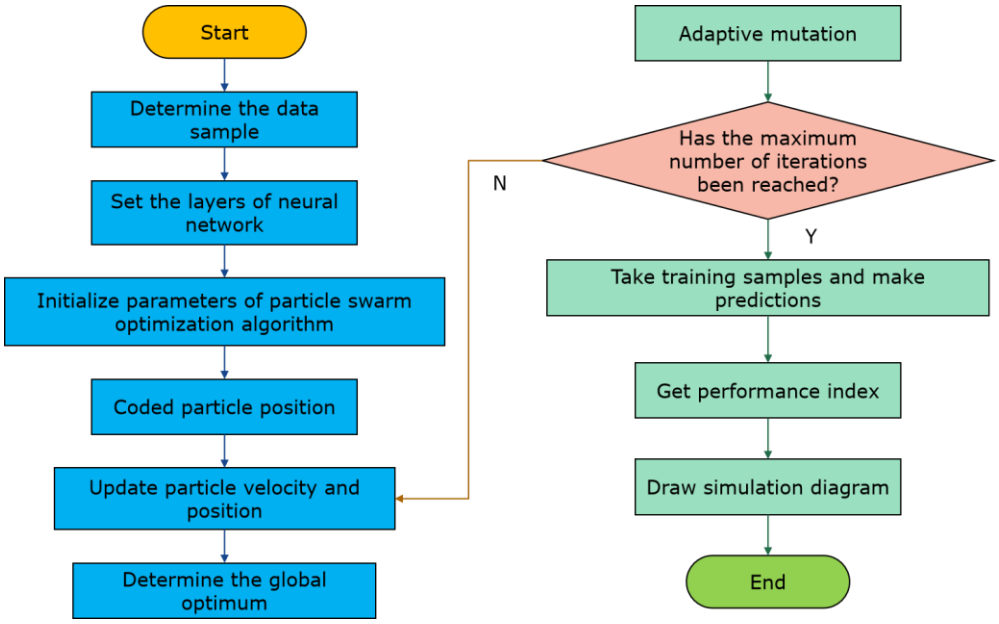

Figure 1: PSO algorithm flow.

Assuming that the positions of particles are randomly distributed, n particles are initialized, and they conduct flight search in public leisure interactive space. Their flight speed and range will be constrained by the level of HMI, so the flight speed of particle initialization can be:

$$v_{xp} = rand * v_{x\max} \tag{1}$$

$$v_{yp} = rand * v_{y\max} \tag{2}$$

v_{xp} and v_{yp} represent the flying speeds of the particles in the horizontal and vertical directions, $v_{x\max}$ and $v_{y\max}$ represent the maximum control speeds of the particles in the horizontal and vertical directions, and p represents the quantity of particles. Calculate inertia weights:

$$\omega(t) = \omega(\omega\min_{\max} / I_{\max})_{\max} \tag{3}$$

Among them, I_{max} is the largest quantity of iterations, $\omega_{\max}$ is the largest inertia weight, and $\omega_{\min}$ is the smallest inertia weight. t represents the quantity of iterations.

Each particle determines the central orientation of the optimized direction by using the cloud generator of qualitative and quantitative transformation of cloud model, combined with the repair rule of the central orientation of the aggregation direction, so as to increase the traction intensity of the central orientation on each residential unit, and then improve its speed change direction.

4.2 Optimization of Interactive Design of Environmental Art in Public Leisure Space

Public art has a close relationship with urban public space, which makes public art adapt to the development direction of urban space environment. Public art is an art that can resonate with the public in the urban space environment, and is an art and culture that can interact with the public mind. Unlike private art, public art is purely a work of art designed and created by individuals. It needs to be placed in a certain public space, and the public will be interested in it and interact with

the public in this form of artistic creation. CAD based interactive methods can display the geographical environment and appearance of buildings.

With the rapid development of high-tech, internet technology has been widely applied. Integrating interactive design thinking into commercial spaces and utilizing mature internet technology for design can further promote the modernization and scientific development of commercial space design. The general situation when the distribution axis is a curve needs further research. In the process of engineering design, it is often necessary to refer to a series of data, such as relevant charts, various standards, experimental curves, various specifications, etc. In traditional design processes, this data is usually obtained through manual queries of manuals or standards, while in CAD processes, this data should be processed through computers. The DM architecture of the HCI space is shown in Figure 2.

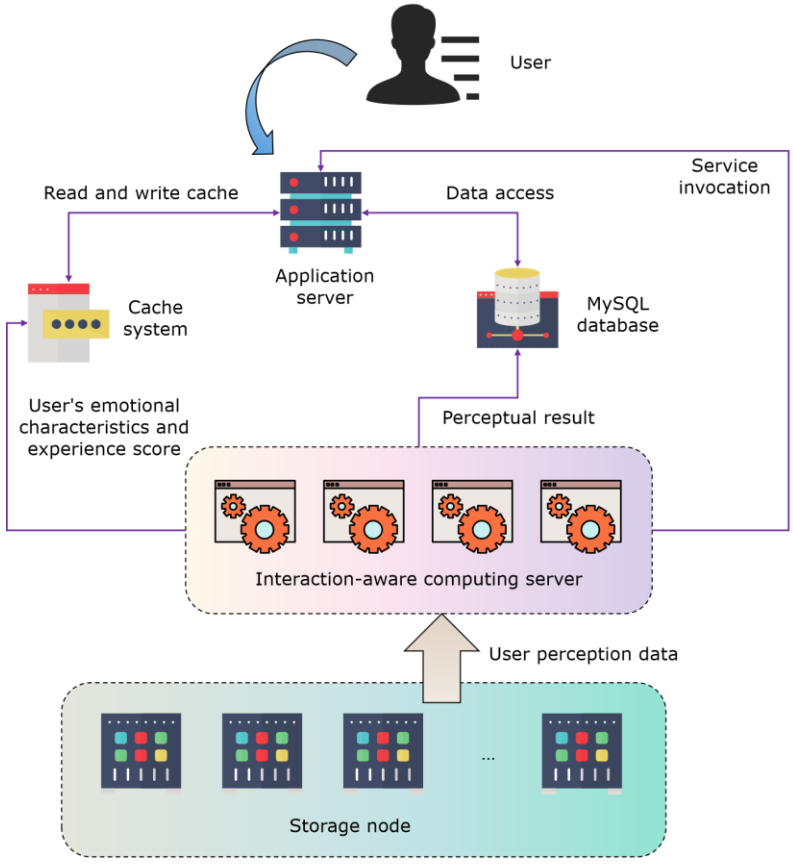

Figure 2: DM architecture of HCI space.

Unsupervised classification, also known as clustering, divides spatial units according to the principle of the closest within a class and the most different between classes. The quantity of classes and the center of classes are uncertain in advance, but the biggest feature of tentative spatial classification is the irreplaceability between indicators, that is, the index values corresponding to units within a class are similar, and the index values corresponding to categories are obviously different. Build a state transition frequency table. Scan each element in the entire interactive space for moments t_1 and t_2, respectively, for elements C_{ij} for moments t_1. Detect its

combined status code, and check the code value table to obtain its code value serial number u. Detect the status code v of the element C_{ij} at the moment t_2 to count and calculate:

$$s(u,v)=s(u,v)+1 \tag{4}$$

The 2D array s is called the state frequency table, and this array should be cleared in advance. Establish a state transition probability table and a state transition probability matrix. Normalize the state frequency table:

$$p(u,v)=\frac{s(u,v)}{\sum_{w=1}^{l} s(u,v)}, \forall u; v=1,2,....,l \tag{5}$$

l is the quantity of space states. At this point there are:

$$\sum_{v=1}^{l} p(u,v)=1, \forall u \tag{6}$$

In spatial analysis and DM, we are faced with various spatial elements with different sources, different times and different types. Only by preprocessing the required data according to a unified spatial unit framework and importing the attribute data of each element layer entity into a unified spatial unit network can we conduct multi-element comprehensive analysis or single-element spatial dynamic analysis. According to the needs of specific knowledge discovery, the relational table of a basic database can be summarized according to the value of a certain attribute, resulting in relational tables of different conceptual levels from micro to macro. Each macro tuple in the summarized relational table corresponds to multiple tuples in the basic relational table, and the macro tuple is the base of the knowledge discovery state space at the corresponding conceptual level and the initial knowledge template. The bilateral filtering discrete form expression of spatial feature information is as follows:

$$R'=[k,j]=\sum_{m=-p}^{p}\sum_{n=-p}^{p} B[m,n,k,j]R[k-m,j-n] \tag{7}$$

$$B[m,n,k,j]=\frac{\exp(-\frac{m^2+n^2}{2\sigma_\delta^2}-\frac{R[k-m,j-n]}{2\sigma_\zeta^2})}{R(k,j)} \tag{8}$$

Where σ represents the scale parameter of spatial feature information.

As a space for public art creation, public space is an effective way for people to perceive the interaction brought by the surrounding environment, and it is also the carrier of urban public art works. The virtual reality technology of computer building effect emphasizes a feeling of being there, and adopts the natural interaction between people. It can realize a realistic and pure 3D scene, and can roam in the scene in all directions and angles, completely controlled by users. As an architect, you can observe the architectural scheme from many angles, so virtual reality technology can not only be used in architectural performance, but also be a favorable means to scrutinize the scheme.

5 MODEL APPLICATION TEST

Interactive experience design is a scientific and technological factor integrated on the basis of artistic design. Every era, due to the progress of technology, will promote the creative thinking of art. In public art creation, it is not only an expression of culture and art, but also a shaping of city image, as well as the construction and expression of regional culture itself, which shows the spiritual attitude of urban citizens and their longing for a better life. By analyzing the environmental characteristics of public space, this article discusses the application of PSO algorithm and CAD technology in the interactive design of public leisure space environment art. According to the idea of solving spatial optimal layout problem, the cloud model is introduced into

PSO algorithm, and combined with the constraint processing technology of feasibility rules, an integrated algorithm of cloud model and particle swarm optimization applied to public leisure space optimal layout is constructed. As shown in Figure 3, the running time comparison results of this algorithm and SVM algorithm are given.

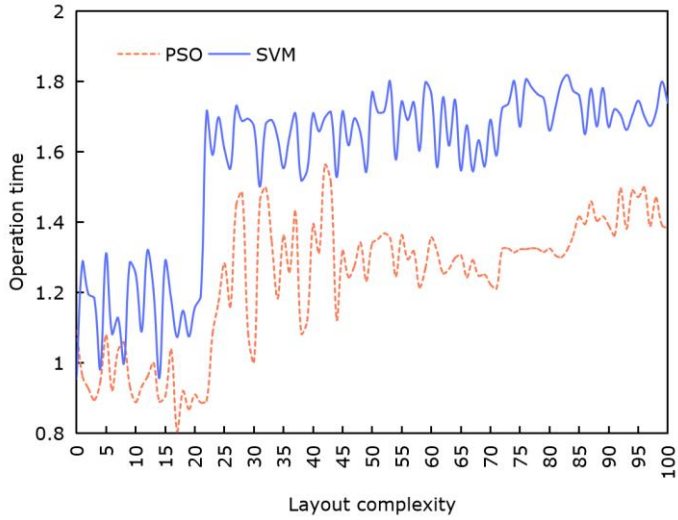

Figure 3: Calculation time comparison of algorithm.

The whole particle swarm always pursues a global optimal value, so its particle swarm will constantly adjust its position and velocity value according to its own individual fitness value and global fitness value, and finally the particles will gather in the surrounding area of the optimal solution position. There are still a small quantity of particles gathering in the periphery, which is influenced by the local optimal value, and the particles fail to jump out of the local optimal value, while a small number are scattered in the peripheral area. The convergence comparison results of SVM algorithm and PSO algorithm are shown in Figure 4.

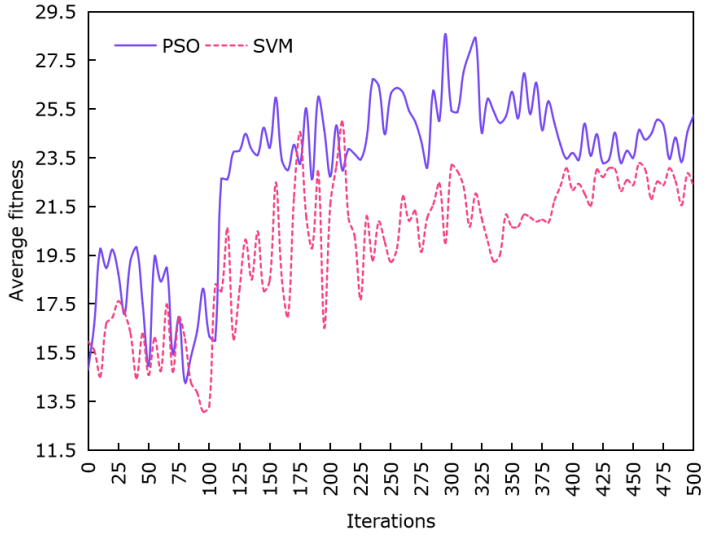

Figure 4: Comparison results of convergence.

In order to explore the complex behavior of cities, models often need to be run repeatedly under different parameters to explore the development law of HCI behavior in urban public spaces.

After the data or line graph in the numerical table is discretized, it is stored in the computer in the form of one-dimensional, 2D or multi-dimensional arrays. When retrieving data, you can use the retrieval method of table lookup or interpolation, and work out the required data by compiling a calculation program. In the process of processing, the input variable values are generally converted into the subscripts of the dependent variable array, and the values of the dependent variable can be found according to the subscripts. For programming languages with structural data types, the method of structural array can also be used to program the numerical table.Figures 5 and 6 show the recall and accuracy of the algorithm for interaction design optimization.

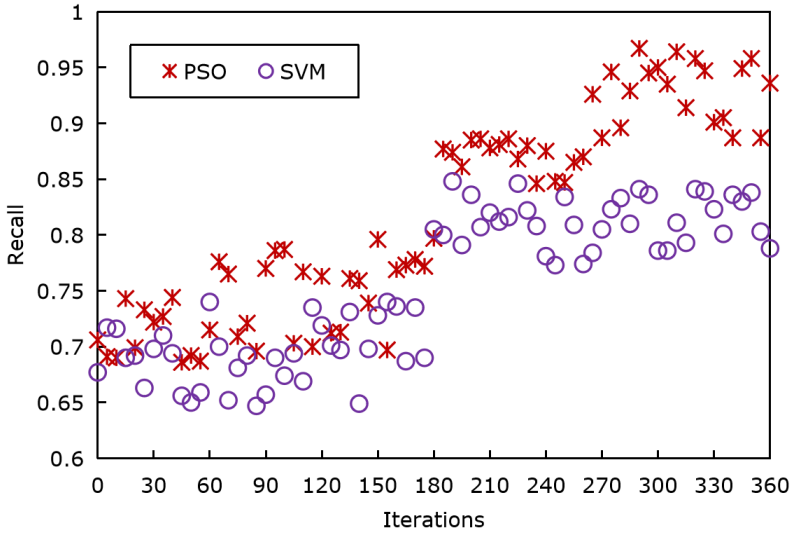

Figure 5: Recall of interaction design optimization.

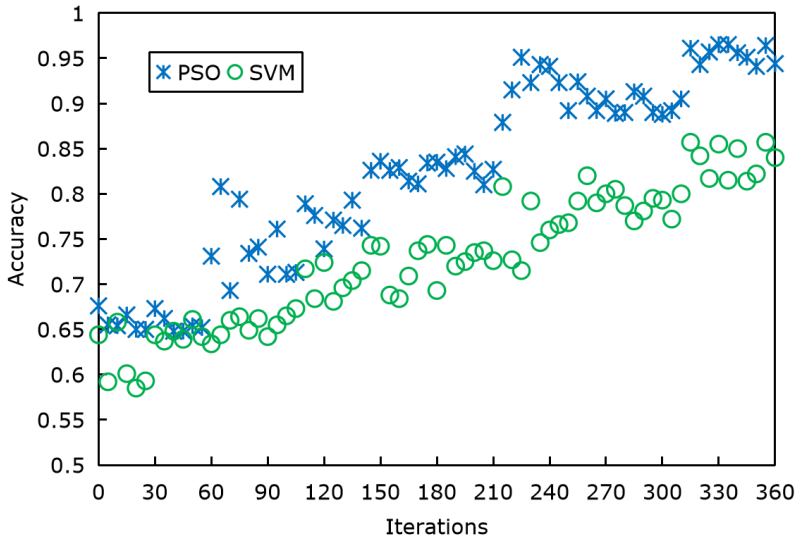

Figure 6: Accuracy of interaction design optimization.

From the test results, it can be seen that this algorithm is more accurate in optimizing the layout of public leisure space, which is more than 15% higher than the SVM-based layout optimization algorithm, and more accurately locates the edge contour of the optimized space. Figure 7 shows the variation curve of the optimal solution of PSO.

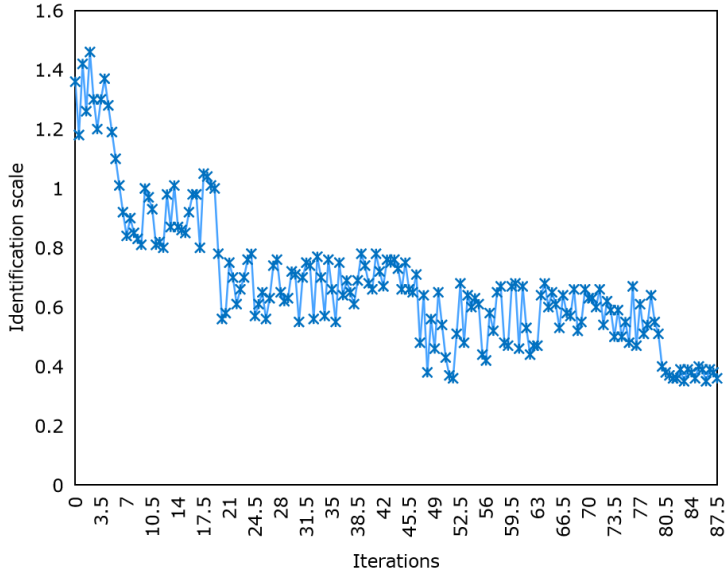

Figure 7: Variation curve of optimal solution of PSO.

From Figure 7, it can be found that the overall spatial optimization solution process is smooth and fast. On the basis of the modification and perfection of the plane scheme and the completion of the drawing, the designer should start to set about the 3D modeling design. By importing the drawn 2D plan into relevant CAD software, the spatial model is constructed. After establishing a complete spatial model, the designer also needs to make or import a single model according to the plane plan.

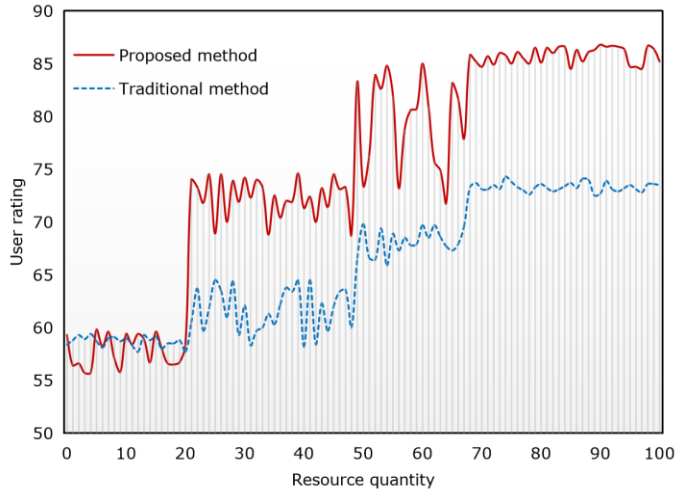

Figure 8: Subjective score of environmental art interaction.

The external emotion of landscape is people's direct perceptual experience in the landscape space without rational thinking, and it is the basis and source for people to get rich and colorful life experiences in the landscape. Experience of different senses, common perception and interaction. In this comprehensive sensory experience, people establish a closer relationship with landscape space through various forms of activities, stimulate emotional recognition, and get the pleasure of experiencing life and expressing themselves. The user's subjective score for the interaction of public leisure space environment art design based on PSO is shown in Figure 8.

The comprehensive results show that the performance of PSO algorithm and user perception score can achieve relatively ideal results, so the application of PSO algorithm has certain guiding significance for interactive design in urban public leisure space. Compared with the support vector machine algorithm, the improved particle swarm optimization algorithm can achieve more reasonable, feasible, and scientific spatial optimization layout results.

6 CONCLUSIONS

Diversified urban public leisure space means that people can get rich and different space experiences in the space, and people's needs are better met. Interactive design of public leisure space is not only to innovate the site treatment method or introduce new urban functions, but also to inject new elements of the times to improve the quality of space, enhance the vitality of public leisure space and strengthen the relationship between people and public leisure space. CAD is not only a design tool, but also a comprehensive test of relevant personnel's design thinking mode, design expression ability and computer ability. This article introduces the concept and function of CAD software, CAD software plays an important role in the environmental art Interaction design of public leisure space, which can help designers achieve diversified space design and improve the quality and user experience of public leisure space. Feasible and scientific than SVM algorithm, and the operation efficiency is obviously improved, which can provide a scientific basis for the interactive design of public leisure space environment art. Applying PSO algorithm and CAD technology to improve the interactive design process of environmental art can effectively improve the design efficiency, continuously improve the design level, present the design content accurately and intuitively, and achieve the ideal design effect.

The next step of research needs to further improve the operating mechanism of fuzzy concepts based on membership cloud, improve the public leisure space optimization layout model of particle swarm optimization algorithm, further explore the coupling relationship between public leisure space layout and particle swarm intelligent optimization algorithm, select more constrained influencing factors, and comprehensively consider the interactive design objectives of environmental art.

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