Global Planning Method of Village Public Space Based on Deep Neural Network

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Abstract. The current overall planning method of village public space is inefficient in land integration, resulting in poor planning effect. In order to solve the above problems, a global planning method of village public space based on deep neural network is proposed. Firstly, the hidden neurons are determined by using the data information obtained from the deep neural network, the green coefficient and spatial comfort are extracted, and the change value of the load curve is calculated at the same time, and the data is filtered. Then, the land planning is realized through data analysis, data preprocessing, rural land planning mapping database and the update mechanism of the database, and the variation coefficient is determined, and the standard deviation is calculated; Finally, the global planning is realized through neural network. The experimental results show that the proposed method can effectively improve the efficiency of land integration and plan a user satisfactory scheme.

Keywords: Deep Neural Network · Village Public Space · Spatial Global Planning · Global Planning Method

1 Introduction

Social and economic development drives the development of villages. The space of villages is gradually expanding and the layout is becoming more and more perfect. While bringing convenience to people, related problems are also emerging. The contradiction between resources and development is becoming more and more prominent. How to solve the problems brought about by the development of villages has become an urgent issue for people. In the process of village construction, we should not only consider the ecological environment, but also take into account the socio-economic development. The ecological environment layout of villages has become the main trend of the world development. China has invested a lot of human and material resources in establishing ecological villages, and has made certain achievements in economic development, social prosperity and ecological protection.

In view of the spatial layout of the village ecological environment, scholars in relevant fields have conducted in-depth research and proposed the spatial layout of "San Sheng",

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a mountainous characteristic town based on the constraints of micro geomorphology. Under the strategic requirements of industrial prosperity and ecological livability, various data have been determined, while ecological functions have been studied, and the mountain micro geomorphology has been used as the constraints to complete the optimization of spatial layout, This method can distribute the unique ecological space and agricultural space of villages and towns, better complete spatial connectivity and aggregation, optimize the layout of the integrated waterfront spatial pattern, and ensure that urban and rural areas can achieve green change through endogenous green theory [1].

Traditional spatial layout optimization methods mostly focus on the layout of a specific area, lacking global thinking. Based on the deep neural network analysis, this paper designs a new village ecological environment spatial layout system.

2 Feature Extraction of Village Public Space Global Planning

The public space architecture integrates the two concepts of ecology and architecture. The principle of public space construction is to use green environmental protection materials to the maximum extent based on the building demand during the design, so that green buildings can live in harmony with nature, which is consistent with the concept of sustainable development advocated by the contemporary society. The design process of public space buildings mainly involves the geographical factors and environmental factors of the building space. The design mainly completes the space planning, design, construction and operation. In this process, the laws of ecological change and the rules of architecture should be considered to finally form a complete structure of green building space [2]. The characteristics of village public space are new energy, environmental protection and people-oriented.

The environmental protection feature of village public space refers to the disposal of some construction waste in the design of a green building space. According to the space design requirements, the waste will be reused to reduce environmental pollution. The feature of environmental protection is that the raw materials used in the space assembly process adopt the most environmentally friendly series, which cannot improve the design profit and cause environmental pollution.

The feature of space architecture based on human text is that the design should not only be based on the concept of green ecology and low carbon environmental protection, but also based on the design principles of residents. Otherwise, the situation of putting the cart before the horse will occur, which does not conform to the construction principles in the field of architecture.

This paper studies a new global planning method of village public space based on depth neural network, extracts village features, and establishes a depth neural network as shown in Fig. 1:

The depth neural network is used to collect relevant characteristics, calculate characteristic parameters, calculate corresponding measurement function index parameters, and judge whether relevant planning is suitable, as shown in Formula (1):

$$A = b + \frac{2}{r(s - w)} \tag{1}$$

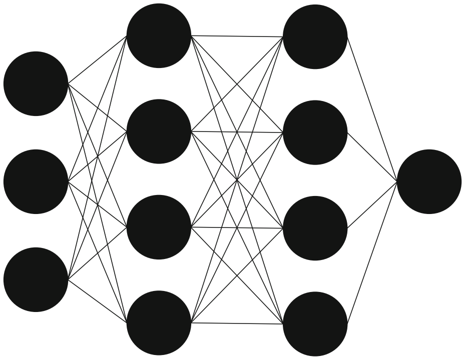

Fig. 1. Structure of Deep Neural Network

In Formula (1), A represents the value of the function index parameter; b stands for upper limit of test; r represents optimization coefficient of functional parameters; s represents the scope of testing; w represents the lower test limit. After the above calculation, determine the corresponding test function index parameters, and use the calculated index parameters to evaluate the basic environmental conditions of the test. Once the value range is exceeded, it indicates that the test environment is abnormal and must be re selected. If the measurement results are within the value range, it indicates that the test environmental conditions are relatively stable, suitable for spatial planning, and subsequent operations can be carried out.

According to the construction of neural network detection algorithm, an intelligent feature extraction model based on depth neural network is established. In the extraction process, an independent intelligent neuron RBM is set. Only when the RBM neuron reaches the inactive condition, can the true integrity of the measured data be determined. After detection, hidden neurons can be determined according to the data information obtained. The calculation formula is shown in Formula (2):

$$M = \frac{\sqrt{j + 2f}}{2} \tag{2}$$

In formula (2), M represents the defined value of hidden neurons in the detection model; j stands for functional parameter index; f represents the function execution coefficient. After the above operations, we can get the corresponding detection mode hidden unit definition value, use the value range to build the actual detection mode, remove the influence of RBM neurons, so that the entire test mode has a higher flexibility and application. At the same time, the hidden neurons can also use the deep neural network to calculate the hidden function, which further expands the test scope of the method.

For the detection of planning parameters, it is necessary to collect the transmission function parameters of village public space planning parameters, and use the depth neural network function detection model to test. The detection of transmission function of village public space planning parameters is divided into two indicators, namely green coefficient and space comfort [3].

Detect the green coefficient. Due to external pollution, the green coefficient will be affected to some extent. The mathematical expression of green coefficient detection is shown in Formula (3):

$$S = \frac{\rho}{U} = \frac{1}{U}\sqrt{\frac{E}{T}} \tag{3}$$

In Formula (3), T represents the parameter coefficient of village public space planning.

The calculation process of space comfort P is expressed by formula (4):

$$P = \frac{M^2}{Z_1 + Z_2} \tag{4}$$

For the detection of the processing function of village public space planning parameters, the data to be processed needs to be put into the detection model to make the processing function of village public space planning parameters run. After the detection, the processing rate of data in the same channel is checked. The specific formula is as follows:

$$L = \left(2\beta + \frac{1}{2}\right) - O \tag{5}$$

In Formula (5), L represents the actual processing capacity in processing function detection; β represents the measurement range of processing function data; O represents the operation parameters of village public space planning parameters.

After the above calculation, we can finally get the processing rate of the processing function in actual operation, analyze the processing rate effect, set the threshold value, and compare with the threshold value. If the processing rate is always higher than the threshold value, it proves that the processing effect is good, otherwise it represents a lack of good processing capacity.

The detection system for abnormal information of village public space planning parameters generally requires two testing technologies, namely, longitudinal difference testing technology and longitudinal difference identification of abnormal data. The whole detection process requires two benchmark indicators, namely, the curve to be measured, the daily load data curve, and the average value of the difference between sampling nodes; The daily change characteristic curve on the curve to be measured and the change rate of the sampling point [4].

The daily load curve and daily load characteristic curve representing the test shall be established. Take a point on the daily load curve to check the i point on the daily load curve to be tested, where $i \in \{1, 2, \cdots, N\}$ and N are the sampling points; Establish the maximum load value, compare it with the load value corresponding to the i point of the daily load characteristic curve, count the load value of the load curve to be tested and the i point of the daily load characteristic curve, and analyze the proportion of the load value of the load curve to be tested and the i point of the daily load characteristic curve. The difference between the two curves d is expressed by the average of the difference between the sample points of the curve to be tested and the daily load characteristic curve.

After calculating the change value of the load curve, measure the change rate at the sampling point, calculate whether the difference between the change values of the two curves is equal to the maximum value of the deviation, analyze whether the change value is within the reasonable range, and determine whether the load curve is an abnormal load curve. If any of the above requirements is not met, the curve to be measured is an abnormal curve, and the load value at the *i* moment is an abnormal value. By calculating the proportion of abnormal values in all abnormal data, the screening rate of abnormal data of village public space planning parameters can be calculated [5].

3 Overall Planning of Village Public Space Land

Integrate and manage various types of village land surveying and mapping data, provide users with corresponding data retrieval functions, and ensure that the data retrieved by users are organized, so as to achieve the effect of high-quality planning.

In this paper, the data types of village land planning and mapping are divided into spatial data and non spatial data by using depth neural network. The spatial data is mainly embodied in CAD, and the non spatial data can be embodied in any plane format. Most surveying and mapping data of village land planning belong to spatial data, so it is necessary to focus on the characteristics of CAD data format. In the data analysis program, the geometric information and solid data contained in CAD data can be satisfied The display function and expansion function of dwg format, and because CAD data has more complex attributes than other plane data, it is necessary to extract in-depth attribute information of the corresponding data, so a set of data attribute table is set up in the data analysis program, which can accommodate a large number of CAD data attributes. The training process based on deep neural network is shown in Fig. 2:

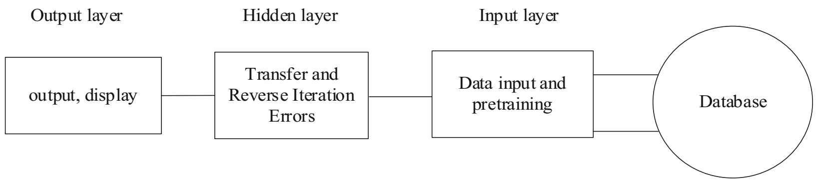

Fig. 2. Training process based on deep neural network

In this paper, the data preprocessing program of the GIS based village land planning surveying and mapping data integration software system is designed. In this program, all village land planning surveying and mapping data are divided again into control planning data, overall control planning data, constructive planning data, land planning data and special planning data. These data are spatial data, Therefore, only after the audit of the data analysis program can the data be transferred into the data preprocessing program. The conversion process can be divided into data extraction step, format conversion step, organization restructuring step, classification code replacement step and quality audit step. The data extraction step is to lock the plannable data in the village land planning surveying and mapping data, extract the data hierarchically, and make the extracted data match the geographical elements [6, 7]. The format conversion step is to reposition the initial data according to the corresponding level after extraction, that is, to adjust the attribute structure of the data. This step has certain requirements on the integrity and standardization of the data, otherwise the data will remain in an error mode, which will lead to the data unable to achieve code conversion. Figure 3 shows the process of data format conversion steps:

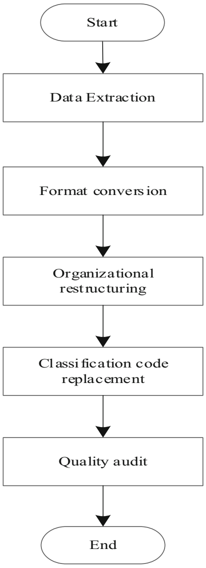

Fig. 3. Data Format Conversion Steps

The organization reconstruction step is to set the data hierarchy and naming according to the village land planning surveying and mapping standards. The classification code replacement step is to replace the classification codes of all data elements entering this step with GB/T 13923–2006, which may cause some codes to be inapplicable or unrecognized in the process of replacement. At this time, the code should be expanded or replaced with reference to other village land planning and mapping data code standards, so as to ensure that there is no omission, loss, etc. of village land planning and mapping data. The last step is to review the data that has completed the code replacement, mainly from the aspects of data attribute, content, format type, integrity, etc. In addition, we also need to check some data to determine whether the location overview, edge clarity, and other information contained in the data are clear and complete [8].

The design of the village land planning and mapping database can achieve data integration more quickly and accurately, and also facilitate the user's data retrieval. The database designed in this paper sets a working mode of synchronous action of centralized construction and operation management, which can well handle the integrated data in the traditional database and the newly added data to be integrated. In the process of designing the database, this paper always adheres to the principles of security, standardization, practicality and maintainability, so as to ensure that the geographic spatial data of village land can be extracted and integrated sustainably without leakage. The management software in the database is Oracle R2. All attributes in the database are in Oracle, and all spatial data are stored in the Oracle 11g data repository. This database has higher flexibility and more accurate computing power, and has lower management costs than other types of databases [9, 10]. In the structural design of the database, this paper pays more attention to the design of the basic village land planning and mapping database. In the basic database, nearly 100 layers are used to reflect the characteristics of the dataset. The names and descriptions of the layers are mainly as follows, as shown in Table 1:

Table 1. Layer Name and Description

Layer Name	Layer representation
MAP500-JTSS-PT	Point traffic facilities
MAP500-JTSS-LN	Linear traffic facilities
MAP500-JTSS-PY	Surface traffic facilities
MAP500-JTYS-LN	Along the road
MAP500-JTYS-LN	Along the railway line
MAP500-GXSB-PT	Pipeline equipment point
MAP500-GX-LN	Pipeline
MAP500-DM-LN	Geomorphic surface
MAP500-ZB-PY	Vegetation surface

At the end of this paper, the updating mechanism of the database is redefined. Although the traditional village land planning and mapping database is also in the real-time updating state, the traditional database still has some defects in the accuracy and practicality of planning and mapping data. The database update mechanism designed in this paper will be completely based on the GIS data management system to update the data in the traditional database rapidly and comprehensively. This paper also studies the matching degree between the basic data space and thematic geographic database and the data update mechanism, and proposes to improve the update efficiency of the database while ensuring the normal use of all village land planning and mapping data.

Considering that most data in the database is in dwg format, and the combination and identification between data and data require unique code, in the new update mechanism, the data code is used as the update node to realize the common interconnection between code elements and attributes in GIS database [11]. In the environment where the code and GIS database attributes are interconnected, the original format in the database and the data format to be updated can be directly transformed into data format and synchronized with attributes through the data processing module, which reduces a lot of format editing operations. There are also some function modules in the data update mechanism. The main function of these modules is to load the data in dwg format into shp format data.

The processed shp format data can be directly entered into the temporary data base, and then the spatial data conversion, data content and type editing, attribute collection, coordinate system collection, data update and data storage process can be carried out in the temporary database.

3 Global planning of village public space based on deep neural network

The depth neural network is used to distribute the space through continuous polygons. In the distribution process, the nearest neighbor principle is followed, and the depth neural network optimization results are applied to the grid optimization, which can ensure that the selected seed points are distributed in a more uniform manner, while improving the utilization rate and reducing the work cost consumed in the spatial distribution process. The village ecological environment spatial layout system software established in this paper needs to use two-dimensional plane space to represent the village environment, and express the discrete points inside the space in the form of sets, as shown in Formula (6):

$$Z = \{z_1, z_2, \cdots, z_n\} \tag{6}$$

In formula (6), Z represents a set of discrete points. It should be noted that any two points of the assembly point inside the plane are not equal. The element $z_i (1 \leq i \leq n)$ inside the plane is extracted. After determining the various adjacent relationships in space, Voronoi polygon $t_{p_i} (1 \leq i \leq n)$ is formed. The calculation formula is as follows:

$$\begin{aligned} & t_{z_i} = s : \|s - z_i\| \leq \left\|s - z_j\right\| \\ & z_i, z_j \in Z, i \neq j \end{aligned} \tag{7}$$

In Formula (7), z_i represents the production element inside the t_{z_i} Voronoi polygon. According to Formula (7), the distance from any original point s inside Voronoi polygon t_{z_i} to generator z_i is less than or equal to the distance from any point s to other generators z_j. After this certain law is satisfied, a plane can be formed, and the plane can be discrete, and the two-dimensional plane space partition can be obtained through continuous integration and distribution.

After discretization, point sets are distributed in different ways in plane space, namely uniform distribution, random distribution and aggregate distribution. The uniform distribution mode is shown in Fig. 4:

According to Fig. 4, after uniform distribution, the plane where the point set is located forms multiple Voronoi polygons. The area difference of these polygons is small, and they are relatively evenly distributed in the same plane.

The random distribution is shown in Fig. 5:

According to Fig. 5, after the random distribution is adopted, the point set lacks a fixed distribution mode, and there are some differences in area. Some point sets are relatively uniform, while some point sets are relatively clustered.

The aggregation distribution mode is shown in Fig. 6:

It can be seen from Fig. 6 that the aggregation distribution mode can centralize point sets in the same location. The aggregation area is not fixed. Some aggregation areas are relatively large, while others are small.

The Voronoi polygon is quantized, the polygon area is determined, and different distribution patterns are obtained according to the changed area. In order to judge the

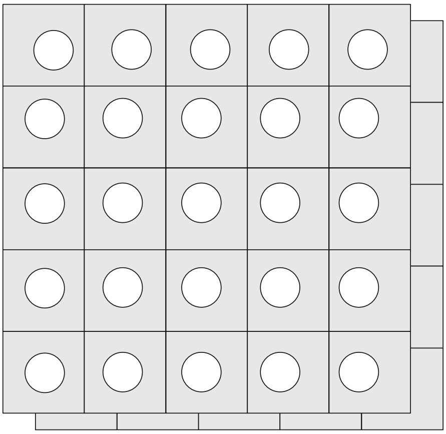

Fig. 4. Point Set Uniform Distribution Mode

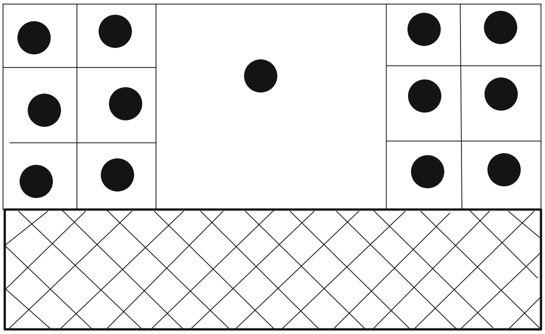

Fig. 5. Random distribution pattern of point set

area change status of Voronoi polygons more accurately, the variation coefficient is set in this paper to determine the continuous change process of the generated area of Voronoi polygons during the formation process. The calculation formula of coefficient of variation is shown in Formula (8):

$$\varsigma = \frac{\sigma}{\overline{s}} \tag{8}$$

In Formula (8), σ represents the standard deviation connected by n Voronoi polygons, and $\overline{s}$ represents the mean value obtained by statistical analysis of Voronoi areas.

The standard deviation is calculated as follows:

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \overline{x}_i)^2} \tag{9}$$

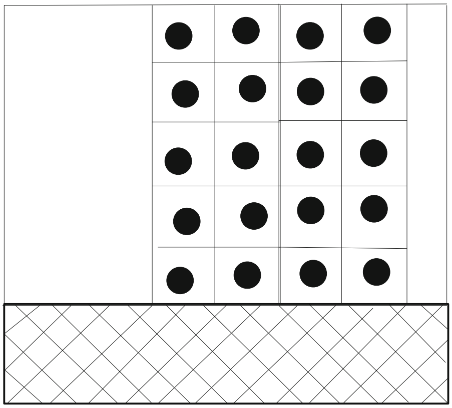

Fig. 6. Aggregation distribution mode

In Formula (9), x_i represents the area obtained by the i th Voronoi polygon in the plane space. Calculate multiple areas to obtain the mean value, which is represented by $\overline{x}_i$.

The average value is calculated as follows:

$$\overline{s} = \frac{1}{n}\sum_{i=1}^{n} x_i \tag{10}$$

According to Formula (8) ~ (10), the calculation formula of polygon area change is as follows:

$$\varsigma = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(x_i - \overline{x}_i)^2}}{\frac{1}{n}\sum_{i=1}^{n} x_i} \tag{11}$$

The unit mean value in the plane can be judged according to the coefficient of variation, and the dispersion degree and distribution state can be determined at the same time. The distribution of spatial points can be determined according to the value results of the coefficient of variation, and whether the distribution pattern is uniform, random and clustered can be judged. Because the division method is artificial, there are some problems. Due to geological reasons, the edges of Voronoi polygons may be incomplete polygons. Calculate the coefficient of variation of trees, establish a buffer zone, realize edge correction, and better realize spatial layout analysis.

4 Experimental Study

In order to verify the effectiveness of the village public space global planning method based on the depth neural network designed in this paper, the system designed in this paper is selected for the spatial layout of the ecological environment of a city.

Table 2. Experimental Parameters

Project	Data
Voltage	200 V
electric current	50 A
power	80 W
Memory	1024 MB
CPU main frequency	1.4 GHz
CPU hard disk capacity	1.2 T
CPU speed	7200 rpm
Operating system	Windows 8
Operating environment	VC ++ 6.3
Operating ambient temperature	-20°C-70°C
Average scan rate	64 kHz
Display resolution	1600*1280
response time	3 ms

The experimental parameters are set as shown in Table 2:

After the successful construction of the method designed in this paper, a large number of village land planning and mapping resources were introduced to test the integration capability, focusing on the basic functions of the data integration system and the efficiency of data integration, to verify whether the system has independent operation capability or data integration advantages in some aspects. In the experiment, a big data integration system and an intelligent office system were used to compare the performance with the system designed in this paper. Before the experiment, the following specifications were made for all documents, software and hardware conditions in the three systems: the performance of all data interfaces and ports in the method was unified to ensure that external data entered into different systems can show the same data format and content. Before the experiment, routine tests should be carried out on the characteristic components or programs in each system to ensure that no accidents occur in the process of data integration. At the same time, a certain amount of abnormal data should be added to each system to test the system's ability to process fault data. The software of the method shall be subject to static test according to the unique code corresponding to the software. Ensure that the statement coverage and branch coverage of village land planning surveying and mapping data reach 100%. On this basis, verify the data format of all village land planning surveying and mapping.

The depth neural network in this paper is applied to spatial layout, and the depth neural network of spatial distribution of ecological environment in village public space is shown in Fig. 7:

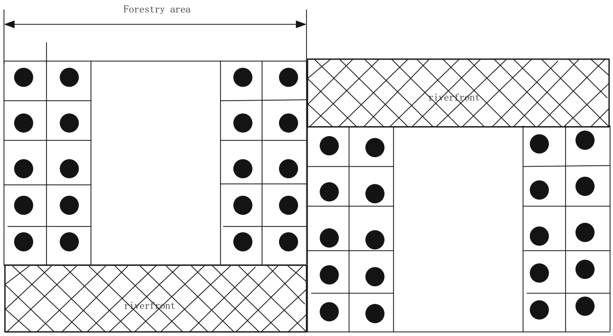

Fig. 7. Spatial Distribution of Ecological Environment in Village Public Space

During the experiment, regardless of the topographic and geomorphic characteristics of the village public space ecology, the entire village public space is set as a two-dimensional plane. If there are trees in the village public space, the trees are distributed in a point form. After the depth neural network is formulated, relevant parameters are obtained, and the spatial structure is analyzed in a qualitative way. According to Fig. 7, the deep neural network can well reflect the state of spatial trees, determine the ecological mode of village public space and the location of trees, and thus judge the ecological environment of village public space. The growth state of trees directly affects the distribution pattern of village public space. After applying the spatial layout system in this paper to the village public space ecology, the edge needs to be corrected to obtain relevant parameters.

The ecological distribution of the public space of the system villages studied in this paper is shown in Fig. 8:

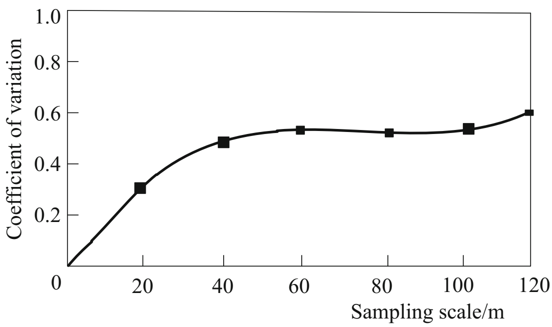

Fig. 8. Ecological Distribution of Public Space in the System Villages

It can be seen from Fig. 8 that if the sampling scale is small and the spatial aggregation degree is intensity aggregation mode when setting up the ecological space layout of the village public space, and the trees in the village public space are obviously clustered together, this area can be determined as a forest area. With the increase of the sampling scale, the coefficient of variation is also increasing. When the sampling scale is 60m, the state presented is basically stable. If the public space scale distance of the village is large, the spatial pattern is no longer a gathering state, but a random distribution state. It can be seen that the sampling scale directly affects the coefficient of variation, so it is necessary to expand the number of samples included in the scale to determine the authenticity of the obtained spatial pattern.

The experimental results of detection accuracy of abnormal data screening function are shown in Table 3:

Table 3. Detection Accuracy Results of Abnormal Data Filtering Function

Amount of detected data/GB	Detection accuracy/%		
	Task scheduling	OTP repair and adjustment function	Neural network
1	62.31	54.25	99.91
2	60.44	53.32	99.87
3	58.73	50.24	99.85
4	56.21	48.69	99.73
5	54.33	45.73	99.64

It can be seen from Table 3 that the ability of traditional detection methods to filter abnormal data is extremely poor, and the limitations of task scheduling and OTP modification methods on abnormal data detection are very obvious, which is less than 65%. The detection effect of the abnormal data filtering function of the detection method proposed in this paper is always more than 99%, which can well determine whether the planning data can filter abnormal data and whether the data information can be transmitted smoothly.

The planning time experiment results are shown in Fig. 9:

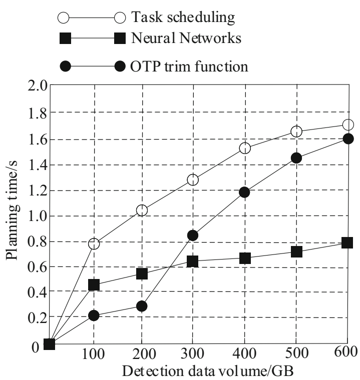

Fig. 9. Planning time experiment results

According to Fig. 9, with the increase of the planning data, the detection time is also increasing. When the planning data is less than 300GB, the detection time of the planning method based on OTP debugging function is lower than that of other detection methods. When the planning data is more than 300GB, the detection time of the planning method proposed in this paper is lower than that of the traditional detection method, which has a good planning effect.

To sum up, the proposed method can well reflect the status of space trees, determine the ecological mode of village public space and the location of trees, and thus judge the ecological environment of village public space; The sampling scale directly affects the coefficient of variation. It is necessary to expand the number of samples contained in the scale to determine the authenticity of the spatial pattern obtained; The detection effect of the anomaly data filtering function of the proposed method is always above 99%, and the detection time is short, which has a good planning effect.

5 Conclusion

This paper designs the village public space layout system based on the depth neural network. Through the depth neural network, the overall spatial state of the village is distributed, and the overall spatial layout is obtained. Set the coefficient of variation, seek the relationship between the coefficient of variation and the angular scale, and combine the characteristics of the village pattern to obtain the spatial structure. The deep neural network can well display the spatial ecological layout state method. Users can judge the aggregation degree and sparse area of villages according to the deep neural network, determine the areas that need to be further improved according to the dense information, and implement effective security prevention strategies. The research in this paper has a positive significance for the ecological development and economic development of villages. In the future, we need to further consider the spatial structure information, and determine a more perfect village ecological space layout model based on the obtained spatial structure information, so as to realize the transformation from two-dimensional plane space distribution to three-dimensional space distribution.

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