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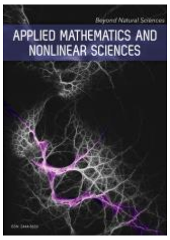

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Rural landscape design strategy based on deep learning model

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Abstract

In order to scientifically allocate rural landscape resources, reasonably plan rural tourism space, and ensure that the local characteristics of the countryside are not homogenized when carrying out rural landscape design, this paper studies rural landscape design strategies based on deep learning models. The extreme learning machine algorithm, DBN-RBM algorithm model and the improved DBN-DELM algorithm are the main technical means to obtain research data and parameter calibration results for tourism planning and development work, and the rural planning direction and planning theme is determined through the rural landscape design pre-analysis work. The data show that the main motives of tourists' rural experience tourism are close to nature 85.90% and leisure vacation 75%, followed by understanding culture 45.30%, novelty 30.70%, parent-child education 29.20%, health retreat 30.40%, and business meeting 5.90%. In this paper, the study of rural landscape planning and design can effectively alleviate the contradiction between people's production and living and ecological environment and coordinate the benign development of rural and tourism elements in their respective spaces.

Keywords: Deep learning model; Rural landscape design; Tourism planning and development; Landscape shaping
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1 Introduction

The countryside has gradually become a popular tourist destination because of its beautiful natural environment, healthy agricultural products and simple folk customs, and the development of tourism combined with agricultural resources can make more effective use of rural background resources, promote resource integration and realize rural revitalization [1]. However, in recent years, with the accelerated urbanization process, rural construction has become less and less regional, replaced by the landscape of a thousand villages, one-sided imitation of urban development and construction mode, and even the development of the rural economy at the expense of the ecological environment, resulting in the deterioration of the rural ecological environment, which has greatly affected people's production and life. In the unilateral pursuit of economic development and urbanization process, the countryside in the construction process ignored the regional cultural characteristics, ignored the use of local native materials, blind development and construction, resulting in the loss of traditional rural cultural characteristics and agricultural production landscape was destroyed, people's daily life landscape gradually lost rural characteristics, the beautiful ecological environment was destroyed [2]. At the same time, the urbanization of residential construction is obvious, and some traditional residential buildings with historical and cultural characteristics are facing the risk of disappearing due to the lack of protection, replaced by reinforced concrete and Western-style houses, and Tao Yuanming's ideal peach blossom source is gradually becoming a scene in people's memory.

The unique prerequisite characteristics and problematic challenges of rural landscape resources determine a relatively more mature set of theoretical and practical approaches for constructing and developing rural landscape resources that are completely different from urban planning. In 2017, the central government proposed to combine tourism, the ecological environment and other industries in a document addressing the development dynamics of rural areas and to promote the sustainable development of rural tourism by making use of the natural, cultural and regional advantages unique to the countryside. The literature [3] studies the protection of traditional rural landscape in Germany, and the German government uses many policies to develop and protect agriculture and rural landscape environment from achieving the harmony and unity of rural landscape planning. The most worthy of learning from Germany is the policy and planning of rural transformation development. Rural landscape planning and design emphasizes "ecology, humanity and beauty" and incorporates scientific and design elements in the construction of rural landscapes to improve the countryside's cultural, ecological, leisure and economic values while realizing the sustainable development of rural landscapes. The countryside has found a new way to protect the ecological environment and develop the countryside economy in the development and construction process, and the creation of the characteristics of the countryside landscape has become the key. The literature [4] found that the integrated development of agro-tourism can contribute to the adjustment of the rural economic model by exploring the development of regional agro-tourism in Tanzania. The literature [5] argues that agro-tourism integration can be realized by urban residents coming to the countryside for agricultural activities during their holidays and that agro-tourism, as a new type of tourism, has great development prospects.

Literature [6] pointed out that rural landscape has ecological, socio-cultural and economic values. The general requirements of a rural revitalization strategy are prosperous industry, ecological livability, civilized countryside, effective governance, and rich living. The development of rural tourism brings new opportunities for the countryside and guarantees the construction of a rural landscape, and a rural landscape with regional characteristics can make rural tourism sustainable. The literature []-[8] points out that ecological wisdom, relying on ecological practices to bring well-being to human society, inspires and guides humans to "do the right thing in the right way in a particular environment". By examining people with ecological practice wisdom, learning and studying representative and typical cases of ecological practices, we can acquire excellent skills and apply them in new socio-ecological practices. The literature [9] explores the relationship between population and landscape by identifying and comparing the relationships that residents maintain in agriculturally intensive areas, pointing out the importance of reintroducing the multifunctional character of the landscape in agriculturally intensive areas. In the planning of rural landscapes, integrated factors, rural geography and humanities, and soil and climate should be considered and combined with urban development plans to form distinctive rural landscapes; the literature [10] argued that residents' perceptions should be considered in landscape planning, thus linking and justifying sustainable resident-led approaches to landscape management with the daily lives of rural residents. The literature []-[12] explores the development of community aesthetics and the impact of art on the aesthetic experience of residents, arguing that art can contribute to the robustness of a community and help it develop the capacity and resources to prosper. Residential architecture is one of the characteristics of rural landscapes, and attention should be paid to excavating the cultural connotations of residential characteristics in planning rural scenic areas. Literature [13] suggests that agricultural integration should adhere to the principles of environmental protection, human-centeredness and sustainability, focus on ecological benefits, and protect rural agricultural survival and development.

Firstly, the extreme learning machine algorithm, the DBN-RBM algorithm and the improved DBN-DELM algorithm are introduced one by one, focusing on the detailed decomposition of the computational process. The pre-training of DBN is used to get better initialization parameters for the deep ELM network, and then the ELM algorithm is used to optimize the whole network and get the research parameters. And then, the rural landscape design pre-work research and analysis, sort out rural tourism landscape types, study rural tourist behavior to determine the planning direction and theme and clarify the principles of design and development.

2 Deep learning model

2.1 Extreme learning machine algorithm

The Extreme Learning Machine algorithm is a neural network optimization algorithm with a single hidden layer model structure and a training method that reverses the idea of the BP algorithm. ELM has the advantage of fast model training and good generalization ability, but the accuracy is slightly worse [14].

For an arbitrary N random sample $(x_i, t_i), x_i = [x_{i1}, x_{i2}, x_{i3}, \dots, x_{in}]^T \in R^n$, the meaning of n is expressed as the number of neurons in the input layer, $t_i = [t_{i1}, t_{i2}, t_{i3}, \dots, t_{in}]^T \in R^m$, the number of neurons in the hidden layer is expressed as $\tilde{N}$, and the activation function of the hidden layer is $g(x)$, then the mathematical model is shown below:

$$\sum_{i=1}^{N} \beta_i g_i(x_i) = \sum_{i=1}^{N} \beta_i g(w_i \cdot x_i + b_i) = o_j,\ j = 1, 2, \dots, N \tag{1}$$

The meaning of $w_i = [w_{i1}, w_{i2}, \dots, w_{in}]^T$ in the above equation represents the vector of link parameters between the i nd hidden layer neuron and the input layer neuron. The meaning of $\beta_i = [\beta_{i1}, \beta_{i2}, \dots, \beta_{im}]^T$ represents the vector of link parameters between the i th hidden layer neuron and the output layer neuron. b_i denotes the bias of the i th hidden layer neuron. $g(x)$ activation function of the neural network, so we can get the following equation:

$$\sum_{j=1}^{\tilde{N}} \left\| o_j - t_j \right\| = 0,\ j = 1, 2, \ldots, N \tag{2}$$

That is, the existence of w_i, β_i, b_i makes:

$$\sum_{i=1}^{\tilde{N}} \beta_i g\left(w_i \cdot x_j + b_j \right) = t_j,\ j = 1, 2, \ldots, N \tag{3}$$

The above equation is expressed in matrix form as:

$$H\beta = T \tag{4}$$

in the formula:

$$H = \begin{bmatrix} g\left(w_1 \cdot x_1 + b_1\right) & \cdots & g\left(w_{\tilde{N}} \cdot x_1 + b_{\tilde{N}}\right) \\ \cdot & \cdot & \cdot \\ g\left(w_1 \cdot x_N + b_1\right) & \cdots & g\left(w_{\tilde{N}} \cdot x_N + b_{\tilde{N}}\right) \end{bmatrix}_{N \times \tilde{N}} \tag{5}$$

$$\beta = \begin{bmatrix} \beta_1^T \\ \cdot \\ \beta_{\tilde{N}}^T \end{bmatrix}_{\tilde{N} \times m}, T = \begin{bmatrix} t_1^T \\ t_N^T \end{bmatrix}_{N \times m} \tag{6}$$

H denotes the output matrix of the hidden layer network of the ELM model, and according to Equation (4) above, $\hat{\beta} = H^+ T, H^+$ can be calculated as the generalized inverse matrix of H by using the least squares idea.

The steps of the extreme learning machine are summarized as follows: randomly initialize the input weights and hidden layer thresholds, compute the hidden layer output matrix H, and compute the output layer weight matrix $\beta = H^+ T$.

2.2 DBN-RBM algorithm model

A restricted Boltzmann machine has a strong unsupervised ability to learn complex patterns in data [15]. RBM has one visible layer, one hidden layer, and no connection within the layer or full connection between the layers. The structure of the restricted Boltzmann machine model is shown in Figure 1.

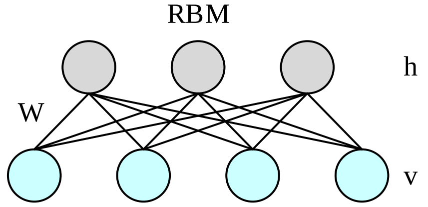

Figure 1. Restricted Boltzmann machine model

The vector *v* is used to represent the partial state of the neuron in the visible layer and *h* is used to represent the partial state of the neuron in the hidden layer. The meaning of v_i is the state of the i th neuron in the visible layer of the RBM, and the meaning of h_j is the state of the *j* th neuron in the hidden layer of the RBM. The RBM is an energy-based formula, and when we determine the current state (v,h), the energy of the RBM is then defined as:

$$E(v,h|\theta)=-\sum_{i=1}^{n}a_i v_i-\sum_{j=1}^{m}b_j h_j-\sum_{i=1}^{n}\sum_{j=1}^{m}v_i W_{ij} h_j \tag{7}$$

In the above equation $\theta=\{W_{ij},a_i,b_i\}$ is the parameter of RBM and they are all real numbers. Here the meaning of w_{ij} is the weight parameter matrix between the visible layer neurons and the hidden layer neurons, the meaning of a_i is the bias vector in the network of visible layer neurons, and the meaning of b_j is the bias vector in the network of hidden layer neurons. Based on the previously obtained RBM network parameters, the joint probability distribution formula for (v,h) can be derived as:

$$p(v,h|\theta)=\frac{e^{-E(v,h,\theta)}}{Z(\theta)},Z(\theta)=\sum_{v,h}e^{-E(v,h\theta)} \tag{8}$$

where $Z(\theta)$ is the normalization factor.

According to the above equation we can obtain the probability distribution $P(v|\theta)$ of the visible layer observations of the RBM model *v*, also known as the marginal distribution of the joint probability distribution equation $P(v,h|\theta)$, which we often refer to as the likelihood function, with the specific equation:

$$P(v,\theta)=\frac{1}{Z(\theta)}\sum_{h}e^{-E(v,h|\theta)} \tag{9}$$

The computation of $P(v|\theta)$ requires the computation of denominator $Z(\theta)$, which we call $Z(\theta)$ the normalization factor, and z^{n+m} times due to the high computational time complexity of $Z(\theta)$.
This leads to the radicalization probability formula for the j th hidden layer neural unit expressed as:

$$P\left(h_j=1|v,\theta\right)=\sigma\left(b_i+\sum_{i}v_i W_{ij}\right) \tag{10}$$

Here $\sigma(x)=\frac{1}{1+\exp(-x)}$ is denoted as the sigmoid activation function.

If we get the state variables of the hidden layer neurons and the links between each hidden layer neural unit exist independently, we can get the probability distribution of the states of the visible layer neurons as:

$$P\left(v_i = 1 | h, \theta\right) = \sigma\left(a_i + \sum_j W_{ij} h_j\right) \tag{11}$$

The process of the CD algorithm can be divided into the following steps: the first step takes the training data as the state variables of the neurons in the visible layer; the second step combines equation (10) so that we can calculate the state variables of the corresponding neurons in the hidden layer; the third step uses equation (11) to solve for the binary probabilities of the neurons in the visible layer, so that we can calculate the results after the reconstruction of the visible layer. The fourth step uses the gradient descent algorithm to optimize the solution on our objective function to obtain the update equations of parameters w_{ij}, a_i and b_j as:

$$\begin{aligned} \Delta W_{ij} &= \varepsilon\left(\left\langle v_i h_j \right\rangle_{data} - \left\langle v_i h_j \right\rangle_{recon}\right) \\ \Delta a_i &= \varepsilon\left(\left\langle v_i \right\rangle_{data} - \left\langle v_i \right\rangle_{recon}\right) \\ \Delta b_j &= \varepsilon\left(\left\langle h_j \right\rangle_{data} - \left\langle h_j \right\rangle_{recon}\right) \end{aligned} \tag{12}$$

Here ε is the learning rate of the gradient descent method and $\langle \cdot \rangle_{recon}$ is the probability distribution obtained from the model after one reconstruction.

For an independent RBM model, it is a single-layer network structure. So multiple RBMs can be stacked to get the deep structure so that a deep belief network is obtained to learn the deep feature representation of the data. The deep belief network model is shown in Figure 2, and the relationship between the restricted Boltzmann machine and the deep belief network structure is that the deep belief network is composed of multiple restricted Boltzmann machines stacked by unsupervised pre-training.

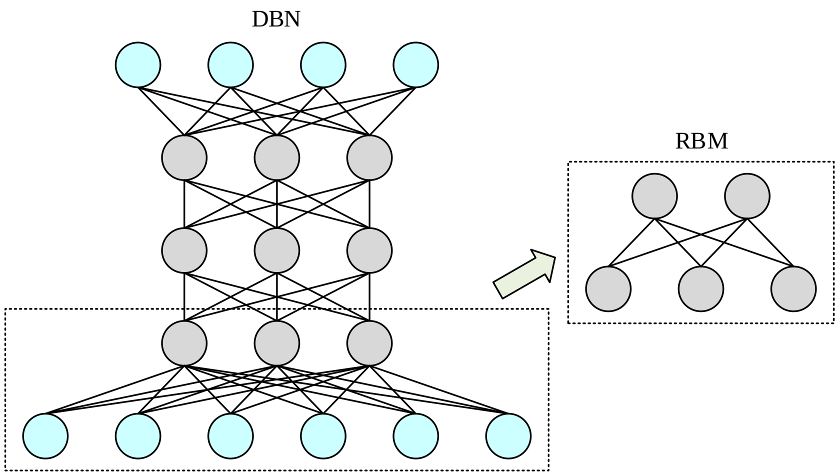

Figure 2. Deep Belief Network Model

The training of the DBN model can be divided into unsupervised pre-training and supervised fine-tuning processes. The first process is through pre-training to get a good initialization parameter to avoid the gradient disappearance problem of the BP algorithm in deep network optimization; the second process is through the BP algorithm in the deep network that has got a good initialization parameter for global parameter fine-tuning to make the algorithm more effective.

2.3 DBN-DELM improvement algorithm

The improved DBN-DELM algorithm proposed in this paper will combine the advantages and compensate for the disadvantages of DBN and ELM and speed up the training speed without affecting the model effect.

The DBN pre-training is used to get better initialization parameters for the deep ELM network, and then the ELM algorithm is used to optimize the whole network. For an ELM containing n a hidden layer, the improved DBN-DELM algorithm obtains the parameters of the first n hidden layers through the DBN pre-training process, connects an output layer, and the 3-layer DBN-DELM network structure is shown in Figure 3.

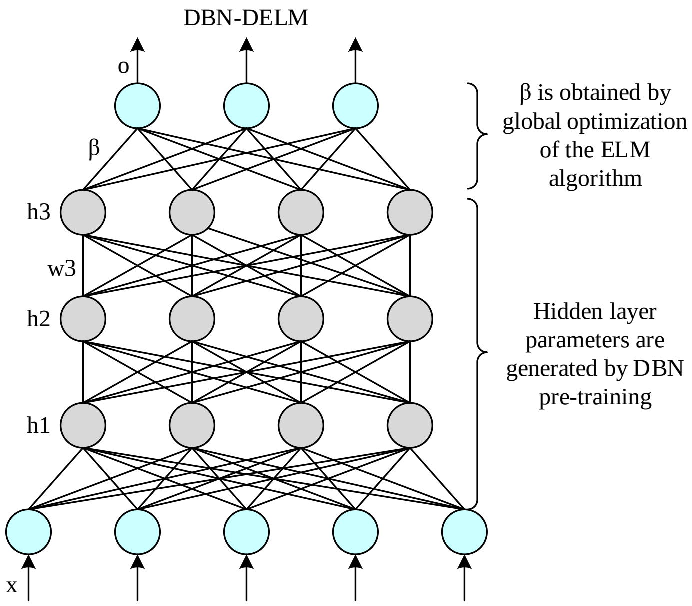

Figure 3. DBN-DELM 3-Layer Network Structure

The DBN-DELM algorithm is summarized in the following steps:

Step 1: Obtain the first $n-1$ layer hidden layer parameters of the DBN-DELM deep network using the DBN pre-training process method.

The vectors v and h are used to represent the states of the visible and hidden units, respectively, where v_i represents the state of the ith visible unit, n_j represents the state of the jth hidden unit, and W_{ij} means the link parameters of the ith visible and jth hidden layer neurons. a_i denotes the bias of the visible unit i and v_j denotes the bias of the hidden unit j. Then, for a given set of states (v,h), the parameter update criterion for learning each layer of the RBM using the contrast scattering algorithm is:

$$\begin{aligned} W_{ij} &= W_{ij} + \varepsilon\left(\left\langle v_i h_j \right\rangle_{data} - \left\langle v_i h_j \right\rangle_{recon}\right) \\ a_i &= a_i + \varepsilon\left(\left\langle v_i \right\rangle_{data} - \left\langle v_i \right\rangle_{recon}\right) \\ b_j &= b_j + \varepsilon\left(\left\langle h_j \right\rangle_{data} - \left\langle h_j \right\rangle_{recon}\right) \end{aligned} \tag{13}$$

Here 1ε is the learning rate and $\langle\cdot\rangle_{recon}$ denotes the distribution defined by the model after a one-step reconstruction.

Step 2: Compute the first $n-1$ layer output of DBN-DELM deep network;

The weight vector $W = W^1, W^2, \ldots, W^n$ of each layer of the deep network is obtained by pre-training, and the bias vector $b = b^1, b^2, \ldots, b^n, n$ of each hidden layer indicates the number of hidden layers of the network. For any M random samples (x_i, t_i) with a hidden layer activation function of $g(x)$, the mathematical model is shown below:

$$\begin{gathered} h^2 = g\left(W^1 x + b^1\right) \\ h^3 = g\left(W^2 h^2 + b^2\right) \\ \ldots\ldots \\ h^{i+1} = g\left(W^i h^i + b^i\right) \end{gathered} \tag{14}$$

Let $h^1 = x$, then the input layer to hidden layer transfer equation is:

$$\begin{gathered} h^{i+1} = g\left(W^i h^i + b^i\right) \\ i = 1, 2, \ldots, n-1 \end{gathered} \tag{15}$$

Step 3: The parameters of the n st hidden layer to the output layer are obtained by global optimization of the ELM algorithm.

The n nd hidden layer to output layer equation is:

$$\begin{gathered} \sum_{j=1}^{N} \beta_j h_j^n = o_j \\ j = 1, 2, \ldots, N \end{gathered} \tag{16}$$

The meaning of $\beta_i = [\beta_{i1}, \beta_{i2}, \ldots, \beta_{im}]^T$ is the parameter vector between the n nd hidden layer neuron and the output layer neuron, and the meaning of N is the number of n th hidden layer neuron.

Firstly, for computational purposes, we set that our model can completely fit our m sample data, i.e.:

$$\begin{gathered} \sum_{j=1}^{\mathrm{m}} \left\| o_j - t_j \right\| = 0 \\ j = 1, 2, \ldots, m \end{gathered} \tag{17}$$

That is, the existence of W, b, β makes:

$$\begin{gathered} h^{i+1} = g\left(W^i h^i + b^i\right) \\ i = 1, 2, \ldots, n-1 \end{gathered} \tag{18}$$

$$\sum_{j=1}^{N} \beta_j h^n{}_j = t_j$$
$$j = 1, 2, \ldots, N \tag{19}$$

The matrix form of Equation (18) is:

$$H\beta = T \tag{20}$$

where

$$H = h^{i+1} = g\left(W^i h^i + b^i\right)$$
$$i = n-1$$
$$\beta = \begin{bmatrix} \beta_1^T \\ \cdot \\ \beta_N^T \end{bmatrix}_{N\times m}, T = \begin{bmatrix} t_1^T \\ \cdot \\ t_N^T \end{bmatrix}_{N\times m} \tag{21}$$

The matrix *H* is represented as the matrix of output features of the implicit layer of the limit learning machine. The above equation can be derived by the least squares idea: $\hat{\beta} = H^{+}T$, H^{+} here means the generalized inverse matrix representation of *H*, which gives the implicit layer parameter matrix as $\beta = H^{+}T$.

The DBN-DELM algorithm proposed in this paper speeds up the training speed of DBN and improves the accuracy of the ELM algorithm by obtaining better initialization parameters for the deep ELM algorithm with random initialization through the unsupervised process of DBN and then global optimization by the ELM algorithm to obtain the top-level parameters.

3 Pre-analysis of rural landscape design

3.1 Rural landscape

Regarding geography, a rural landscape refers to the geographical space outside the urban landscape, a combination of human and ecological landscapes. Rural landscape mainly includes natural ecological landscape, rural settlement landscape, agricultural production landscape and economic landscape [16]-[17]. In terms of tourism, the rural landscape is a complete spatial system, which includes: rural natural space, settlement space, economic space, social space and cultural space, which are interconnected and permeable, but not the same, reflecting different tourism values. A rural landscape is a landscape complex, a physical landscape created by terrain, vegetation, buildings, roads, water and so on in a certain range, and contains local folk culture and other non-physical landscapes containing life.

3.2 Rural tourism landscape classification sorting

3.2.1 Basic types of rural tourism

Rural tourism is a business model centered around the village residents, i.e., the farmers, who are the main focus of their site resources and serve tourists as a means of operation. Rural tourism is a project to meet the needs of urban residents to escape from the busy urban life. The basic types of rural tourism are shown in Table 1. China is a vast country and has accumulated different spiritual civilizations over its long history. There are certain deviations in the development of each village, whether it is cultural customs, architectural style, natural environment, and other resources, and different regions and groups of people from each individual. Therefore, it is impossible to have uniform planning and design, which will not only cause aesthetic fatigue to tourists but also cause a certain degree of damage to the current resources because they are not considered in the design process according to local conditions.

Table 1. Basic Types of Rural Tourism

Basic types of rural tourism	Tourism theme
Sightseeing rural tourism	Green landscape and pastoral style
Leisure rural tourism	Leisure Farm
Folk custom rural tourism	Local characteristics and folk customs
Recreational, rural tourism	Physical fitness and recreation

3.2.2 Analysis of rural tourism experience dimensions and statistical features under extreme learning algorithm

The ultimate learning algorithm was applied to the rural tourism experience value scale to conduct validation factor analysis and conceptual validity test, and finally formed a rural tourism experience value scale containing 18 items. Factor 1 emotional value, which contains 5 measurement items, reflects the tourist's perception of whether the emotional experience is satisfied and is consistent with the dimensional conceptualization of "emotional value". The connotation of "Affective Value" is consistent with the dimensional concept of "Affective Value" and is named "Affective Value". "Factor 3, Social Value consists of 3 items, reflecting the tourist's perception of the relationship with the community or tourist group, which is consistent with the connotation of "social value" in the dimensional concept. "Factor 4, Economic Value, consists of three measures reflecting the tourist's perception of the cost of travel and the return on investment and is consistent with the connotation of Economic Value in the dimensional concept. Factor 5 Contextual value, which contains 3 items, reflects the tourist's perception of the specific rural experience tourism context, is consistent with the connotation of "contextual value" in the dimensional concept and is named "Contextual value". The rural tourism experience dimensions are shown in Table 2.

Table 2. Dimensions of rural tourism experience

Dimension	Index	Measurement items
Functional value (FV)	Transportation convenience	FV1:Transportation convenience
	Planning layout	FV2:Rationality of design layout
	Infrastructure	FV3:Infrastructure improvement
	Service facilities	FV4:Perfect service facilities
Situational value (CV)	Environmental atmosphere	CV1:Harmonious environment
	Sensory enjoyment	CV2:Rich sensory enjoyment
	Thematic features	CV3:Distinctive and outstanding characteristics
Emotional value (EMV)	Attractivity	EMV1: Attraction of tourist destinations
	Happiness	EMV2: Provide happy mood
	Sense of seclusion	EMV3: Forget worries and stress
	Cordiality	EMV4: Feeling cordial
	Sense of integration	EMV5: Can be integrated into local life
Social value (SV)	Cultural experience	SV1:Experience the characteristic local culture
	Friendly interaction	SV2:Friendly and harmonious relationship between residents and tourists
	Good memories	SV3:Very good travel memories
Economic value (ECV)	Reasonable cost	ECV1:Rural tourism costs are reasonable
	Save time and effort	ECV2:Low cost of rural tourism
	Value for money	ECV3:Value for money experience in rural tourism

Five eigenvalue factors were extracted from the 18 measured question items of rural tourism experience value, and these five factors explained 71.129% of the overall variance, which was higher than 65%, and the factor structure was similar to the dimensional constructs.

The dimensional conceptual evaluation of the rural tourism experience value is shown in Figure 4. The results of the validation factor analysis show that the internal consistency coefficients of the five dimensions of rural tourism experience value, namely functional value, contextual value, emotional value, social value, and economic value, are 0.809, 0.812, 0.801, 0.826, and 0.885, respectively, all of which are above 0.75, indicating that each dimension has good reliability and rural tourism experience value is concentrated in these five The value of rural tourism experience is concentrated on these 5 dimensions. Therefore, the rural tourism experience value scale developed in this study has a good internal consistency.

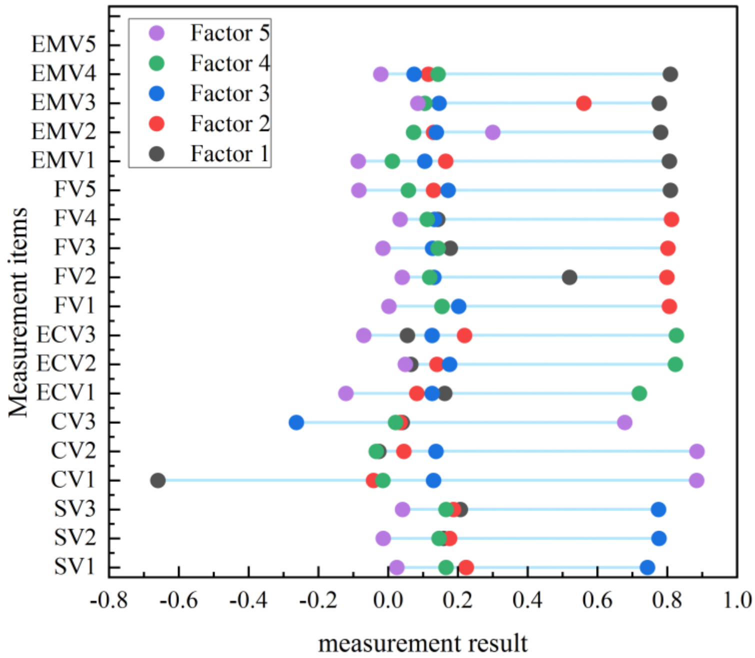

Figure 4. Dimensional Conception of Rural Tourism Experience Value

3.3 Study of rural tourists' behavior based on deep learning

3.3.1 Motivation of rural travelers to travel

The purpose of surveying the motivation of rural tourists is to clarify the source market before carrying out landscape planning to avoid creating a planning scheme that is not in line with the inner expectations of tourists, resulting in the loss of customers.

The travel motives of rural travelers are shown in Figure 5. The main motives for tourists' rural experience travel are close to nature 85.90% and leisure vacation 75%, followed by understanding culture 45.30%, freshness 30.70%, parent-child education 29.20%, health recuperation 30.40%, also some tourists' travel motives are comforting nostalgia 17.60%, other 11.80%, buying local specialties 10.80%, business meeting 5.90%. This shows that most of the tourists choose rural experience tourism to get close to nature and leisure vacation, relax their body and mood to release and relieve the pressure of work and life. At the same time, they can understand the local culture and get a fresh and unique sense or raise the family to travel together for parent-child education and health recuperation for middle and older people, or comfort nostalgia to meet the homesickness, etc. Therefore, rural landscape design should create high-quality, diversified leisure and vacation tourism products to meet the needs of tourists from sightseeing to vacation and from rural tourism to the rural residence.

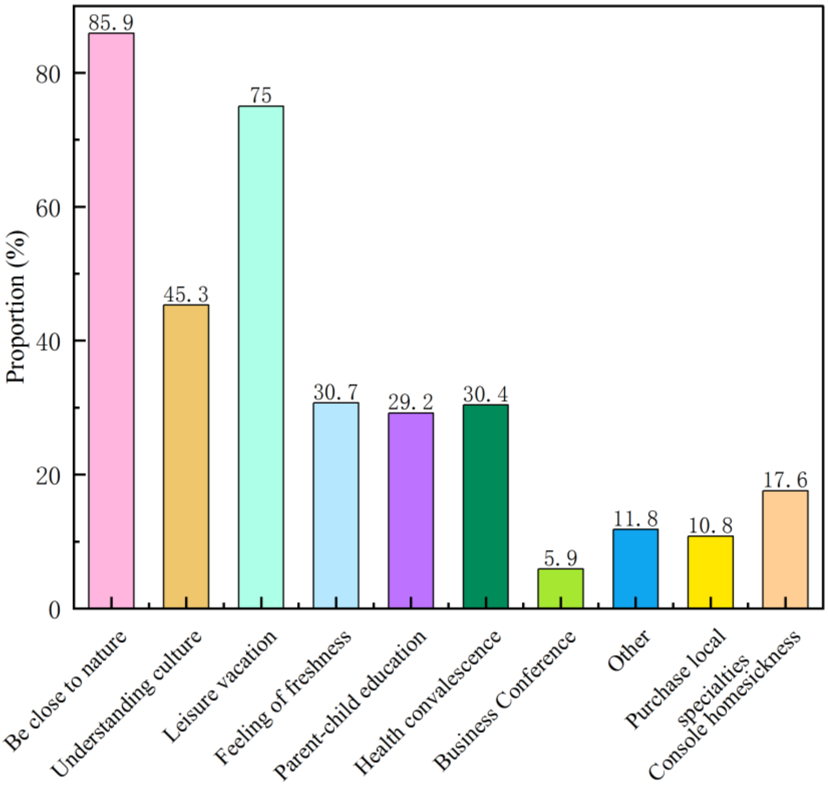

Figure 5. Motivation of Rural Tourists

The rural travelers' peer partner selection is shown in Figure 6. In terms of peer partner selection, rural tourists are mainly family members 64.60%, followed by friends 21.30%, colleagues 3.90%, relatives 4.30%, partners 1.50%, and others 4.40%, which indicates that rural tourists are mostly family tourism, and in the development of rural tourism landscape can provide more parent-child education tourism products for family tourism, middle-aged and elderly leisure In the development of rural tourism landscape, we should provide more parent-child education tourism products, middle-aged and elderly leisure tourism products, elderly health and recuperation tourism products, etc.

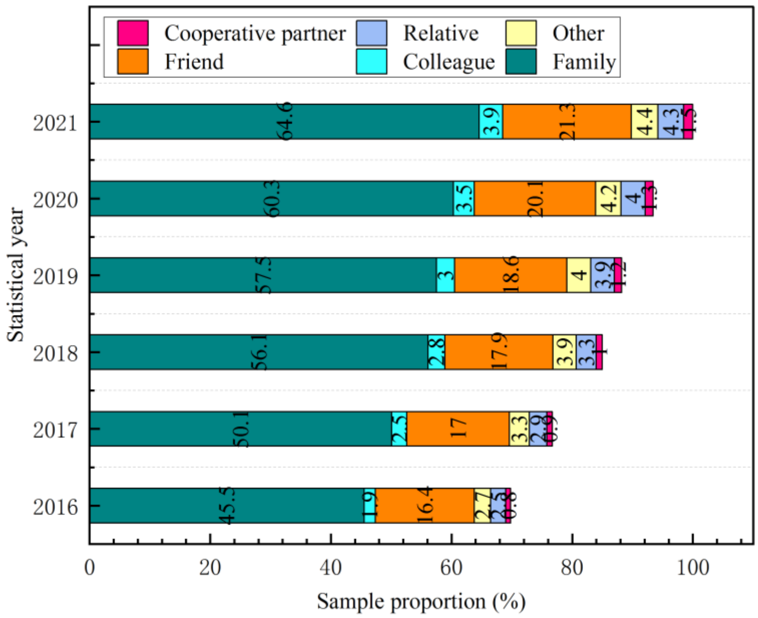

Figure 6. Selection of peer partners of rural tourists

3.3.2 Rural Tourists' Travel Patterns under DBN-RBM Algorithm

Perfect rural tourism should be reflected in all six elements of food, accommodation, transportation, travel, shopping and entertainment tourism. The accessibility of the tourism destination determines the size of the passenger flow, and the DBN-RBN algorithm should be used to investigate the mainstream travel mode of tourists and the traffic condition and the number of parking lots in the rural destination to be developed when planning the rural landscape.

The travel modes of rural travelers are shown in Table 3. In the mode of travel, self-driving tour 52.90%, train 22.20%, car 5.39%, airplane 3.70%, other 7.30%, etc. This indicates that in addition to the short- and medium-distance rural leisure tour, long-distance rural experience tourism also presents a certain percentage. In the casual and group tours, 8.51% of the group tours, indicating that the rural tourism market is dominated by self-driving casual tourists, and should strengthen the construction of infrastructure and service facilities in rural tourism places, keep the roads smooth, traffic signs clear, sufficient parking spaces, etc., to ensure the convenience of transportation.

Table 3. Travel Mode of Rural Tourists

Travel mode of rural tourism	Statistics proportion
road trip	52.90%
Group tour	8.51%
automobile	5.39%
train	22.20%
aircraft	3.70%
other	7.30%

4 DBN-DELM improves rural landscape planning and design

4.1 Rural landscape tourism theme image design

Research must be conducted at the beginning of tourism product design to find the destination's most suitable landscape temperament. Avoid blindly copying existing successful cases, resulting in the homogenization of rural landscapes, losing the advantages of local characteristics. The DBN-DELM algorithm is used to classify the rural landscape personality traits into nine elements: safety and convenience, agricultural landscape, street landscape, residential landscape, cultural gathering space, mountain landscape, water landscape, plant landscape, and intangible culture, which are evaluated in order of numbers 1~9. The results of the rural landscape elements index are shown in Figure 7.

In the scoring results, the order from high to low is 0.33 for agricultural landscape, 0.31 for mountain landscape, 0.29 for plant landscape, 0.27 for residential landscape, 0.26 for street landscape, 0.24 for safety and convenience, 0.1 for water landscape, 0.09 for intangible culture, and 0.08 for cultural gathering space. Agricultural landscape and mountain landscape have the highest evaluation value among the nine elements, so the agricultural landscape and Mountain landscape is the most prominent advantage of the countryside, and the positioning of landscape construction is to develop modern organic agriculture as an opportunity to optimize rural natural habitat and residential life landscape and improve the landscape quality of the countryside.

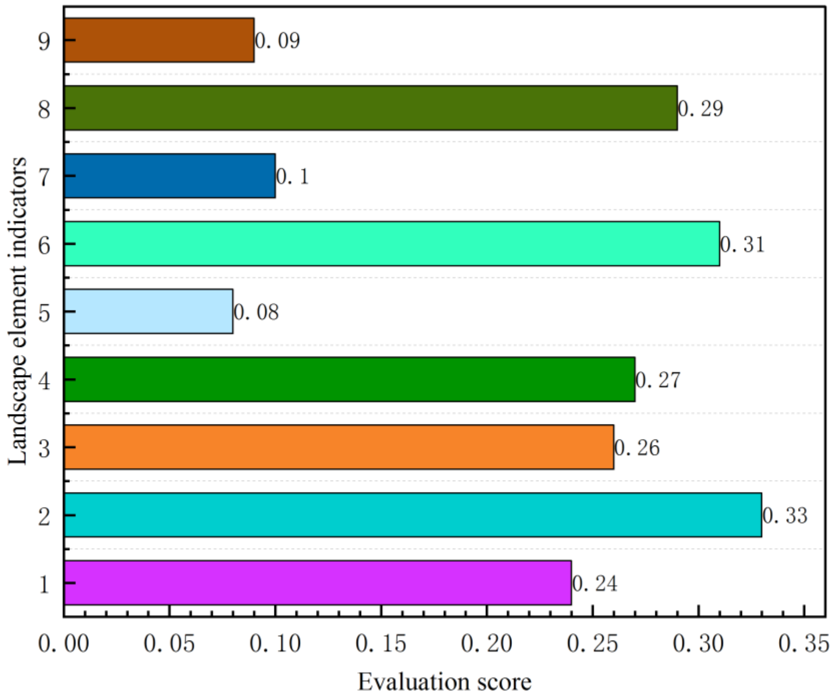

Figure 7. Indicators of rural landscape elements

4.2 Shaping of the rural landscape

1) Based on ecological elements. This planning strategy is divided into two aspects of concern. On the one hand, the native natural ecology is fully protected, but also need to take into account from the other side of the rural landscape resources have been ecologically damaged, or the ecological environment has been eroded in the area of ecological vulnerability restoration. In practice, the current hydrological, topographical and vegetation conditions should be fully integrated and linked so that the ecological conditions of the landscape pattern can be improved based on preserving the original habitat; at the same time, it is necessary to restore the natural resources such as damaged natural hills, eroded woodlands and grasslands.

2) Preserve the elements of rural life, i.e., including settlement landscape, folk culture, etc. Due to the differences in geographical environment, history and culture and lifestyle, the residential buildings in each village have formed different architectural styles and layout forms, which have become important tourism resources in the countryside with their unique shapes and cultural charm and can be combined with tourism through visits and excursions after protection and restoration. The settlement landscape is the tourism carrier of material attributes and rural folk culture. These intangible resources, such as water festivals, mountain song duets, dragon and lion dances, etc., promote agricultural tourism integration through the way experience of tourism resources.

4.3 DBN-DELM Improving Rural Landscape Design

1) Vernacular heritage

Rural landscape has different characteristic forms in different regions. Those with regional characteristics in the countryside often have unique natural landscapes, ways of life and production, architectural and cultural characteristics, local intangible cultural heritage, etc.

These are also the main factors that attract urban tourists. With the advancement of urbanization in the country, there is a great difference between urban and rural development, and often there is a divergence between the choice of economic modernization and traditional folk culture development. It can be seen that the development of rural landscape culture should take cultural differences as the design principle to create a unique cultural landscape and characteristic appearance under the improvement of rural life quality in order to promote the common development of rural residents in order to promote the development of the rural landscape fundamentally.

2) Characteristic experientialization

The intrinsic motivation of rural development is to feature agricultural experience as the main feature, a continuous and consistent response of body, environment and consciousness. Traditional rural labor is concentrated in the family, and farming is closely related to people's lives, which is more real and functional. In rural tourism planning, the combination of agriculture, life and production is used to introduce tourist participation and bring a full range of experiences to tourists and residents. The characteristic experience display area in the planning can be set up with a characteristic farmland experience area, farmland classroom area, characteristic picking area and rose theme park. Taking the characteristic farmland experience as the core of rural tourism and the cultural landscape creation as the main design, in the planning, tourism is used to get close to nature and truly participate in the farmland production and life to draw closer to the connection between people and people, people and nature.

5 Conclusion

This paper is based on a deep learning model to study rural landscape design strategy through extreme learning machine algorithm, DBN-RBM algorithm model and improved DBN-DELM theory and algorithm to determine the research framework and data through pre-analysis and classification of rural landscape resources to determine the planning direction and design principles, the main conclusions of this paper are as follows:

1) Rural tourism experience is concentrated in five aspects: functional value, contextual value, emotional value, social value and economic value, and these five dimensions should be used as design undertones when planning and developing. Furthermore, the development of each village has deviations in the development of rural tourism resources, and planning design can not copy the existing cases causing the loss of local characteristics of the countryside, resulting in aesthetic fatigue of tourists.

2) According to the results of the study on the behavior of rural tourists, 85.90% of the tourists' main motive for traveling is to get close to nature, 75% is for leisure and vacation, in order to relax and release stress, and the peers are mostly family and friends. Therefore, rural landscape design should create high-quality, diversified leisure and vacation tourism products to meet the needs of tourists. The countryside lacks transportation compared with the towns, and the mainstream travel mode of tourists is changing from traditional group travel to self-driving travel, so attention should be paid to the accessibility of tourist destinations in transportation planning.

3) Rural landscape planning and construction is a very important part of rural revitalization, which not only designs and constructs rural landscapes but also improves the living environment of rural residents, and can lay the foundation for rural industrial development.

Therefore, when planning rural landscapes, we should insist on the ecological elements as the base, retain the elements of rural life, and adhere to the principles of local heritage and characteristic experience.

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