

Human Environment based on Symmetric Connection Network and Feedback Neural Network

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Abstract: HSE is the key object of human environment(HE) research. Although the theory of HSE was first put forward by foreign scholars, China has long been involved in the theory of HSE. With the proposition of "human settlement" by Greek scholar Daosadias, the study of human settlements around the world has entered a new stage. This paper studies the HE based on symmetric connection network(SCN) and feedback neural network(FNN) technology. The basic theories of HE behavior and human settlements construction are briefly analyzed; The SCN and FNN technology are discussed, and they are applied to the monitoring of HE air quality. Through comparative analysis of experiments, the effectiveness and feasibility of the methods in this paper are verified.

1. Introduction

The proposition of human settlement plays an important role in the development of the theory and practice of HSE, and profoundly and extensively affects the global HE research. The research object of HSE science is all natural environments and HEs, including rural areas and towns. It is mainly divided into five systems: residence, environment, human, society and nature. Nature is the basis of HSE, with the purpose of meeting human residential needs. A good HSE requires the participation of all sectors of society. This has also promoted the continuous development of systematic research on theories and practices related to human settlements in China.

In the 1990s, Academician Wu Liangyong introduced Taoism into China and proposed the science of human settlements in China. The science of HSE proposed by Wu Liangyong is a discipline that studies the interaction between human beings and the environment in a variety of human settlements. Compared with the previous studies in China, it emphasizes the study of multiple elements involved in human settlement as a whole from multiple angles and aspects [1]. The purpose of scientific research on HSE is to understand and master the laws and characteristics of human settlement development and evolution, find out its internal formation mechanism and

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main contradictions, so as to better build an ideal and comfortable human living environment. Since then, the science of human settlements and its related theories have been developing continuously, and the related research has become increasingly rich, becoming one of the basic theories in the field of human settlements in China [2].

Man is the reformer of nature and the creator of human development society. It is necessary to analyze the mechanism related to human material needs and psychological needs. Physiological needs include water, air, oxygen, sleep, space and other needs. This paper analyzes the basic theory of HSE construction, introduces SCN and FNN technology to monitor the air quality of HE, and through experimental comparison, verifies that SCN and FNN have high efficiency prediction for the protection of HE, which is conducive to environmental protection [3, 4].

2. HE Research

2.1. Theory of HE Behavior

As a new discipline, HE behavior focuses on the study of human behavior, the physical and social environment in which the behavior is located, and the relationship between them. The application of environmental behavior in the rural area is conducive to improving the rural physical environment and improving the quality of life of rural residents. The research of environmental behavior covers a wide range, including physiology, psychology, sociology, etc. According to the definition of environmental behavior, the external performance of the psychological activities triggered by human interaction with the environment in a certain spatial state is called environmental behavior [5]. According to the theory of environmental behavior, the change of living environment is due to the fact that human beings constantly try to use and transform nature in the process of production and life, establish a new environment that meets our needs by breaking the original natural environment, and finally form a new balance between people and the environment; At the same time, human behavior is made under the guidance of human experience consciousness, while the physical environment space determines human behavior consciousness. The distinctive regional characteristics of different regions determine the unique behavior characteristics of local people, and also create a variety of unique ways for people in different regions to transform nature and create living environments [6, 7].

2.2. Sustainable Development Theory

Since the Industrial Revolution, human beings have seriously violated nature and destroyed the ecological balance while developing production and scientific and technological progress. Although the quality of life has been improved in the short term, it is not conducive to long-term development and harmony. Its goal is to pursue the balance of economy, environment and society on the basis of economic development, environmental protection and social justice construction, considering both the current and the long-term. Later, with the development of society, it has been endowed with new connotation, becoming a comprehensive dynamic concept involving economy, society, culture, technology and natural environment [8]. The sustainable development of rural residential environment is not only to deal with the relationship between good people and nature, but also to deal with the relationship between good people. From the protection and development of the ecological environment to the establishment of a harmonious society, it is the basis for the sustainability of the entire human settlement environment (HSE). Introducing the concept of sustainable development into the study of rural human settlements not only enriches the theoretical system of human settlements, but also provides a feasible direction for sustainable development [9, 10].

2.3. Basic Theory of HSE Construction

Human values and social equity should be regarded as important nodes in the construction of the HSE. The said social equity not only covers the economic concept but also includes the ethical perspective. The development of remote mountain areas in China requires relevant institutions to strengthen the protection of vulnerable groups and put their most basic living requirements and living requirements on the agenda. Only in this way can the function of the social system achieve its ultimate functional purpose - to care about the most basic psychological activities of human beings. Similarly, the ultimate sense of belonging of human beings is also the starting point of HSEal science [11].

Nature refers to land, climate, plants, biology, animals and plants, geography, resource management, environmental analysis, etc. The loss of non renewable resources is irreversible and irreparable to the change of natural environment. The pressure of deterioration of natural environment and ecological environment facing mankind is getting more and more serious. Both ordinary residents, real estate developers and urban planners and builders should pay attention to the current earth ecological environment problems [12, 13]. Natural resources are controlled in moderation. When human behavior crosses a critical point, sudden changes should be severely punished by the law. Only in this way can an orderly harmony be achieved [14].

Residential system: residential system mainly refers to housing, community facilities, urban centers, etc. Human system, social system, etc. need to use the living material environment and artistic features. The focus of the settlement is to build the community, with an open space system. The open space within the community is connected with the whole system. One of the major problems facing contemporary society is the problem of housing. Housing has become a commodity for businesses, and even more, people can't catch up with housing. It should be seen as a way to promote social development and meet people's lives. The urban living space is constantly being planned to shrink. Apart from the necessary road and square space, the remaining living space is very small. How to reasonably arrange the urban public space and let more people participate in the activities in this space is the most difficult problem at present [15, 16].

3. Analysis of SCN and FNN Technology

3.1. SCN

3.1.1. Analysis of Human Brain Functional Connection Network

Human brain connectivity network can be divided into structural connectivity (or anatomical connectivity), functional connectivity and causal connectivity. The analysis layer corresponds to a single neuron, a group of neurons, or an anatomically separated brain region. Among them, structural connectivity refers to the anatomical connectivity connected by synapses or fiber pathways, while functional connectivity is basically a statistical concept. Functional connectivity acquires the statistical correlation between spatially remote neural units.

3.1.2. Calculation of Human Brain Causal Connection Network Based on Symbol Transfer Entropy

The method based on information theory can quantify the statistical correlation of information transmission between time-varying systems, but the mutual information method cannot include the dynamic information and directional information of the system. In the actually observed nervous system, the connection between neurons or brain regions is asymmetric, and the information

transmission between neurons or brain regions is also asymmetric due to different connection functions. The transfer entropy method not only has the statistical characteristics of mutual information, but also can detect the dynamic nature of information transmission between systems and the asymmetry of interaction between systems [17].

The symbolic analysis method of time series is developed from the combination of chaotic sequence analysis theory and symbolic dynamics. Its essence is to first symbolize the original time series, and then analyze and calculate the entropy. The traditional time series symbolization method uses the static range to divide the symbol area, while the dynamic adaptive segmentation method used in this chapter can effectively avoid the loss of detail information and better capture the dynamic information in the signal [18].

3.1.3. Transfer Entropy Theory

The transfer entropy can be used to detect the interaction between neurons, and it does not need to establish the interaction model, so it can be used to analyze the linear and nonlinear interaction.

The future information of y (t) is predicted by combining the past information of time series x (t) and time series y (t). The future prediction will be improved according to its own historical information. This improvement is considered as the causal effect of x (t) to y (t). Assuming random processes X and Y, the theory can be regarded as conditional mutual information, such as formula (1), that is, under the condition of the past state y of Y, the conditional mutual information of the future state y+of Y and the past state x - of X (time series x (t) and y (t) can be regarded as the observed scalars of X and Y):

$$TE(X \to Y) = I(y^+; x^- | y^-)$$
 (1)

3.1.4. Transfer Entropy Derivation

With the development of information theory, researchers no longer just quantify the amount of information between systems, but need to explore the information transmission relationship between systems. Therefore, the proposition of mutual information provides a new method for exploring the relationship of information transmission between systems.

$$I(A) = -\log_2 P(A) \tag{2}$$

Firstly, the basic concepts of information theory and the derivation process of mutual information are introduced. Formula (2) represents the self information of event A: where P (A) represents the probability of occurrence of event A. Multiple events may occur in a system, so it is necessary to determine the average value of self information, which is defined as:

$$H = -\sum_{i=1}^{n} p_i \log_2 p_i \tag{3}$$

Wherein, H is the information entropy defined by Shannon. If the prediction time is set to u, the transfer entropy is:

$$TE_{J \to I} = -\sum P(i_{n+u}, i_n^{(k)}, j_n^{(l)}) \log \frac{p(i_{n+u} | i_n^{(k)}, j_n^{(l)})}{p(i_{n+u} | i_n^{(k)})}$$
(4)

It can be seen that it is asymmetric. Because of the asymmetry of transfer entropy and the characteristics based on transfer probability, transfer entropy provides a method to quantify the directivity and dynamics of information transfer between systems, and this method can be used in nonlinear systems.

3.2. Research Overview of FNN

Generally, neural networks are divided into feedforward neural networks and FNNs according to the flow direction of information during the operation of neural networks. In the feedforward neural network, the information flows forward continuously from the input layer to the output layer, the information flow direction is unidirectional, and the output state is determined by the input and connection weights; In the FNN, there is loop recursion in the flow direction of information processing, and the state of neurons in the FNN is affected by many factors. The most basic feature of FNN is recursive iteration, that is, the previous output is re fed into the system in each iteration.

3.2.1. FNN

The FNN is a kind of neural network with hidden state variables dynamically changing with time. The basic structure of the FNN is shown in Figure 1.



Figure 1. The basic structure of FNNs

Xt represents the input of the network at time t, ht represents the output of the network, t=1,..., T. H0 represents the initial state of the network, which can be set as a constant. If all are 0, it can also be set as parameters of the network for learning. The dotted box represents a unit of the FNN. The FNN is formed by repeating and connecting such units. The connection between cells represents the input of state variables at the previous time. Box A inputs the input xt of the current time t and the state variable of the previous time, and outputs the result ht of the current time t after some operations. In FNNs, we usually set the step size. Here, step size refers to how long the input time interval is regarded as a time. The longer the step size is, the more information you can see at the same time, and the shorter the sequence is. The main consideration for setting the step size here is to accelerate the calculation of the FNN. Because the calculation of the next time series depends on the previous time series and cannot be completed in parallel, increasing the step size and reducing the sequence length will speed up the calculation of the whole network. It is worth noting that if we say that a deep network is a FNN, it does not mean that there is no convolution layer in the network. On the contrary, FNNs are usually used together with convolution layers. However, there is a layer in the network that uses temporal information, which is generally called FNN.

3.2.2. Simple FNN

The simple FNN is composed of an implicit state variable. As shown in Formula (2 - 3), g is a nonlinear function, and the tanh function is generally used. Here, ht is both an output and a hidden layer. It will be transmitted over time t, t=1,..., T. Wi, Wh, bh, h0 are time independent model parameters. Its calculation is very simple, but its training will encounter the problem of gradient

disappearance or gradient explosion. Gradient disappearance and explosion refers to the process of gradient propagation over time. According to the chain rule of derivation, the gradient is expressed in the form of continuous multiplication. If the gradient is less than 1 or greater than 1, it will be exponentially reduced or increased. Gradient explosion can generally be overcome by gradient clipping, that is, when the gradient norm is greater than a certain fixed value, the gradient will be reduced in the same proportion. The gradient disappearance problem will cause the gradient signal in the distance to decay exponentially with time, that is, the network cannot transmit the signal with a long time. In addition, SRN is too simple to express some complex temporal relationships.

$$h_{t} = g(W_{i}x_{t} + W_{h}h_{t-1} + b_{h})$$
(5)

3.2.3. Bidirectional FNN

Bidirectional FNN (BRNN) is a FNN that propagates in two directions at the same time, as shown in Figure 2, where time T+1 and time 0 are the same, and both exist as initial values. It can be understood as knowing the information of the previous time and the next time at the same time at the current time. In the case of a fixed length of time, the performance can almost always be improved. In the same way, two-way long short neural network and two-way gate FNN can also be realized.



Figure 2. Bidirectional FNN

In addition to the above common FNNs, there are many other FNN structures, such as clock FNNs. Its hidden layer is divided into several parts with different clock frequencies. It uses fewer parameters than SRN, and achieves better results than LSTM in some tasks.

4. Research on HE based on SCN and FNN

Through the analysis of the spatial characteristics of the quality level of rural human settlements in A province, this paper shows that the spatial differences are affected by economic or regional differences and other factors, so as to better explain the correlation between the development of rural human settlements in A province and the influencing factors, Further, the method of SCN and FNN is used to quantitatively analyze the influence degree of various factors of rural human settlements and calculate the influence value of each influencing factor on the quality of rural human settlements. The results of the influencing factors are shown in the following table 1.

It can be seen from Table 1 that the factors influencing the spatial characteristics of the quality of rural human settlements in Province A include the income of main agricultural methods, the penetration rate of water supply, the number of middle schools, the number of clinics, the number of rural doctors, the rate of garbage disposal, the intensity of fertilizer use, the intensity of agricultural plastic film use and other factors.

Next, this paper applies SCN and FNN to the HE to monitor its air quality. The test accuracy is

shown in Table 2 and Figure 3.

Influence factor	Influence value	Influence factor	Influence value	Influence factor	Influence value
Per capita residential building area	0.226	Water supply penetration rate	0.335	Sewage treatment rate	0.182
Proportion of residential building area	0.058	Power consumption per capita	0.122	Waste disposal rate	0.302
Per capita cultivated area	0.109	Number of secondary schools	0.386	Number of primary schools	0.283
Number of clinics	0.579	Per capita water resources	0.187	Proportion of new housing	0.106
Per capita road area	0.103	Village doctor	0.585	Gas penetration rate	0.168
Harmless treatment	0.276	Fertilizer use intensity	0.386	Per capita disposable income	0.177

Table 1. Statistical table of influence value of each element

Table 2. Air quality test results of different methods

	Day 1	Day 2	Day 3	Day 4	Day 5
Traditional monitoring	56.6%	48.5%	65.5%	58.8%	64.7%
SCN	78.8%	85.7%	80.4%	84.9%	88.3%
FNN	81.5%	83.2%	88.8%	80.5%	83.4%



Figure 3. Analysis chart of air quality test results

It can be seen from the above chart data analysis that the monitoring of HE air quality by SCN and FNN is relatively accurate. Compared with traditional monitoring methods, the method

explored in this paper has a higher accuracy, which is more conducive to the research of HE and the proposal of HE protection strategies.

5. Conclusion

Today, the trend of urbanization is more and more obvious. It is particularly important to develop and improve the HE, and the HSE can best reflect the state of the HE. The research focus of this paper is to explore the enlightenment of ecological concept on the construction of modern ecological HSE. The HE is studied based on SCN and FNN. As an important part of HSE planning, for the study of natural systems, human subjective use and transformation of nature is only one of the ways of behavior, and it should be grasped from the overall perspective of the whole natural evolution process. The evolution of organisms and non organisms in natural systems cannot be ignored.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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