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Taking Into Account the Practice of Using Neural Networks in Nature Conservation Environments

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Abstract: BP neural network (NN), as one of the NN models and one of the most widely used NN models at present, is widely used in such nonlinear problems as air quality prediction(AQP). This paper focuses on the practice of using NNs in nature conservation environment; analyzes the necessity of establishing an AQP system for AP management; develops an AQP system, mainly describes the process of implementing the data collection module, data processing module, air quality index calculation module and BP neural design module of the system, which provides guidance for nature conservation environment.

1. Introduction

With the continuous progress and development of society, environmental pollution has become more and more serious, and nowadays air pollution(AP) has become a concern in China. For us in the development of China, poor air quality seriously affects health, natural environmental protection is the first task is to control AP.

In the face of serious AP problems, the national requirements for the construction of ecological civilization environment, many local and municipal government environmental protection departments have established online monitoring systems for air pollutants to achieve online monitoring of air pollutants, and has accumulated a large number of air pollutant concentration data, but these online monitoring systems are only in the daily and monthly reports and other simple data report statistics stage. However, these online monitoring systems only stay at the stage of simple data report statistics such as daily and monthly reports, and fail to effectively utilize the collected air pollutant concentration data. In this paper, we analyze the application of NN technology to natural environment protection(NEP) [1, 2].

This paper addresses the current situation of serious AP problems faced by China, we apply NN technology to natural environmental protection and study a method based on BP NN to achieve

AQP, which can provide quantitative indicators and references for natural environmental protection by predicting the trend of air quality changes in a period of time in the future by learning the change pattern of historical air pollutant project concentration data [3, 4].

2. Nature Conservation Environment Analysis

2.1. Harmony of Natural Systems

Natural ecosystems are usually ecosystems that are not subject to the following human production and living activities, and can be divided into terrestrial and marine ecosystems. Natural ecosystems have a more complete self-regulation and control mechanism, and all components of the system will be regulated and acted by this mechanism of the natural system, so as to maintain the ecological harmony of the natural ecosystem itself [5]. Chen J proposed that recent research shows that the translation invariance of CNN is not good enough. When translation occurs in the input, it will lead to fragile feature extraction and sharp degradation of model performance. In order to improve the translation invariance of CNN and consider the periodicity of vibration signals, a multi-scale feature alignment CNN (MSCNN-FA) for bearing fault diagnosis under different working conditions is proposed[6].In Shah Mohammadi F's proposal, each CR operates based on the prediction of its transmission effect on PN. By managing the impact of SN on PN, the proposed technology keeps the relative average throughput change in PN within the specified maximum value. At the same time, it is also found that the transmission setting of CR causes the throughput to be as large as that allowed by the PN interference limit[7].Allahabadi S proposed to use a simple feedforward neural network to estimate the neighborhood of GMPP. In the second stage, HC algorithm is used to ensure accurate tracking of GMPP. Test the conclusion through simulation in MATLAB/Simulink environment and experimental test under uniform irradiance condition, partial shadow condition and wide temperature range[8].

2.2. Harmony between Man and Nature

Respecting nature, protecting nature and symbiotic co-prosperity with nature are important basic conditions for building a sustainable urban habitat environment. Therefore, to build a livable urban habitat ecosystem and ensure the safety of the system, it is necessary to make full use of the natural geographical conditions to ensure that the artificial environment is in harmony with the natural environment and that human activities are in harmony with the natural system in an ecological environment so as to meet the many material, emotional, physical and spiritual needs of human beings [9, 10]. In the process of urban habitat construction, humans should make full use of the natural environment that the city itself possesses, such as, respecting the original natural geographic features of the city, maintaining the ecological pang of the environment set, avoiding as much as possible the destruction of the topographic structure and the surface mechanism, and maintaining its self-regulating ability, activity, difference and ecological diversity and other laws [11, 12].

2.3. Harmony between People

This is a high level pursuit. On the basis of the high harmony of the natural ecosystem and the harmonious and balanced relationship between human and natural ecological environment has been reached, advocating and building a perfect open, fully communicative and humane urban living culture, strengthening the interaction of urban people through various ways, constructing the social network of urban communities, creating a harmonious neighborhood environment, and achieving a high degree of harmony between human beings, a relatively affluent life of residents, and everyone

enjoying equal right to development, environment, housing, etc. [13, 14].

3. Analysis of NN Application in Nature Conservation Environment

3.1. Artificial NN

The abbreviation of artificial NN is NN. Artificial NN is mainly an information processing system built on the basis of the research on NN of human brain, which simulates the behavior and characteristics of human brain to process information processing. Artificial NN is made up of many neural units extensively connected. As shown in Figure 1 is a schematic diagram of a typical neuron, the neuron mainly includes the input vector ai, the weight Wi of the neuron, the threshold b of the neuron, and the transfer function f and the output vector t.

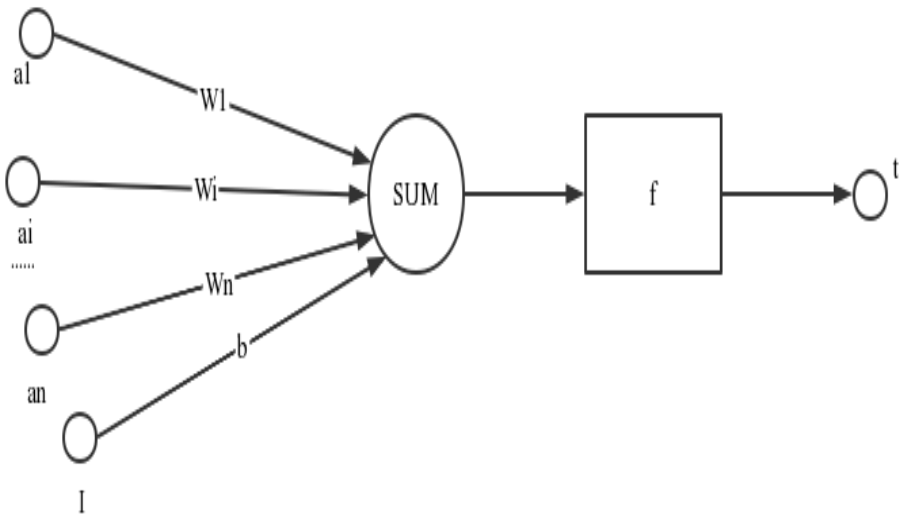

Figure 1. Neuron model

Artificial NN is a network structure containing multiple layers, which can be divided into input layer, hidden layer and output layer, and the layers of artificial NN are connected to each other by weights, and the connected weights are dynamically adjustable, and the whole NN system contains at least one hidden layer [15, 16].

3.2. BP NN Model for AQP

Figure 2 shows the BP NN model diagram.The top layer is the application layer, which is used to send user requests to the control layer and encapsulate the prediction results returned by the control layer and present the results to the user using design visualization tools; the control layer is the core of the whole air pollutant prediction system, which mainly contains the statistical data collection module, AQP module, data processing module The control layer is the core of the whole air pollutant prediction system, which mainly contains the statistical data collection module, AQP module, data processing module, and prediction module; the bottom layer is the data layer storing the monitoring station information, pollutant concentration data and metadata [17].

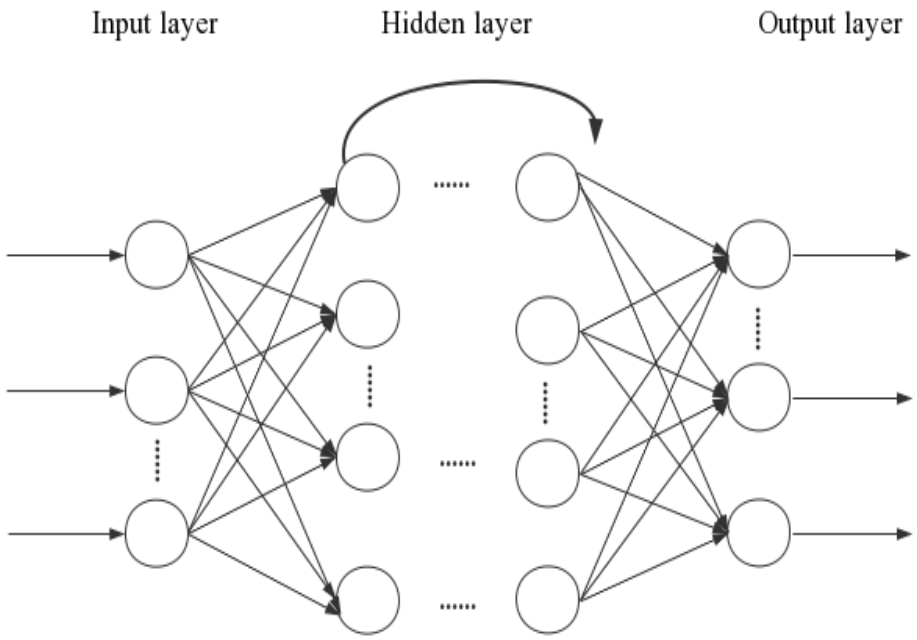

Figure 2. BP NN model diagram

The data layer stores the input factors related to the implementation of the AQP model, including the concentration data of individual air pollutant items and the calculated air quality index. It also stores information on monitoring stations, monitoring hardware and equipment, and metadata related to the implementation of the forecast.

3.2.1. Data Acquisition

In this paper, air pollutant concentration data are collected as input factors for the prediction model, and air pollutant concentration data are collected in two ways: one is to obtain real-time air pollutant item concentration data through monitoring hardware devices; the other is to obtain historical pollutant item concentration data from existing monitoring systems. The collected concentration data are used to calculate the corresponding AQI, and the air pollutant concentration data and AQI are used as the original input factors to achieve AQP [18].

3.2.2. Data Pre-Processing Process

As shown in Figure 3, it is the flow chart of data pre-processing method implementation, firstly, accessing the database to obtain the concentration data of air pollutant items collected by the data collection module, then judging whether the data are null values, if the collected concentration data of air pollutant items have missing cases, it is necessary to perform data missing processing on the air pollutant concentration data; then judging whether there are abnormal values in the concentration data If there are outliers in the pollutant concentration data, the obtained concentration data need to be processed for outliers; finally, the data are normalized in a unified manner to obtain the final training set sample data.

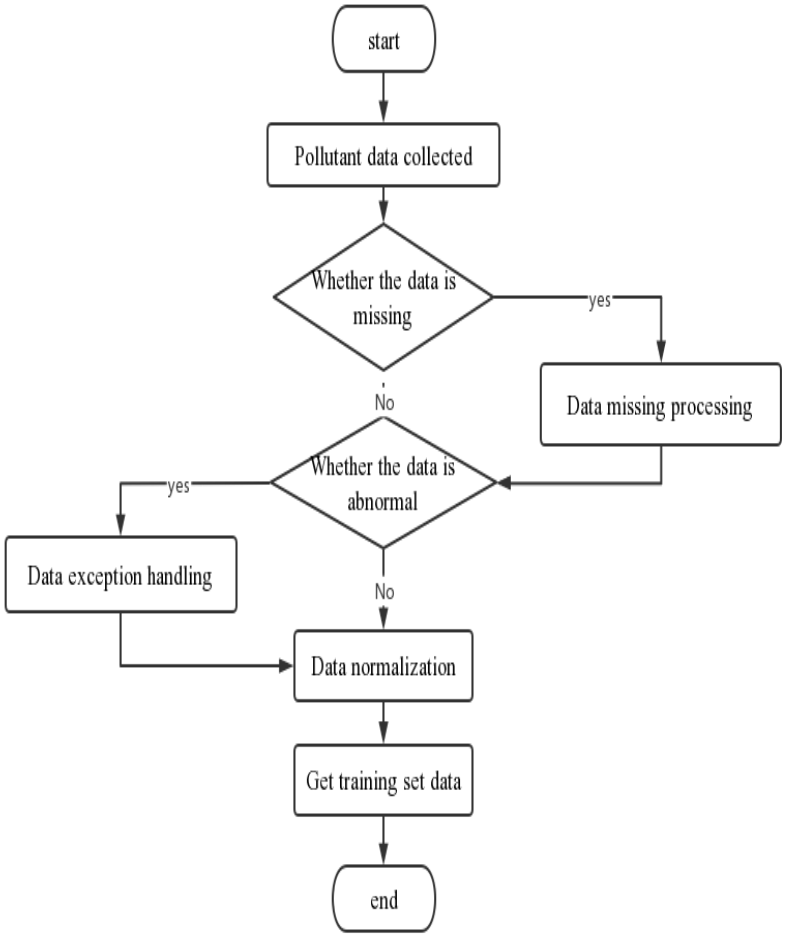

Figure 3. Flow chart of data preprocessing module

3.2.3. Data Normalization Process

In this paper, BP NN is selected as the AQP model algorithm. In the BP NN learning model algorithm, if the threshold difference between the initial input and the neuron is too large, it leads to extreme cases of maximum or minimum value of the actual output of the neuron in the output layer during the training process.

In the BP NN model, limiting the amplitude of neuron reception can effectively prevent neurons from entering the saturation state. The input layer receives the input of the whole network, which itself only transmits data, and the neurons in the input layer do not exist to enter the data inclusion state. As for the implicit layer, since the implicit layer generally takes data missing processing whether through real-time data collection or historical data collection method to obtain air pollutant concentration data, the final implementation of both is through monitoring hardware equipment in the sensor to monitor the concentration of pollutants in the air, and then read to the software system.

This paper establishes a BP NN to achieve AQP, and in order to improve the learning speed of the prediction network and prevent the phenomenon of overfitting, this paper performs data normalization on the collected air pollutant concentration data to ensure that the input data values received by the entire prediction network are limited to between 0 and 1. The data normalization

formula is as follows.

$$y = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}} \tag{1}$$

Where, x_i is the value of the i-dimensional component of the input vector, y denotes the value of the i-dimensional component of the corresponding input vector after data normalization, x_{min} denotes the minimum value of the i-dimensional component in the training set, and x_{max} is the maximum value of the i-dimensional component of the input vector.

3.3. Air Quality Index Calculation

As shown in Figure 4, it is the flow chart of air quality index calculation. The air quality sub-index IAQI corresponding to each pollutant item in the air is calculated according to equation (1); the air quality sub-index is calculated as follows.

$$IAQI_p = \frac{IAQI_H - IAQI_L}{BP_H - BP_L}(C_p - BP_L) + IAQI_L \tag{2}$$

By calculating the air quality sub-index IAQI values of different air pollutant items and selecting the maximum value from all IAQI, equation (3) is the formula of AQI, IAQIi indicates the air quality sub-index of different pollutant items and AQI is the maximum value of all IAQIi.

$$AQI = \max\{IAQI_i, IAQI_i, ..., IAQI_m\} \tag{3}$$

In the fifth step, determine whether the AQI value exceeds 500, and if the value of AQI exceeds 500, make the value of AQI equal to 500.

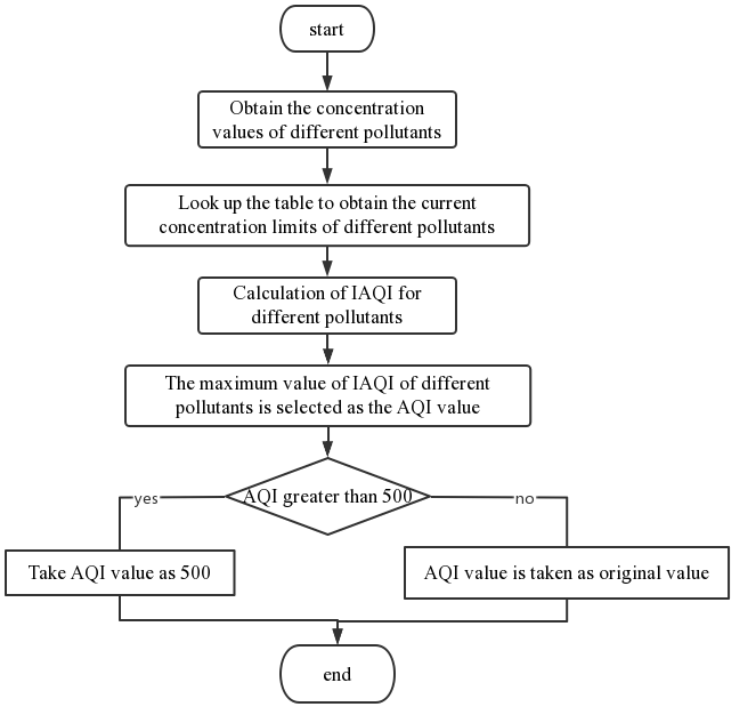

Figure 4. AQI calculation flow chart

4. NN Nature Conservation Environment in Practice

4.1. Design of a Graph Convolutional NN Model based on AQP

In AQP, the information of multiple monitoring stations can be combined to predict the target location In AQP, the information of multiple monitoring stations can be combined to predict the target location In response to the problem of inadequate consideration of spatial factors in traditional models, this chapter proposes a model oriented graphical convolutional NN model for AQP to fuse the information of multiple spatially relevant nodes such as road networks, points of interest in cities (poi), geographic coordinates of air quality monitoring stations and distances, weather forecast data, etc. to extract spatial features, thus solving the problem of inadequate consideration of spatial correlation in existing AQP models. The multilayer iteration of the graphical convolutional NN uses the information of the edges in the matrix to perform multilayer aggregation, so as to produce a final and stable feature matrix containing the information of air quality monitoring stations, and finally the new feature matrix can better predict the pollutant levels. The graphical convolutional NN model for AQP in this paper is shown in Figure 5.

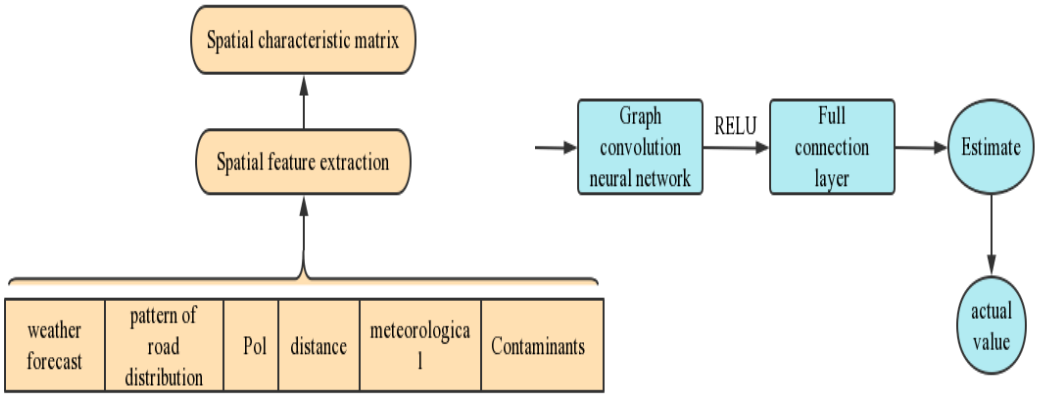

Figure 5. Graph convolution NN model for AQP

The input layer of the graphical convolutional NN model for AQP is H. The information contained in it is the spatial information of each monitoring station, and the associated information of air quality monitoring stations will be transformed into a graph structure and input into the input layer. The fused feature matrix is then fed into the fully-connected layer for training and prediction.

In the graphical convolutional NN for AQP, for an L-layer NN, the output $H^{(l)}$ of each layer is a matrix of |V|xd', each row represents - a monitoring station, and the columns of a station represent the spatial feature vector of this one monitoring station. The number of monitoring stations in each layer is kept constant, after which the feature vector changes with the progression between layers, and the calculation process between layers in this paper is shown in Equation (4).

$$H^{(l-1)} * W^{(l)} = AH^{(l-1)}W^{(l)} \tag{4}$$

where A is the adjacency matrix describing the graph structure, the product of A and H(-) will summarize the features of the neighborhood around each vertex, and w' assigns weights to this product so that linear combinations between features can be considered. Immediately afterwards, graph convolution can be utilized in each layer of the NN. The representation of the operations performed in each graph convolution layer is shown in Equation (5).

$$H(l) = f^{(l)}H^{(l-i)} = \sigma(AH^{(l-1)}W^{(l)}) \tag{5}$$

In this paper, the adjacency matrix is shared among all layers of the graph convolutional NN model oriented to AQP. The reason for this is that the association between air quality monitoring stations is mainly affected by spatial factors and the degree of change over time is not significant, which can reduce the parameters to enhance the efficiency of the model. The adjacency matrix A will be transformed into a Laplacian matrix to input into the model, facilitating the training of the graph convolutional NN model.

4.2. Develop Specific Measures for Nature Protection Environment

The control plan of NEP system is different from the urban control plan, which not only pays attention to the control and guidance of the development and construction of different functional spaces, but also pays more attention to the effective protection of natural environment resources. At present, the theoretical system and the content of urban control regulations have become mature, but they are more inclined to the research content of urban development management, and the control content of natural resources protection and recreation display planning is extremely lacking.

The objectives of the control plan of the NEP system: to improve the planning level of the NEP system; to realize the functions of the NEP system; to realize the sustainable development of the NEP system; the basic principles of the control plan of the NEP system are: the principle of protection priority; the principle of rational use; the principle of operability; the construction of the content system applicable to the control detailed plan of the NEP system proposes The planning content applicable to the control plan of the NEP system: scope and functional zoning boundary control: control of the planning scope of the NEP system, functional zoning boundary control, functional zoning protection control and peripheral protection zone control; land use control: land use nature and type, construction land boundary, construction intensity of construction land, human activity area, land use compatibility and nature protection control; facilities Community construction control: community development direction, community population scale, industrial activity control and community control index system.

5. Conclusion

This paper takes into account the practice of using NN in nature protection environment, and has achieved certain results in the actual project, but still some areas need to be improved in the process of research. In terms of data collection, the historical collection method to obtain the concentration data of air pollutant items only takes into account the most commonly used Excel file storage form, and there may be other file storage methods to be considered; in the process of data processing for missing data and data anomalies using the mean filling method, which may have some impact on the accuracy of the final AQP. Due to the actual engineering development needs only using BP NN as a method to achieve AQP, in the later research can be combined with other data mining algorithms to further improve the accuracy of prediction.

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Data Availability

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

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Conflict of Interest

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

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