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Research Article

Eco-Environmental Civilization Construction System in Remote Areas Based on Multiple Data Collection and the Internet of Things

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For a long time, the development strategy of remote areas is basically resource-oriented. Large-scale exploitation of resources not only damages the corresponding balance of resource reserves but also causes serious damage to the ecological environment. To this end, this paper has carried out research on the construction of ecological environment civilization in remote areas based on multidata collection and edge computing. Based on the understanding of the connotation, composition, and characteristics of ecological civilization, this paper selects representative indicators to reflect the specific requirements of ecological civilization, constructs an evaluation index system for the construction of ecological civilization in remote areas, and uses the evaluation indicators analysis and sorting. Second, edge computing and sensor technologies are applied to the process of data collection and information transmission and providing solutions for data collection and transmission in remote areas. This paper also presents the security method to protect the information transmission. Through testing, the program has shown good adaptability and can provide ideas for the construction of ecological environment in remote areas.

1. Introduction

New technologies are implemented in every field of life and make the services more convenient and feasible for people life. Wireless sensor networks (WSN), Internet of Things (IoT), smart cities, and cloud/edge based networks are few examples of technologies. These technologies are also adopted for eco-environmental civilization construction systems for data monitoring and analysis [1]. In the industrial society, the productivity of human society has been greatly improved and huge wealth has been created, and a major social transformation has been fundamentally completed. The economic, political, cultural, spiritual, social structure, and the way of life have all been greatly changed. Human beings have the ability to plunder the natural resources [2, 3]. In the middle of the last century, as the conflict between humans and the environment intensified, a series of environmental problems brought serious consequences, and humans began to reflect on the impact of industrial civilization [4]. Righteousness has entered a new stage. Mankind recognizes that in the choice of development path, it is necessary to take the path of sustainable development that is in harmony with the ecological environment, and a new way of civilization should be established [5, 6]. Therefore, ecological civilization came into being. Ecological civilization is a choice made by mankind on the basis of reflection on industrial civilization. The index system of ecological civilization plays a very important role in measuring and evaluating the development status and situation of various regions, especially remote areas, helping decision-makers to monitor and evaluate past and present development, and formulating future development goals [7].

At the same time, the establishment of ecological civilization development ideas has also raised a new major issue for the academic community, how to define the theoretical, and how to better implement the practice of ecological civilization. Some other challenges are data analysis, data monitoring, security, and resource allocations. Roy Morrison of the United States clearly put forward the concept of "ecological civilization" in 1995. He regarded "ecological civilization" as a form of civilization after "industrial civilization". [8]. Since the 1960s and 1970s, Western countries have taken the lead in environmental protection and ecological construction. International organizations such as the United Nations (UN) have subsequently put forward the concept of sustainable development. More and more countries have joined the ranks of ecological civilization construction, although they may not use the term "ecological civilization" [9]. There are many studies on ecological civilization, mainly focusing on the sustainable development indicator system. After entering the 21st century, Albert Weir proposed a new theory "Ecological Modernization Theory," which changed people's views on environmental policy [10]. The ecological footprint method is the concept and model proposed in [11] to calculate the carrying capacity of the ecosystem to humans. Authors in [12] believed that the construction of ecological civilization is the inevitable path of national development and suggestions from the aspects of improving ecological awareness and developing circular economy. Authors in [13] pointed out that it is necessary to establish an ecological civilization development mechanism from the perspective of the country, society, enterprises, and the whole people. In the quantitative analysis, the fuzzy neural network model is mainly used to screen the indicators, and the set pair analysis and the direct value method are used to carry out the static evaluation construction [14].

The main purpose of this paper is to introducing the background and significance of constructing. Construct an evaluation index system for the construction of ecological civilization in remote areas on the basis of understanding the connotation, composition, and characteristics of ecological civilization. This evaluation index is used to analyze and rank the level of ecological civilization construction among regions. In addition, this paper discusses the main factors that affect the changes in the remote areas from the growth of various indicators and comprehensive levels of construction. Using spatial statistical analysis in this study to level the ecological civilization construction, and introducing a data development model to dynamically simulate the operation trajectory of ecological civilization construction, good results have been achieved. This paper also discusses the technologies aspect and its security issues for data monitoring and analysis. The main contributions of this paper are as follows:

(i) Proposed a model for construction of ecological environment civilization in remote areas based on multidata collection and edge computing

(ii) Proposed a model based on edge computing and sensor technologies for data processing and collection

(iii) Proposed a security model to protect the process and analyzed data at the edge computing side

The rest of the paper is organized as follows: Section 2 presents the related technologies. Section 3 discusses the ecological environment monitoring based on fuzzy neural network. Section 4 presents the model evaluation based on data development. The paper concludes with future direction in the last section.

2. Related Technologies

2.1. Edge Computing and Sensor Technology. Edge computing and sensor technologies are applied to the process of data collection and information transmission, providing solutions for data collection and transmission in remote areas [15]. Traditional cloud computing requires front-end equipment to return the collected data from the network to the cloud. As computing nodes increase, it will inevitably lead to increased network load and insufficient bandwidth resources, which will lead to system response delays. This is in the era of high real-time requirements for the Internet of Everything. It is a fatal flaw [16, 17]. Edge computing is to offload part of the computing tasks in the cloud center to the edge of the network, effectively reducing the loss of network bandwidth and improving the real-time response of the system. Edge computing and sensor technology are applied in the process of data collection and information transmission, providing solutions for data collection and transmission in remote areas [18, 19]. Use edge computing to build an efficient network computing paradigm, comprehensively analyze and process data collected by smart devices in different fields, realize information query, prediction, abnormal signal detection, and other functions, and provide city managers with comprehensive and practical information that is conducive to decision-making. Realize the optimization and promotion of urban management and also provide low-latency and high-quality services for the majority of users [20, 21]. Figure 1 describes the risk monitoring process from the cloud to the edge and then to the user end.

Node monitoring system and edge computing network system architecture, this paper constructs a three-tier container risk monitoring model from the cloud to the edge to the user side, as shown in Figure 1. This article makes full use of network resources and meets all user needs, achieving the goal of the least total deployment cost [22, 23]. Different from the service function chain deployment problem under the traditional single platform, the underlying network elements of the heterogeneous NFV environment are diversified. Each NFV platform can be installed on a common server to realize multiple types of virtual network functions. However, the processing power, resource consumption, deployment cost, and distribution of the data are not the same [24].

2.2. Construction of Ecological Environment Civilization. The establishment of indicators for ecological civilization construction is not only a concrete manifestation of the civilization but also an assessment of the current success of ecological civilization construction [25]. By referring to a large number of documents, this article will start from three aspects: ecological economy, ecological environment, and

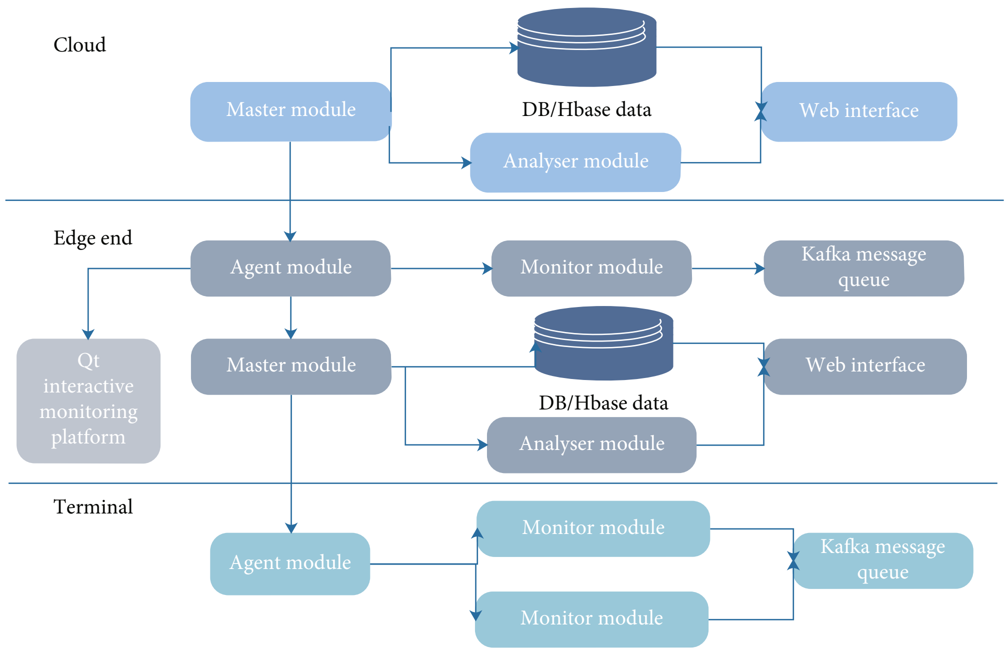

Figure 1: Risk monitoring from the cloud to the edge to the client.

ecological people's livelihood. The research methods used in this article include comprehensive literature analysis, investigation, empirical research, and quantitative analysis. In the quantitative analysis, the fuzzy neural network model is mainly used to screen the indicators, the set pair analysis and the direct value method are used to carry out the static evaluation, the spatial statistical analysis is used to study the spatial distribution pattern of the level of ecological civilization construction, and the data package is introduced. The network model dynamically simulates the operation trajectory and has achieved good results [26, 27]. The sustainable development evaluation index system is the basic content of sustainable development research and the core issue of sustainable development guiding regional development practice. Many scholars have been committed to establishing a more scientific and accurate evaluation index system, but there is still no set of truly widely accepted and recognized index system [28]. At present, two types, four main research directions, and three types of construction models have emerged in the international sustainable development evaluation index system. Figure 2 describes the technical roadmap for the construction of ecological environment civilization.

Through the combing of foreign sustainable development evaluation research, we can learn from the successful experience of some researches. First of all, we must adhere to the process of national economic development and fully implement it in the whole process of government decision-making, social progress, and economic development. It can be reflected in people's daily life and in national policies and regulations [28]. Second, sustainable development evaluation focuses on coordinated development, whether it is urban and rural overall or regional coordination, it can be reflected in the indicator system.

3. Ecological Environment Monitoring Based on Fuzzy Neural Network

As a systematic project, regional ecological civilization involves the construction of many aspects such as society, economy, and culture. The effectiveness of regional ecological civilization is difficult to directly measure with a single indicator, and the simple aggregation of multiple indicator sets cannot be reflected [29]. Therefore, the establishment of a scientific and effective evaluation model, and the integration of the selected evaluation index system into a whole, has become an important content of the evaluation of the construction of regional ecological civilization [30, 31]. The basic neural network structure is shown in Figure 3.

The second stage adjusts the connection weights between nodes according to the propagation direction opposite to stage one, that is, according to the error between the actual output and the expected output of the output layer, and finally makes the error to the minimum value. In order to make the function continuous and differentiable, the root mean square difference is minimized here, and the loss function is defined as follows:

$$L(e) = \frac{1}{2}\mathrm{SSE} = \frac{1}{2}\sum_{j=0}^{k} e_j^2 = \frac{1}{2}\sum_{j=0}^{k}\left(\overline{y_j} - y_j\right)^2. \tag{1}$$

This paper uses stochastic gradient descent to minimize L, that is, for each training sample, the weight changes in the direction of its negative gradient. We use the following formula to solve the gradient of L to the connection weight W. The critical value can be determined according to the average value of the corresponding index in the area, that

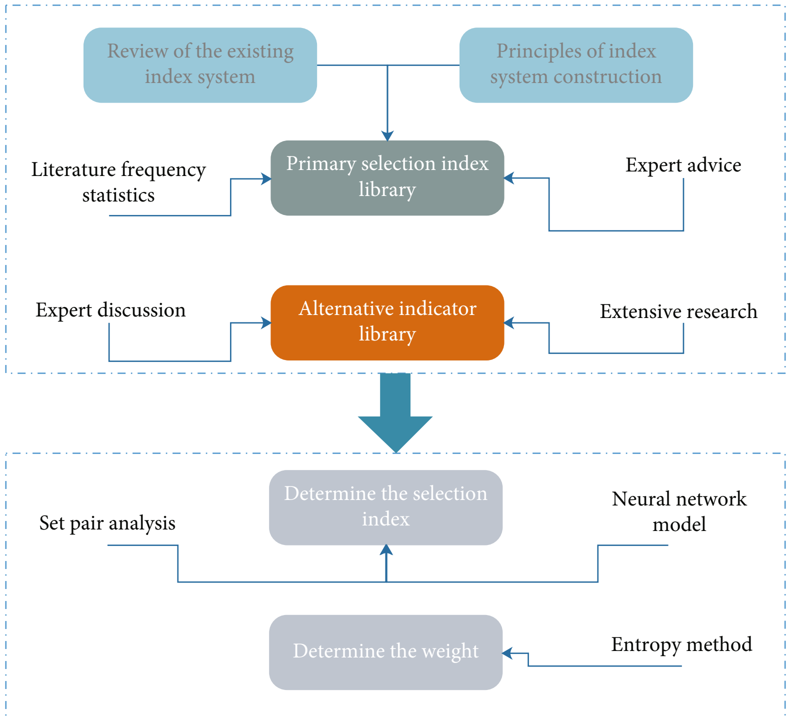

Figure 2: Technical roadmap for the ecological environment civilization.

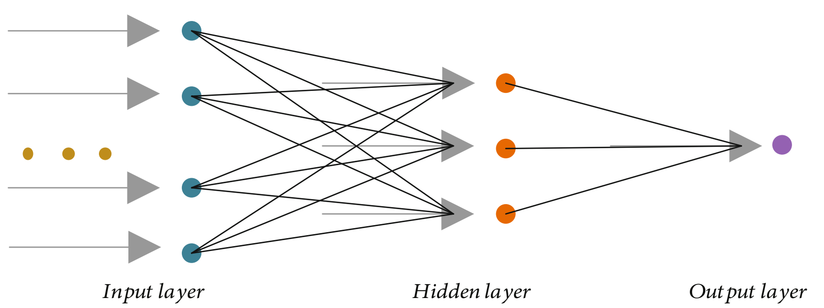

Figure 3: Schematic diagram of the basic neural network structure.

is, the average level of the index in the study area.

$$\frac{\vartheta L}{\vartheta \omega_{ij}^{1}} = \frac{\vartheta L}{\vartheta s_j^1} \bullet \frac{\vartheta s_j^1}{\vartheta \omega_{ij}^1}. \tag{2}$$

Among them, s_{2j} represents the input of the jth node of the output layer, where 1 represents the connection weight of the first layer.

$$s_j^2 = \sum_{i=1}^{m} x_i \bullet \omega_{ij}^1, \tag{3}$$

$$\frac{\vartheta s_j^1}{\vartheta \omega_{ij}^1} = x_i. \tag{4}$$

Substituting the previous formula can get

$$\frac{\vartheta L}{\vartheta \omega_{ij}^1} = x_i \frac{\vartheta L}{\vartheta s_j^1}. \tag{5}$$

Then, just ask for $\vartheta L / \vartheta s_j^1$. Since s_j^1 has an effect on all output layers, so

$$\frac{\vartheta L}{\vartheta s_j^1} = \sum_{i=1}^{k} \frac{\vartheta L}{\vartheta s_j^2} \bullet \frac{\vartheta s_j^1}{\vartheta s_j^2}, \tag{6}$$

$$s_i^2 = \sum_{j=0}^{n} \theta\left(s_j^1\right) \bullet \omega_{ij}^1, \tag{7}$$

$$\frac{\vartheta s_i^1}{\vartheta s_j^1} = \frac{\vartheta s_i^2}{\vartheta \theta\left(s_j^1\right)} \bullet \frac{\vartheta \theta\left(s_j^1\right)}{\vartheta s_j^1} = \omega_{ij}^1 \theta'\left(s_j^1\right). \tag{8}$$

Substituting the previous formula can get

$$\frac{\vartheta L}{\vartheta s_j^1} = \sum_{i=1}^{k} \frac{\vartheta L}{\vartheta s_i^2} \bullet \omega_{ij}^2 \theta'\left(s_j^1\right) = \theta'\left(s_j^1\right) \cdot \sum_{i=1}^{k} \frac{\vartheta L}{\vartheta s_i^2} \bullet \omega_{ij}^2, \quad (9)$$

$$\delta_j^1 = \frac{\vartheta L}{\vartheta s_i^1}. \quad (10)$$

The hidden layer is

$$\delta_j^1 = \theta'\left(s_j^1\right) \sum_{i=1}^{k} \delta_j^1 \bullet \omega_{ij}^2. \quad (11)$$

The output layer δ is

$$\delta_j^1 = \frac{\vartheta L}{\vartheta s_i^1} = e_i \bullet \theta'\left(s_i^1\right). \quad (12)$$

The back propagation process is that each node in the output layer will get an error e, and use e as the reverse input of the output layer. At this time, then the output layer δ is transmitted to the hidden layer according to the connection weight.

$$s_j^1 = \theta'\left(s_j^1\right) \cdot \sum_{i=1}^{k} \delta_i^1 \omega_{ij}^2. \quad (13)$$

Now let us look at the gradient of the first layer of weight:

$$\frac{\vartheta L}{\vartheta \omega_{ij}^2} = x_i \bullet \delta_j^1. \quad (14)$$

The second layer of weight gradient:

$$\frac{\vartheta L}{\vartheta \omega_{ij}^2} = \frac{\vartheta L}{\vartheta s_j^2} \bullet \frac{\vartheta s_j^2}{\vartheta \omega_{ij}^2} = \delta_j^1 \cdot \theta\left(s_i^1\right). \quad (15)$$

You can see a rule: the gradient of each weight is equal to the output of the node of the previous layer connected to it multiplied by the output of the backpropagation of the next layer connected to it. Some of the rule knowledge bases formulated on this basis are shown in Table 1.

From the given rules through multiple learning, all possible combinations of rules are obtained, and take the learning rate $\alpha = 0.7$, $\beta = 0.8$, and iteratively follow the learning rules to get the following randomly selected the predicted value of the optimal unit price of the task package.

4. Security Model

In section presents the security model by using the neural network due to its more powerful features and high accuracy and classification mechanism [32]. This method also uses its internal state which is also called memory to process variables length for the sequence of inputs. The output value of the input sequence depends on past computed value [33]. In the proposed security model, the first step is dataset collection and creation. The used dataset contains twelve classes and called CICDDOS 2019. This dataset already has a number of distributed denial of services (DDoS) attacks and categorized as either exploitation-based or reflection-based attacks at edge computing level. Figure 4 shows the proposed security model.

Dataset exists sin raw form and has many redundant values and zeros. The feature extraction is started and then selection process began by using different learning algorithms. For the filter method, the univariant is selected to identify the significant features from dataset. The SVM, LSTM, and Naive Bayes methods are used in to select the k best features from dataset. Feature selection is applied on twenty-two data mining and ML applications to remove the overfitting, reducing training time and improve accuracy [34]. The different feature method is used to check the accuracy and remove the columns which are greater than the given threshold, which has only one unique value and remove collinear features which are greater than the given value and remove the features which have 0.0 importance from a gradient boosting machine. The proposed security model performs better in terms of accuracy by using five classification methods and different feature ranges. The accuracy achieved between total instances analyzed and total correctly identified instances in a dataset. Accuracy is compared against every algorithm in each data set.

5. Model Evaluation Based on Data Development

This module takes remote areas as an application case. Based on the collection of a large amount of statistical data, the use of data envelopment and fuzzy neural network is used to filter and obtain the evaluation index system of regional ecological civilization construction, and the entropy method is used to assign weights to the index system. The sustainable development evaluation index system is the basic content of sustainable development research and the core issue of sustainable development guiding regional development practice as shown in Equations (16) and (17).

$$\max h_{j0} = \frac{\sum_{r=1}^{n} u_r y_{rj0}}{\sum_{i=1}^{m} v_r x_{rj0}}, \quad (16)$$

$$t = \frac{1}{\sum_{i=1}^{m} v_i x_{ij}}, \omega_i = t v_i, \mu_r = t u_r. \quad (17)$$

By referring to a large number of documents, this article will start from three aspects: ecological economy, ecological environment, and ecological people's livelihood. Different from the service function chain deployment problem under the traditional single platform, the underlying network elements of the heterogeneous NFV environment are diversified. Sustainable development evaluation focuses on coordinated development, whether it is urban and rural overall or regional coordination, it can be reflected in the

Table 1: Part of the rule knowledge base.

	If							Then
Serial number	$x_1\lambda_1 = 1$	$x_2\lambda_2 = 1$	$x_3\lambda_3 = 1$	$x_4\lambda_4 = 0.95$	$x_5\lambda_5 = 0.45$	$x_6\lambda_6 = 0.84$	$x_7\lambda_7 = 0.91$	
1	1							1
2		1						1
3			1					-1
4				1				-1
5					1			-1
6						1		1
7							1	-1

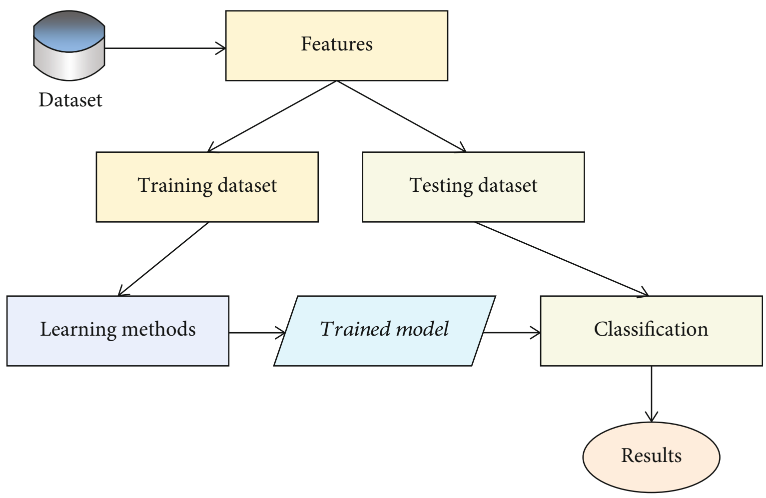

Figure 4: Proposed security model.

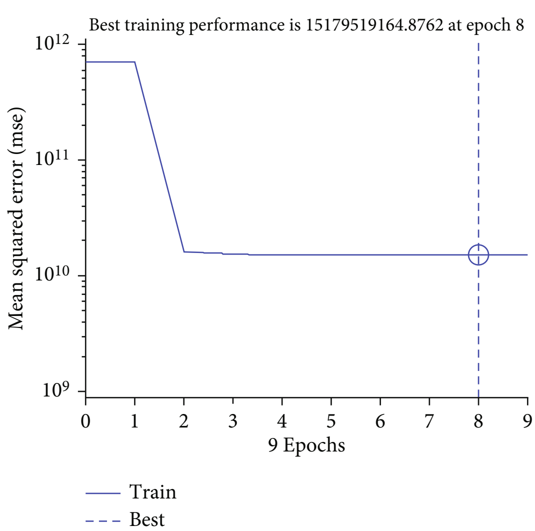

Figure 5: Training accuracy of original data.

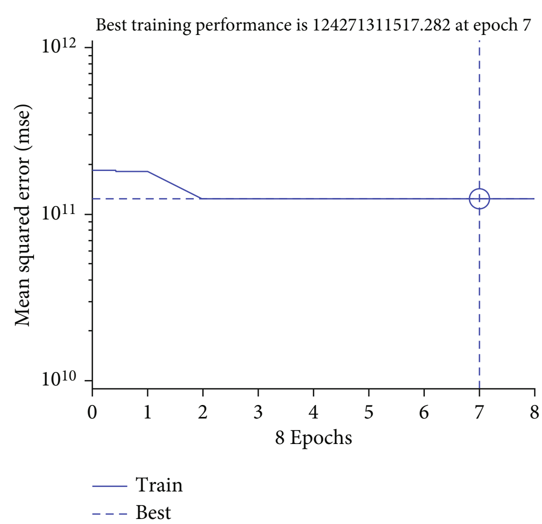

Figure 6: Training accuracy of new variable data.

indicator system. Figures 5 and 6, respectively, show the training accuracy of the original data and the training accuracy of the newly added variable data.

The indicators designed in this paper not only meet the needs of the government's macromanagement but also be widely recognized by the society, and should not be too much; it should not only be combined with the actual economic and social development of the western region in recent years but also consider its future development. It is necessary not only to objectively and dynamically reflect the remote areas but also from the perspective of adapting and perfecting the weights of indicators with changes in

Table 2: Analysis of relevant variables in environment civilization.

	B	S.E.	Wals	DF	Sig.	Exp (B)	95% of EXP(B) C.I.	
							Lower limit	Upper limit
V1	-0.609	0.076	63.549	1	0.000	0.544	0.468	0.632
V2	0.036	0.007	24.422	1	0.000	1.036	1.022	1.051
V3	-0.326	0.084	14.962	1	0.000	0.722	0.612	0.851
V4	-0.202	0.060	11.098	1	0.001	0.817	0.726	0.920
V5	0.174	0.080	4.747	1	0.029	1.190	1.018	1.392
V6	-0.310	0.122	6.433	1	0.011	0.733	0.577	0.932
V7	-0.468	0.191	5.998	1	0.014	0.627	0.431	0.911
V8	-0.309	0.122	6.382	1	0.012	0.734	0.578	0.933
Constant	2.693	0.654	16.963	1	0.000	14.775		

economic and social development, making them representative, maneuverable, and innovative, guiding, practical, scientific, and forward-looking indicator system for the construction of ecological civilization. Many scholars have been committed to establishing a more scientific and accurate evaluation index system, but there is still no set of truly widely accepted and recognized index system. This paper uses SPSS software to process a large amount of data to get the following analysis (Table 2). Table 2 describes the results of the analysis of variables related environmental civilization.

This module takes remote areas as an application case. Based on the collection of a large amount of statistical data, the use of data envelopment and fuzzy neural network is used to filter and obtain the evaluation index system of regional ecological civilization construction, and the entropy method is used to assign weights to the index system. Using the evaluation index system of regional ecological civilization construction in this remote area, an evaluation model of regional ecological civilization construction based on set pair analysis was established, and the evaluation results of each subsystem and the overall were obtained. It can be seen from Table 2 that each indicator has an upper limit, a lower limit, and a value; compared with the traditional simple weighting method, there is no need for the size of the expert's subjective judgment weight coefficient, and to reduce subjective arbitrariness. Righteousness has entered a new stage. Mankind recognizes that in the choice of development path, it is necessary to take the path of sustainable development that is in harmony with the ecological environment, and a new way of civilization should be established.

The lower limit of the index can be determined according to the minimum value of the corresponding index in the study area, the upper limit of the index can be determined according to the highest target, and the critical value can be determined according to the average value of the corresponding index in the area, that is, the average level of the index in the study area. Each value can also be determined according to the planning goal and make appropriate adjustments to local conditions. The last attempt of this chapter introduces a simplified data envelopment model to simulate the development. Actual calculations show that the data envelopment model can be applied to complex systems such as regional ecological civilization construction. The analysis results obtained are not only helpful for grasping the development direction of regional ecological civilization construction but also for analyzing the evolution of the complex system of economic-society-ecological environment provides new ideas.

6. Conclusion

At present, the theoretical research on the civilization construction is almost all from the perspective of traditional ecology and economics, and the conclusions drawn have two biases, one is biased towards ecological protection, and the other is biased towards development. Traditional cloud computing requires front-end equipment to return collected data from the network to the cloud. As computing nodes increase, it will inevitably lead to increased network load and insufficient bandwidth resources, which will lead to system response delays. A large number of studies are homogenized seriously, and simply apply indicators and methods, and the evaluation results obtained cannot guide the work and practice of ecological civilization construction. Based on the understanding of the connotation, composition, and characteristics of ecological civilization, this paper selects representative indicators to reflect the specific requirements of ecological civilization, constructs an evaluation index system for the construction of ecological civilization in remote areas, and analysis and sorting. The model constructed by the indicator system is still subjective. How to further improve the scientificity of indicator construction and strengthen the reliability of the constructed model is still the focus of research work for a long time. How to strike a balance between the availability, applicability, and scientificity of the indicators, how to make the indicators meet the needs of future development, and have better foresight and guidance, are all difficult points for research. Although this paper tries to introduce fuzzy neural network and data envelopment model, it is only a simple model that simplifies the conversion rules. It can not only further improve the application of this model but also can be combined with other models to achieve more powerful analysis and evaluation capabilities. The paper also presented the security model by using some methods at the edge network side to protect the data from unauthorized access and users.

Data Availability

The data of this article is already included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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