

Research on Intelligent Monitoring of Industrial Fan State based on Data Mining

Limei Fang, Wenjuan Wang, Xu Min and Ting Zhang

China tobacco Zhejiang industrial co. , ltd, China, 315504

Keywords: Data mining; industrial fan; intelligent monitoring

Abstract: A set of remote monitoring and diagnosis platform for fan based on network, database and data mining technology is built. Through this platform, authorized users can obtain and exchange diagnosis and maintenance information conveniently and quickly.

1. Introduction

The operation state of large-scale fans (such as induced draft fan, forced draft fan) and other high-speed rotating key equipment directly affects the production of many enterprises. How to make these devices run at full load for as long as possible in a safe and reliable state is always a concern of enterprises, and online monitoring has become a commonly used means. With the development of equipment fault diagnosis technology and Internet, it has become a reality to monitor field equipment through network and carry out remote diagnosis. For fan remote monitoring and fault diagnosis system, many analysis methods must rely on a large number of historical data. Therefore, it is necessary to use database and data mining technology for better fault diagnosis. According to the above analysis, this paper introduces the data mining technology into the field of remote fault diagnosis, and constructs a set of remote monitoring and diagnosis platform of fan based on Internet, database and data mining technology. The platform provides a strong guarantee for the safe operation of the fan.

2. Introduction to Database and Data Mining

DW is a topic oriented, integrated, unchangeable and time-varying data set, which is used to better support decision analysis and processing. It is a better way for fault diagnosis system to process more complex decision analysis. The main implementation process is to establish a number of data marts with different themes and uniform formats through data organization, extraction, cleaning and transformation, to store the existing real historical data, so as to reduce the physical and semantic inconsistencies as much as possible, and achieve the purpose of data application in decision analysis and management. From the perspective of data mining (DM), database is the platform of data mining implementation [1].

Data mining is a high-level process of discovering trends or patterns from data, also known as database knowledge discovery (KDD). DM is a means of analysis and decision. Mainly according to the principles of artificial intelligence, machine learning and statistical learning, analyze and mine historical data based on database [2]. The application of DM technology in the field of remote diagnosis improves the efficiency and depth of data analysis, and provides a powerful means for intelligent diagnosis, especially fault prediction, so that the equipment can enjoy expert level remote diagnosis.

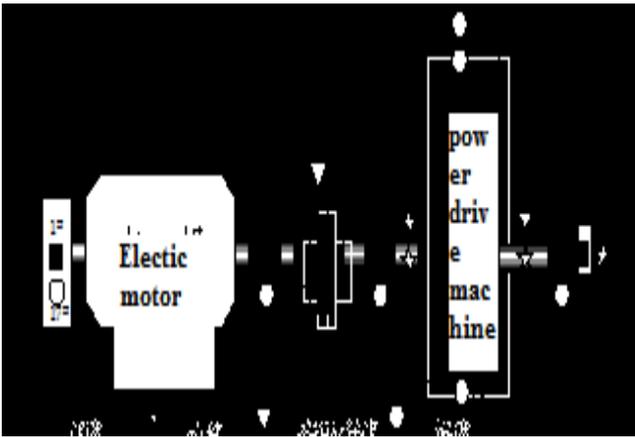


Figure 1. Data Mining 1

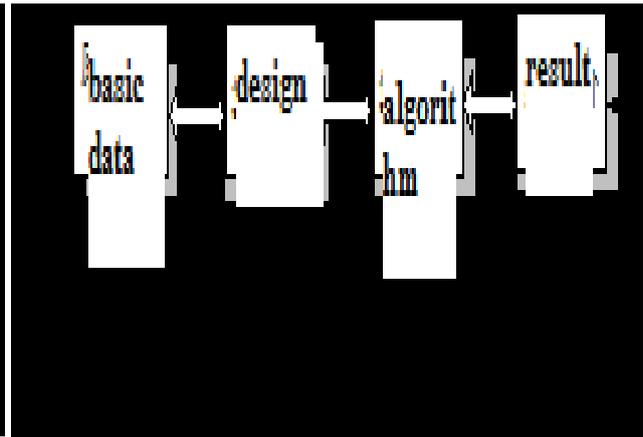


Figure 2. Data Mining 2

3. Construction of Fan Remote Monitoring and Diagnosis Platform

3.1 Monitoring object

The monitoring object of this system is 2 induced draft fan of a sintering plant, and the following monitoring items are obtained according to the specific situation of the fan:

(1) vibration speed: the vibration speed signals of the output shaft bearing pedestal of synchronous motor and the bearing pedestal at the input end of fan in horizontal and vertical directions, the vibration speed signals of the bearing pedestal at the tail of motor (with thrust bearing pad end) and the bearing pedestal at the non-power end of fan in horizontal, vertical and axial directions, a total of 10 speed signals.

(2) vibration displacement: vibration displacement signals in horizontal and vertical directions of fan shaft, shaft displacement signals at non power output end of fan, 5 displacement signals in total.

(3) temperature signal: temperature of oil film bearing at both ends of motor and fan, 4 bearing temperature signals in total; fan casing temperature, 4 signals in total.

(4) speed and phase identification: one phase identification signal.

(5) process parameters: flow; oil temperature and oil pressure; air pressure and temperature at inlet and outlet; temperature at inlet and outlet of cooling water; current and voltage, etc.

The layout of measuring points of the unit is shown in Figure 1. Vibration speed sensors 1, 2 and 3 are respectively installed in the horizontal, vertical and axial directions of the bearing pedestal at the rear of the motor; vibration speed sensors 4 and 5 are respectively installed in the horizontal and vertical directions of the bearing pedestal at the output of the motor; vibration speed sensors 6 and 7 are respectively installed in the horizontal and vertical directions of the bearing pedestal at the input of the fan; vibration speed sensors 8 and 9 are respectively installed in the non power end of the fan; 10 # vibration speed sensors are respectively installed in horizontal, vertical and axial direction of bearing pedestal. Install the shaft displacement signal (11) at the non power output end of the fan; install two vibration displacement sensors (12, 13, 14, 15) in the horizontal and vertical directions at the input and output shafts of the fan. A proximity switch is installed at the coupling of the motor and the fan to monitor the phase change of the rotor and obtain the speed (16). Install temperature sensor (17 ~ 20) on oil film bearing at both ends of motor and fan. Install 4 temperature sensors (21 ~ 24) on the fan casing.

3.2 Network operation structure of diagnosis platform

The remote monitoring and diagnosis platform is an open multi-layer distributed system, which is mainly composed of three subsystems: online monitoring subsystem, network communication subsystem and intelligent diagnosis expert subsystem.

3.2.1 Monitoring subsystem on line

The online monitoring subsystem includes data acquisition module and data management module. Data acquisition includes sensor system, signal acquisition system and self-developed real-time online monitoring software, which mainly completes real-time sampling, real-time data display and alarm of acquisition card hardware. The data management module receives and processes the signal data sent by the data acquisition system, and writes the processed data into the characteristic database and historical database. Then, with the help of Microsoft analysis services, the database is established through data extraction, cleaning and transformation.

3.2.2 Intelligent diagnosis expert subsystem

When the on-line monitoring subsystem detects that a certain characteristic quantity exceeds the standard, the system will start the intelligent diagnosis expert subsystem to extract the characteristic symptom from the relevant data of the comprehensive state database and start the fault diagnosis. Diagnosis center subsystem consists of diagnosis center module and knowledge base management module. The diagnosis center module is responsible for regularly inspecting and monitoring the rolling mill equipment, accepting and processing the diagnosis requests sent by authorized customers. Return fault diagnosis result after diagnosis. The faults that the diagnosis center can't handle temporarily can be submitted to the domain experts through the Internet for processing. If necessary, the experts can directly control the field equipment. The knowledge base management module can get fault rules through traditional experience and expert experience, and can also use data mining technology to form rule algorithm.

4 Application of Data Mining Technology

4.1 remote diagnosis mining model

The main content of the remote diagnosis system is to find potential rules from a large number of fan operation monitoring information, extract useful knowledge, intelligently judge the current operation state of the fan, and find hidden or existing faults. Data mining is a process that needs to be processed repeatedly. It can use the constantly enriched diagnosis knowledge base and appropriate algorithm to gradually mine the real fault mechanism and diagnosis rules. Implementation process: first, the original data is sorted into the information related to the mining theme; then, according to the characteristics of the mining theme and various learning algorithms, the data mining algorithm is designed, and the knowledge of the specified data set is extracted. By checking the consistency and rationality of the mining results, it is compared with the expected target. If the deviation between the result and the expected target is large, return to the algorithm design stage, adjust or redesign the mining algorithm; if the deviation is small, return to the algorithm design stage, adjust the mining algorithm; if the result is ideal, return to the data preparation stage, expand the data set, and restart the mining process. Repeat the above steps until the final goal is achieved.

5. Conclusions

In this paper, database and data mining technology are applied to the remote monitoring and fault diagnosis platform of a simpering plant fan, and preliminary research results are obtained. The traditional experience, expert experience, rough set knowledge and association rules are integrated into the expert system comprehensive decision-making technology, which can enhance the comprehensive diagnosis ability of the system, while Soap / Web service technology provides technical guarantee for remote diagnosis. Therefore, the platform has high reliability, stability and practical application value.

References

- [1] Han, J. and M. Kamber. Data Mining: Concepts and Techniques. Morgan Kaufmann, San Francisco, 2000.
- [2] Zhang Wenxiu, et al. Rough set theory and method. Science Press, 2001
- [3] Gao Yilong. Data mining and its application in engineering diagnosis. Xi'an Jiaotong University, 2000
- [4] Mehmed kantardzic. Data mining: concepts, models, methods and algorithms. Tsinghua University Press, 2003