Environmental Monitoring Prediction Based on Graph Convolution Neural Network

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Abstract: Environmental monitoring plays an important role in identifying environmental characteristics. Abnormality is related to negative effects and seriously affects human life. Many sensors can be placed in specific areas and are responsible for monitoring the environmental characteristics of specific phenomena. Sensors report their measurement results to a central system, which can carry out invitational reasoning. Therefore, the system responds to any event related to the observed phenomenon through decision-making. This paper proposes an event recognition mechanism based on sensor measurement, and gives the corresponding decision, so as to realize the real-time event recognition. The system adopts the statistical learning method of data fusion and prediction (time series regression) to effectively collect the measurement data of sensors. Fuzzy logic is used to deal with the uncertainty of derivative alarm decision. This paper introduces the application of GIS, geostationary, meta database and cart in environmental monitoring by querying survey data in meta-data database connected with GIS. The results show that the I | o value of mechanical ventilation is 36% with indoor heat source and 18% without indoor heat source.

1. Introduction

With the continuous progress of science and technology, computer technology has become an indispensable part of our life. Environmental monitoring is one of the most important applications of wireless sensor networks, which usually takes months or even years of life cycle. However, the inherent limitations of the energy carried by the battery of sensor nodes bring great difficulties to obtain a satisfactory network lifetime, which becomes the bottleneck of the application scale of wireless sensor networks.

With the continuous development of information technology, many experts have studied environmental monitoring. For example, some domestic teams have studied the multi-purpose remote sensing image debarring based on double deep convolution neural network, and designed a new multi-purpose remote sensing image blurriness algorithm based on double deep convolution neural network. According to the characteristics of multi-purpose remote sensing images, a double convolution neural network is designed to obtain the external prior information and improve the ability of image restoration. In order to simplify and strengthen the existing environmental monitoring equipment for disease prediction, a microcomputer is designed. Centralized principal component analysis (PCA) is used to compress and recover the prediction data on CHS and sink, respectively, in order to save communication cost and eliminate the spatial redundancy of environment aware data. Finally, the errors of these processes are evaluated theoretically, and the results show that the errors are controllable. On the basis of theoretical analysis, some algorithms are designed and implemented. The framework uses real data for simulation, and provides a cost-effective solution for cluster based wireless sensor network environment monitoring and other applications. Due to the limitations of industrial data acquisition system, CBOD is not recorded at a fixed time interval, which will lead to the gap of time series data. Through a large number of experiments to approximate the functional relationship between input and output parameters, in order to fill the lack of CBOD data. The model with seasonal effect is studied. Four data mining algorithms including multi-layer perceptron, classification regression tree, multiple adaptive regression spline and random forest are used to establish the prediction model, and the maximum prediction period is 10 days [1]. Some experts have studied the research and development of base station edge intelligent monitoring and antenna monitoring terminal height measurement technology. By constructing a small edge server based on B / S architecture, combining TCP / IP and web socket protocol, the data communication middleware is completed, and the terminal monitoring data is presented on the web page in real time, which realizes the integration of open measurement and remote monitoring. In order to improve the spatial resolution of climate change information, the change of plant phenology and temperature was combined with GIS overlay technology, and applied to the vector incidence prediction at regional scale. This paper proposes a system model based on three-tier architecture of Internet of things, which is realized by geometric merging of surface data of Internet of things initiator. Considering the temporal and spatial aspects of environmental processes, the institutional basis of this system based approach is discussed, and how to encode environmental processes in the system based on graph convolution neural network technology is explained. This paper introduces some preliminary research results of station scientists in the prediction modeling and early warning of ecological environment. The co-environmental process is affected by many factors, such as hydro-meteorological conditions, biological factors and human activities. Therefore, it is difficult to incorporate all these effects and their interactions into deterministic or analytical models. A prediction model of marine ecological parameters is proposed, which combines time series prediction method with neural network nonlinear modeling. Some experts have studied the design and implementation of the indoor environment monitoring system based on Android, designed and developed a set of indoor environment monitoring system based on Android, which can realize the real-time monitoring of temperature, humidity, PM2.5 and flue gas status, as well as the regulation of the environment. It relies on a framework called adaptive model selection (AMS), which is designed to run time series prediction technology on resource constrained wireless sensors. We use two demos to show our implementation, related to environmental monitoring and video games. TinyOS is the reference operating system of Low-Power Embedded system. Trotsky and convention are wireless sensors. This paper extends the literature of normal and cliometrician simultaneous prediction interval to gamma distribution. Gamma distribution can adapt to all kinds of non normal distribution (with inclined right tail) and the existence of mutability. Gamma prediction limit is the best candidate for conventional application in groundwater monitoring network of waste treatment facilities and / or other related environmental monitoring applications. The effectiveness of the method is illustrated by taking the groundwater detection and monitoring data as an example. Although the research results of environmental monitoring are abundant, the research of convolution neural network in environmental monitoring and prediction is still insufficient [2, 3].

In this paper, in order to study the environmental monitoring and prediction of graph convolution neural network, through the study of convolution neural network and cloud environmental monitoring, we find the convex set projection method. The results show that the convolution neural network technology is conducive to the prediction of environmental monitoring.

2. Method

2.1 Graph Convolution Neural Network and Environmental Monitoring

(1) Constructional neural network

The spatial distribution of output data in convolution layer is affected by sliding step size, convolution kernel size and boundary filling [4]. The number of output layers is a super parameter, which is determined by the number of filters used [5]. What the filter does is look for features in the input data. When sliding the convolution window, you must specify the step size. Input layer, convolution layer, linear correction layer, convergence layer and full connection layer are the main components of convolution neural network [6]. Constructional neural network can be obtained by combining these layers for many times. In order to reduce the number of network layers, the linear rectification layer is integrated into the convolution layer, and the interlinear after convolution operation is superimposed by the activation function to fit the nonlinear model [7]. In addition to the activation function, the convolution layer also uses the weights and deviations of neurons when extracting the input image features [8].

(2) Devolution reconstruction and jump

For the super-resolution reconstruction of a single image, although the LR image loses the high-frequency information contained in its corresponding HR image, the LR image is still highly correlated with the super-resolution SR output image [9]. Therefore, how to make full use of all the features extracted from the input image to reconstruct high-quality SR image is very important. Because the features learned by the recurrent residual network are directly connected, the features of different paths have different distribution. Pixel convolution does not need to learn any parameters, so it is unable to adapt distinguish the local and global information extracted from different paths. Therefore, devolution is the preferred method for further mining useful information [10].

(3) Cloud environment monitoring

In the cloud computing platform, exceptions based on performance data are easier to obtain and occupy less system resources. In contrast, the monitoring efficiency is more ideal. The essence of this method is pattern recognition, that is, to establish the abnormal data discrimination model based on the existing abnormal data. In this way, the unknown performance data can be identified. Introducing machine learning method into anomaly judgment can make the anomaly judgment method have high robustness and adaptability, which is also the research hot spot of many scholars. Compared with the traditional server, the cloud environment can integrate the physically dispersed physical resources into the virtual machine resource pool through vitalization technology to realize the unified allocation of resources.

2.2 Convex set Projection Method

Another iterative method is based on the concept of iterative projection. These algorithms define an implicit cost function to solve stochastic resonance problems. In the iterative projection method, the imaging model given by the equation is used. Suppose that every LR image applies prior knowledge to the final solution, and the final solution is a closed convex set KS(1):

$$S_k = \{f \mid \delta_I \leq | dh_k w_k f - g_k | \leq \delta_m\} \tag{1}$$

Where, kg is the kth LR image, f is the solution, and l δ and u δ are the upper and lower uncertainties of the model. The following iteration can be used to estimate the HR unknown image, as shown in equation (2):

$$f^{L+1}(x, y) = \wp_m \wp_{m-1} \cdots \wp_2 \wp_1 f^{(L)}(x, y) \tag{2}$$

The observation function is defined as the matching degree between the candidate HR patch and the known LR patch, and the transition function assumes that the adjacent patches in the super-resolution HR image are related to each other. After training the model, in the process of learning and reasoning, Markov hypothesis is used to decompose the posterior probability, and belief propagation algorithm is used to infer the missing HR details in LR input image to obtain map super-resolution image. To infer HR patches, the following formula (3) is used:

$$f_i = \arg\max P(f_i) P(g_i \mid f_i) \prod L_{i,j} \tag{3}$$

Where if is the i-th patch of HR image f, Ig is its associated LR patch, and j is all adjacent nodes including the patch. The definitions of I and JL are shown in formula (4):

$$L_{i,j} = \sum_{f_i} P(f_i \mid f_i) P(g_j \mid f_j) \prod_{k \neq i} L_{jk} \tag{4}$$

3. Experience

3.1 Experimental Object Extraction

According to the classic three-tier architecture of Internet of things, environmental monitoring system can be divided into perception layer, transmission layer and application layer. The sensor layer corresponds to the environmental information acquisition terminal of the system, namely the acquisition node. The transport layer corresponds to the Lora gateway of the system, that is, the wireless and wired networks are used to encode, authenticate and transmit the collected data. The application layer corresponds to the information monitoring platform of the system, that is to store and visualize the uploaded data. Environmental information collection terminal is the bottom and basic layer of atmospheric environmental monitoring, and the number of monitoring points should be enough. These terminals are mainly used to accurately perceive the external environment information, and this process needs to be completed with the help of various sensors, and then the collected information and data are transmitted to the gateway through the wireless network. The transport layer needs to transmit data, and the gateway is the bridge between the terminal and the server. In short, the information collected by the terminal will be transmitted to the gateway, and then the gateway will analyze the data, and then standardize, store and transmit the data to the server. The monitoring platform can access the server to display the atmospheric environment.

3.2 Experimental Analysis

The Lora star network used in this system is composed of information acquisition terminal, Lora gateway / concentration node and remote information monitoring platform. The sensor network based on Lora wireless communication, which is composed of information acquisition terminal and Lora gateway node, is the focus of this paper. The function of these terminals is to collect and process atmospheric environment information. At the same time, the data will be sent to the gateway node regularly. Gateway concealer gateway concentration plays a role of bridge in the whole network, connecting terminal nodes and servers. In the whole network, the collection part sends data, and then the gateway receives the data. This process mainly occurs in the upstream. Although most of the communication data is uplink, it is bidirectional in the network, so there is a connection between the gateway and the server, which is based on TCP / IP. Three. Information monitoring platform is the monitoring platform to obtain the final data, and display these data in the form of text and pictures. Users can get the environment data of different areas according to the distribution of the collection nodes, and display it on the web interface of the host computer intuitively.

4. Discussion

4.1 Analysis of Interference Factors in Dose Rate Monitoring

According to Pearson coefficient, humidity is positively correlated with rainfall, but not with air pressure. However, the Pearson coefficient of dose rate and rainfall is less than expected, and the effect of humidity on dose rate is greater than rainfall. As shown in Table 1.

Table 1. Correlation coefficient between agent rate and meteorological parameters of a station in 2020

Pearson coefficient	dose rate	humidity	pressure
dose rate	1.03	3.64	0.57
humidity	0.98	2.48	1.58
pressure	2.84	1.56	2.86

It can be seen from the above that the dose rate coefficient is 1.03, the humidity coefficient is 3.64, and the air pressure coefficient is 0.57. The humidity coefficient of Pearson coefficient is 2.48 and the air pressure is 2.86. The results are shown in Figure 1.

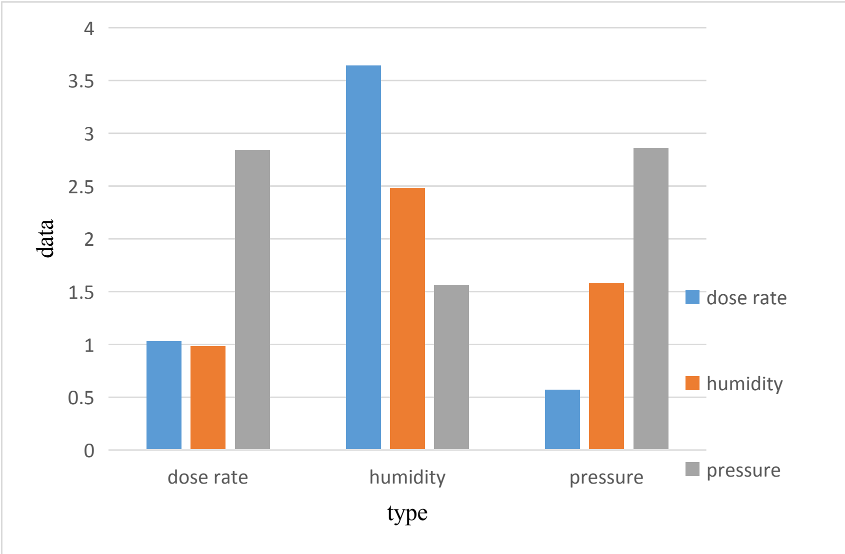

Figure 1. Correlation coefficient between agent rate and meteorological parameters of a station in 2019

It can be seen from the above that the highest humidity coefficient is 3.64 and the lowest pressure coefficient is 0.57 in 2020.

4.2 Sources and Characteristics of PM2.5 Particles in Residential Buildings

In the modern urban environment, whether at home, at work, at school, or even in leisure activities, people spend most of their time indoors. Therefore, understanding the relationship between indoor and outdoor PM2.5 levels is the key to characterize pollutants. In the modern urban environment, whether at home, at work, at school, or even in leisure activities, people spend most of their time indoors. Therefore, understanding the relationship between indoor and outdoor PM2.5 levels is the key to characterize pollutants. PM2.5 levels found in indoor environment are mainly caused by ventilation airflow or combustion during heating and cooking. As shown in Table 2.

Table 2. Average pm2.5i/o ratio for different ventilation types and internal sources

Ventilation type	Indoor source	average value	I|O value	standard deviation
mechanical ventilation	yes	1.44	36%	0.1
	no	0.47	18%	0.1
natural draft	yes	1.89	21%	0.2
	no	1.73	25%	0.1

It can be seen from the above that the average value of mechanical ventilation with indoor source is 1.44, I | o value is 36%, and the standard deviation is 0.1; the average value of mechanical ventilation without indoor source is 0.47, I | o value is 18%, and the standard deviation is 0.1; the average value of natural ventilation with indoor source is 1.89, I | o value is 21%, and the standard deviation is 0.2; the average value of natural ventilation with indoor source is 1.89, I | o value is 21%, and the standard deviation is 0.2 73, I | o value was 25%, standard deviation was 0. 1. The results are shown in Figure 2.

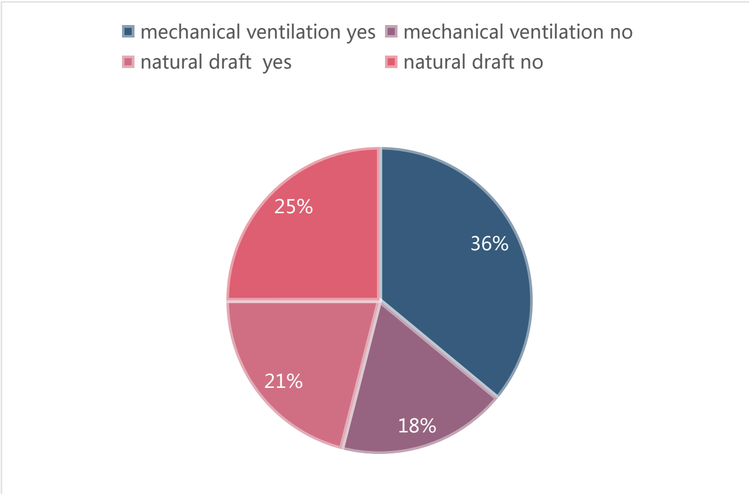

Figure 2. Average pm2.5i/o ratio for different ventilation types and internal sources

It can be seen from the above that the highest I | o value of mechanical ventilation is 36% when there is indoor source, and the lowest I | o value is 18% when there is no indoor source.

5. Conclusion

The process in the environment is often complex. The description and prediction of environmental pollutant behavior need complex methods, including multidimensional technology and convolutional neural network technology. When monitoring the environment, it is very important to have a small portable system that can quickly identify the pollutants on site. On the one hand, these systems play an important role in our society; on the other hand, their adoption will bring some security and privacy issues, which may pose obstacles to the development of environmental applications in the future. In many fields such as environmental monitoring, prediction and control, low-cost equipment is needed to achieve real-time response. For example, the ability to quickly obtain weather information for agriculture and many other purposes; or the ability to obtain air pollution information in environmental monitoring; or the ability to obtain river water level information for flood warning; or the ability to obtain water information for avoiding drought; will have a huge impact on the environment, many people's lifestyles and economic conditions. In many cases, systems that provide such environmental information must complement global or large-scale data with local data to provide effective local facilities. The air temperature, air humidity, atmospheric pressure and other parameters that affect the environment are analyzed and recorded. Convolution neural network technology and statistical modeling method are used to analyze the recorded values and predict the real-time measured values and model output.

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