IOP Conf. Series: Materials Science and Engineering **631** (2019) 042011 doi:10.1088/1757-899X/631/4/042011

Research on Power Grid Environmental Protection Management Information System Based on Time Series Characteristic

Yang Dan[a], Li Jinyang, Li Rui, Dai Shimeng, Luo Ning

State Grid Sichuan Economic Research Institute, Chengdu 610000, China.

[a]Sunflowerfordan@163.com

Abstract. With the continuous improvement of the voltage level of power system and the continuous expansion of the scale of power grid, the problem that the environmental protection information data of power grid is single and can not be centralized analyzed and utilized is highlighted. It is necessary to strengthen the construction of information management for power grid environmental protection. The time series characteristic is an orderly set of elements composed of the recorded value of a physical quantity and the time node. Through the time series characteristic, it provides data query, analysis and transmission line electromagnetic environment parameter prediction function for power company, provides the basis for power grid environmental protection management and technical supervision and monitoring, and realizes the electronic management of power grid environmental protection information system.Real-time monitoring of electromagnetic environment parameters of power transmission and transformation lines, providing technical support and data support for the formulation of environmental protection policies and solving environmental disputes, and realizing information management of power grid environmental protection. It is convenient and quick to increase the grid environment monitoring node, and the networking is flexible and simple; the monitoring center has a friendly interface, which can realize multi-point control of a large number of terminals.

1. Introduction

With the rapid development of power industry and the improvement of people's living standard, the power grid has been further developed. Especially, the capacity and voltage level of high-voltage transmission and transformation facilities are more and more developing toward the direction of large capacity and high voltage, and the problems of electromagnetic environmental pollution caused by it are also gradually emerging [1]. Fully combines the latest development trends of computer network technology, database technology, multimedia technology and Intranet technology. The functions of processing, storage, maintenance, utilization and output of relevant information are realized. The environmental monitoring data of power transmission and transformation projects are analyzed to provide theoretical basis for managers and decision makers [2]. It provides convenient data inquiry, analysis and transmission line electromagnetic environment parameter prediction functions for managers, designers and researchers at all levels of power companies, and integrates scattered and complicated data and related application software into useful information system [3]. Because the influence of electromagnetic environment on noise and water pollution is invisible and can not be

touched, it is easy to cause panic among the masses, thus causing more and more environmental problems and disputes related to power transmission and transformation projects [4]. The electromagnetic pollution caused by this has become more and more important to the society, and the contradiction between power grid construction and environmental protection has become increasingly prominent. The communication system is the information transmission channel of the monitoring terminal and the monitoring center. The quality of the communication system is related to the success or failure of the monitoring system. To meet the needs of grid environmental monitoring, the choice of communication system should be based on the actual situation of the grid environment [5].

The task of environmental protection in power system is arduous. Every year, a lot of testing work has been done in the environmental evaluation of power transmission and transformation projects. Similarity matching of temporal characteristics can be divided into full sequence matching query and subsequence matching query [6]. Full-sequence matching query is to find out the temporal characteristics that satisfy the similarity with the queried sequence as a whole from the set of preset query sequences. The matching sequence obtained should be approximately the same as the potential of the queried sequence [7]. Timeliness is an important feature of renewable energy units affecting the operation of the system, and it has an important impact on the production simulation results. The production simulation based on simulation retains the timing of the system operation process and can obtain a more detailed operation information system [8]. To this end, the grid environmental protection management information system is constructed to realize the daily supervision of the grid environmental protection and the real-time monitoring of the electromagnetic environment parameters of the transmission and transformation lines. The monitoring terminal transmits the collected data to the remote server through the wired network in real time, and the staff can store and analyze the monitoring information and return the result to the field staff. This approach is currently the main remote monitoring mode [9]. Through the electromagnetic environment parameter prediction software system, the user can predict the electromagnetic environment parameter value generated by the transmission line, and the system also has the function of comparing the current monitoring data with the predicted calculation value. Supporting decision-making by information and data, providing basis for power grid environmental protection management and technical supervision and monitoring, and realizing electronic management of power grid environmental protection. Therefore, it provides technical support and data support for the formulation of environmental protection policies and environmental disputes, and it is very important to realize the information management of power grid environmental protection [10].

2. Materials And Methods

2.1 Design goal

In view of the impact of power grid construction on the surrounding environment, the design goal of provincial power grid environmental protection management information system is to use information technology, combined with computer network technology and database technology. In the grid environment, the sensitive points of the grid environment need to be monitored are mainly located near the high voltage transmission line, the substation and the substation. Generally speaking, the number of sensitive points in power grid environmental monitoring is very large. Through the software system of electromagnetic environment parameter prediction, users can predict the electromagnetic environment parameters generated by transmission lines. At the same time, the system also has the function of comparing and verifying the current monitoring data with the predicted calculation values. Subsequence matching query is to find out the location offset and length of all the subsequences whose distance from the query sequence is less than the given distance from the query sequence from the query sequence whose potential is far greater than the query sequence.System design and development not only need the support of the development language platform, but also the support of electromagnetic environment parameter calculation software and database technology. The distributed open application component

can run on various operating systems supporting Internet network protocols, and can easily realize the docking and interconnection of distributed heterogeneous software systems. To achieve information sharing, provide a direct communication and dialogue platform for power companies at all levels and various engineering design and construction units to meet the needs of power grid environmental protection management.

2.2 Key technology

It mainly realizes the functions of supervision and management of environmental protection technology, information management of power transmission and transformation projects, case management of environmental protection disputes, announcement and news management, etc. Among them, the information management function of transmission and Transformation Engineering realizes the analysis and summary of transmission line related information and transmission line environmental test data. Establish special environmental protection management archives, which include environmental assessment report, environmental measurement data before and after construction and operation, environmental protection approval documents at various stages, local governance measures, etc. The basic information of transmission and transformation projects, environmental assessment in construction, water and soil conservation, environmental protection completion and acceptance report and approval, environmental protection technology monitoring data and environmental disputes cases are dynamically managed. At the same time, we should pay attention to the interface between the prediction database and the database system, determine the key fields of the interface when designing the database, and preprocess the data of different formats, different sources and different requirements in order to meet the prediction requirements. The edit distance is a measure of the distance between two strings of sequences; it requires quantization of the timing characteristics and encoding to form a string, and then calculates the minimum number of edit steps required to convert one string to another. In addition, the system is designed with openness and standardization as the design principle, with componentization, layering and interface as the design idea. In the development process, the mainstream software development technologies such as WebService technology, AJAX technology and Matlab engine technology are used reasonably.

The environmental protection system of power grid has a large amount of data, and different functional modules may cause incomplete data processing. Through the stored procedure, the related processing of database can occur together, thus the integrity of database can be maintained. Correspondingly, the monitoring terminal only needs to design a collection circuit suitable for the sensitive points of the power grid environment, because the price of sensors for monitoring the power grid environment is generally relatively expensive, which can greatly save costs and give play to the advantages of the embedded system that is easy to expand and tailor. This allows Web applications to quickly respond to user requests to reduce data transfer between servers and browsers and reduce the load on the background server. Understand the geographical information of existing power transmission and transformation projects, and timely supplement the relevant information of new substations and lines. The system should dynamically mark the precise location of each substation in the administrative area map, including the substation name, latitude and longitude, administrative area and other detailed information. The use of a network to represent the simultaneous occurrences of sequences in a system can be described by a weighted directed network. For power systems, the connections between components, protection, and circuit breakers can be graphically represented. The matrix analysis method describes the dynamic changes of the network in the fault process. The electromagnetic environment parameter calculation subsystem can predict, calculate and analyze the electromagnetic environment parameters of different transmission lines and different voltage levels. In order to carry out research on the power frequency electromagnetic field of ultra-high voltage and ultra-high voltage transmission lines, find the optimal arrangement of the conductors and The best design of the transmission line, the grid environmental protection management information parameter test is shown in Table 1.

Table 1 Measurement of Information Parameters of Environmental Protection Management in Power Grid

	Query	Administration
Prediction of electromagnetic environment parameters	0.35±1.82	1.25±0.71
Safety Early Warning of Electromagnetic Environment	1.22±0.71	0.58±1.35
Sensitivity monitoring	0.78±0.19	0.72±0.68

3. Result Analysis and Discussion

3.1 Prediction of audible noise

Considering the storage and backup of environmental protection data of power grid, especially the original test data of electromagnetic environment. Processing digital signal, the processor converts the obtained digital signal into the corresponding grid environment value, and real-time transmission through the wireless local area network to the remote monitoring center server. These data have the characteristics of professional and archivable data increasing at an accelerated rate every year. The transmission and transformation lines, substations, engineering projects, environmental protection cases and related approval information in the system are interrelated. For this reason, the system also provides the interrelated information linkage query function to facilitate the operation of users. Attention should be paid to the interface between the prediction model database and the database system, the key fields of the interface should be determined in the design of the database, and the data of different formats, sources and requirements should be preprocessed to meet the requirements of the prediction model. According to the relationship between audible noise value and its influencing factors, a prediction model of audible noise time series characteristics is established by using time series characteristics. Select the input variables of the network, voltage value, temperature, humidity, wind speed, air pressure, altitude, wire diameter, wire cross section, background noise, edge and edge spacing, and the value is audible noise. In order to adapt to network topology changes, the sub-models of bus master protection, backup protection, line master protection, near backup protection, and far backup protection can be established by using topology information, and then merged to form a comprehensive diagnosis model. When the system performs real-time dynamic monitoring, it can be monitored strictly according to the monitoring commands set by the monitoring center. The real-time monitoring of the audible noise line diagram is shown in Figure 1.

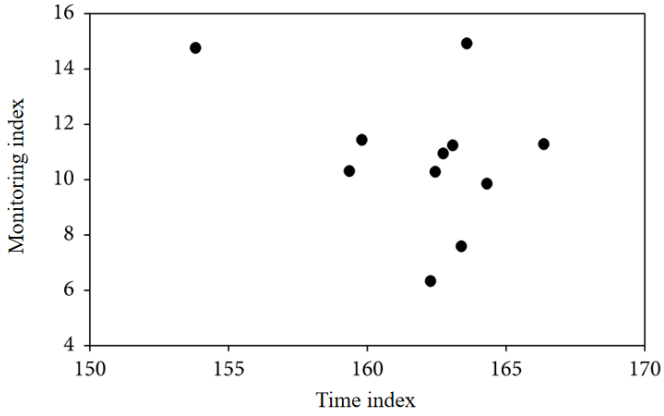

Fig. 1 Real-time monitoring of audible noise polygraph

3.2 Management Information Application

Power grid environmental protection management information system involves a large number of substation location maps and transmission line maps, and it is necessary to dynamically label the location of substations and the relevant information of line sensitive points on the drawings. Therefore, centralized data collation, maintenance and update is adopted. The system stipulates that the time, plan and steps of centralized storage and backup should be set by the system administrator. If not, the system will store and backup data at the default time. Send a notice to the monitoring terminal; set the parameters of the monitoring terminal; view the real-time monitoring broken line diagram of the monitoring terminal; check the alarm situation of the monitoring center; add, delete and query the administrator information, monitoring index information, monitoring terminal information and monitoring value information.The timing information of the electrical quantity feature is converted into the initial confidence of the event by the time series inference operation and the Gaussian function, so that the reliability of the target or event information used by the primary device can be significantly improved. Each decision variable in integer coding uses a decimal integer to map the solution space of the original problem to the integer string space for timing characteristic operation. The result is then restored to its phenotype for fitness evaluation through the decoding process.

There is a large amount of data in the environmental protection system of power grid. Different functional modules may cause incomplete data processing. Through the stored procedure, related data processing can occur together. The sensor collects the environmental information of the power grid and outputs the corresponding voltage (or current) value. The voltage (current) value of the sensor is transformed from analog signal to digital signal through A/D converter. The microprocessor then performs a series of analysis and processing operations on the received digital signal. The outer optimization model of energy storage optimization allocation is based on the reliability analysis and operation economy analysis of the system after energy storage allocation. The objective of optimization is to minimize the annual value of the system comprehensive cost after energy storage allocation. The system provides application interface functions with other software, which enables the system to realize linking functions with subsystems related to electromagnetic environment parameter calculation system, audible noise prediction and environmental sensitive point real-time monitoring system. The timing constraint adopts the concept of time window. It can only perform simple timing selection of alarm information. Whether the preliminary wind information is valid information, the information contained in the timing constraint is not fully utilized, and the confidence of the alarm information cannot be given.The real-time monitoring subsystem of the environmental sensitive point realizes large-scale network control of the grid environment and real-time monitoring and graphical control of the monitoring terminal. The user sets different environmental parameters, geographical location parameters, wire structure parameters, etc., and obtains predicted values of different parameter conditions. The data results can be given by the system, which is intuitive and easy to see, and assists managers and designers in decision-making and analysis.

4. Conclusion

In this paper, the power grid environmental protection management information system based on time series characteristics is studied. According to the hardware requirement of power grid environment monitoring system, the stable and high-speed wireless LAN communication module is selected according to the hardware platform of monitoring terminal and embedded operating system. Through the construction of environmental protection management subsystem of power grid, the informationization level of environmental protection of power grid has been improved, the integrated environmental protection management of State Grid Corporation, provincial company and municipal company has been realized, and information sharing and business interaction have been realized. Combining the concept of number-grip mining of time series characteristics and related methods with power system, the corresponding time series characteristics model is constructed, the time series characteristics distance is defined, and the time series characteristics matching query method is used to

solve the problem. The proposed method makes better use of the timing characteristics of the information sequence. It strives to cover the environmental impacts of various high-voltage power transmission and transformation facilities under different geographical and climatic conditions during construction and operation, and realizes comprehensive, intuitive, convenient and accurate data query. Simple and reliable information management function, real-time stable sensitive point electromagnetic parameter monitoring function, convenient and accurate electromagnetic environment prediction function, safe system environment and flexible expansion capability have greatly improved the working efficiency of power company environmental protection staff and researchers.

References

[1] Gu W,Wu Z,Bo R,et al. Modeling, planning and optimal energy management of combined cooling, heating and power microgrid: A review[J]. International Journal of Electrical Power & Energy Systems, 2014, 54:26-37.

[2] Yuan W,Zhao L,Zeng B. Optimal power grid protection through a defender–attacker–defender model[J]. Reliability Engineering & System Safety, 2014, 121:83-89.
Nejabatkhah F,Li Y W. Overview of Power Management Strategies of Hybrid AC/DC Microgrid[J]. IEEE Transactions on Power Electronics, 2014:1-1.

[3] Glancy B,Hartnell L M,Combs C A,et al. Power Grid Protection of the Muscle Mitochondrial Reticulum[J]. Cell Reports, 2017, 19(3):487-496.

[4] Rao R,Xingping Z,Zhiping S,et al. A Systematical Framework of Schedule Risk Management for Power Grid Engineering Projects'Sustainable Development[J]. Sustainability, 2014, 6(10):6872-6901.

[5] Krook J,Svensson N,Wallsten B. Urban infrastructure mines: on the economic and environmental motives of cable recovery from subsurface power grids[J]. Journal of Cleaner Production, 2015, 104:353-363.

[6] Haas J,Olivares M A,Palma-Behnke R. Grid-wide subdaily hydrologic alteration under massive wind power penetration in Chile[J]. Journal of Environmental Management, 2015, 154:183-189.

[7] Yue D,Slivinsky M,Sumpter J,et al. Sustainable Design and Operation of Cellulosic Bioelectricity Supply Chain Networks with Life Cycle Economic, Environmental, and Social Optimization[J]. Industrial & Engineering Chemistry Research, 2014, 53(10):4008-4029.

[8] Hu J,Cardin M A. Generating flexibility in the design of engineering systems to enable better sustainability and lifecycle performance[J]. Research in Engineering Design, 2015, 26(2):121-143.

[9] Wei L,Sarwat A,Saad W,et al. Stochastic Games for Power Grid Protection AgainstCoordinated Cyber-Physical Attacks[J]. IEEE Transactions on Smart Grid, 2016, 9(99):1-1.

[10] Koussa D S,Koussa M. A feasibility and cost benefit prospection of grid connected hybrid power system (wind–photovoltaic)–Case study: An Algerian coastal site[J]. Renewable and Sustainable Energy Reviews, 2015, 50:628-642.