Research on Equipment Management Decision Model based on Semantic Analysis

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Abstract. In recent years, the industrial automation of cigarette enterprises has made great progress, and the underlying data acquisition, centralized control and condition monitoring systems have been established. The management has also established a large number of application systems. There are a large number of equipment data resources in these industrial automation systems and application systems, but incremental data value mining is difficult to really solve the problem. The exploration of big data and machine learning has gradually encountered bottlenecks and ceilings, Lack of integration of domain knowledge, it is difficult to mine high-value application scenarios. From the point of view of "semantic analysis" and "equipment management", it is necessary to establish a unified method of data collection and application, which is the basis of effective data collection and management. From the perspective of "semantic analysis" and "equipment management", it is necessary to establish a unified method of data collection and application.

Keywords: Equipment Management; Semantic Analysis; Cigarette Enterprises.

1. Introduction

At present, the equipment management information system mostly adopts modular classification management, which has the contents of basic data management, process management, standard and specification management, maintenance strategy management, maintenance management, status management, fault management, on-site management and so on. The modules need to be integrated, and the dynamic correlation needs to be strengthened. In the process of equipment operation, it is also necessary to study how to achieve or approach the ideal effect. The establishment of factory "semantic analysis" is the primary breakthrough to solve such problems by using artificial intelligence technology.

2. Research Steps

Draw lessons from international and national standards and apply semantic analysis technology to establish a complete equipment data dictionary database of factory equipment and unify the basic semantic definitions.

Design and plan the knowledge base of all elements of main production equipment, and build the knowledge base of rolling and packaging or silk making pilot production equipment, covering all elements of equipment management.

Explore the research and development of key technologies of artificial intelligence semantic analysis, and pilot build semantic analysis of main production equipment on the basis of knowledge base. The core technologies include: semantic analysis and extraction technology, knowledge extraction of structured data and unstructured text; Knowledge fusion technology disambiguates and links the atlas; Knowledge reasoning technology finds new knowledge points based on reasoning rules and automatically completes the output of intelligent diagnosis and processing suggestions.

Research on speech recognition platform and explore the establishment of intelligent kbaq (expert question and answer system based on knowledge base) Fault Diagnosis Robot Based on semantic analysis.

Explore the dynamic fault diagnosis model of the pilot model based on spectrum technology, explore the association of fault semantic analysis with real-time state data, and form a data-driven visual analysis platform of fault diagnosis spectrum.

3. Application in Equipment Management

This paper will explore the application of artificial intelligence technology in equipment management, develop ideas, innovate ideas and refine methods.

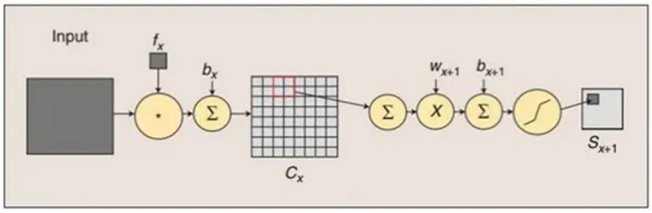


Fig 1. Semantic analysis process

3.1 Chart Database

Graph database is a data storage engine, which combines the basic graph structure of vertices and edges with persistence technology and traversal (query) language to create an optimized database for storing and quickly retrieving highly correlated data. The relationship between entities is equal to or more important than the entities in the data. Because entities and relationships are equally valued in graph database, we can more accurately and easily represent and infer real-world relationships. Semantic analysis can use graph database to describe the relationship of the objective world, store these and find the relationship among them.

It is a structured database, not a high-performance table, that stores the data in the neoj graph. Neo4j can also be regarded as a high-performance, embedded, disk based Java persistence engine with complete things characteristics. The engine has all the characteristics of a mature database. Programmers work in an object-oriented, flexible network structure rather than strict, static tables - but they can enjoy all the benefits of an enterprise class database with full transactional features. There are two basic data types in a graph: nodes and relationships. Nodes and relationships contain attributes in the form of key / value. Nodes are connected through the relationships defined by relationships to form a relational network structure. The details are shown in the figure below.

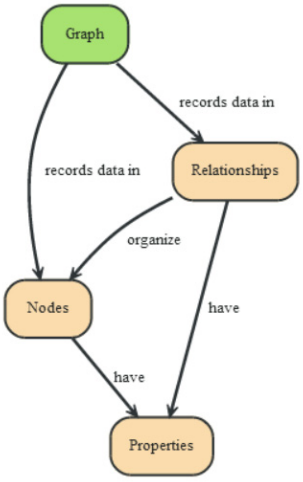


Fig 2. Relational network structure

The nebula graph database uses kV pairs to process graph data, and uses vertexid + TagID as keys to store in key and out key related data between different partitions. This operation can ensure high availability on large-scale clusters. The use of distributed partition and sharding also increases the throughput and fault tolerance of nebula graph. Graph data (points and edges) are stored in different partitions through hash. The hash function used here is very direct, that is, vertex_ ID is the remainder of the partition number. In the nebula graph, partitions represent a virtual data set. These partitions are distributed in all storage nodes, and the distribution information is stored in the meta service. Be aware of the different meanings of the homophones “affect” and “approximately” or “effectively”.

Typical semantic analysis application tasks include inconsistency verification, rule-based feature extraction, pattern-based judgment, intelligent retrieval, community mining, dynamic network analysis, etc.

Inconsistency verification: in order to judge the target information in the relationship network, a simple method is to do inconsistency verification, that is, to find out the potential contradictions through some rules. These rules are defined in advance in an artificial way, so some business knowledge is needed in the design of rules.

Rule based feature extraction: some features can be extracted from semantic analysis based on rules, and these features are generally based on depth search, such as 2D, 3D or even higher dimensions. It may be observed that two entities in the two-dimensional relationship touch the target information. After these features are extracted, they can generally be used as the input of the target information analysis model.

Pattern based judgment: this method is more suitable for finding target information clusters. Its core is to find groups or sub graphs that may have target information through some patterns, and then make further analysis on this molecular graph. We can also find strong connected graphs from semantic analysis and mark them for further target information analysis. Strongly connected graph means that each node can reach other points through a certain path, which means that there is a strong relationship between these nodes.

Intelligent retrieval: match the question template according to the syntactic structure of the question. If the appropriate question template can be matched, instantiate the matched question template according to the entity attributes and relationships of the question obtained in the preprocessing stage; Then the query language of graph database for semantic analysis is generated according to the instantiated question template. Combined with knowledge reasoning, the entities, attributes and relationships corresponding to the query results are obtained in the graph data database; Finally, the answer is generated according to the answer template.

Community Mining: for communities, it can be intuitively understood that the relationship density between nodes in the community is significantly greater than that between communities. After these communities are obtained, further target information analysis can be done. Because community mining is a probability based methodology, the advantage is that it does not need to define rules artificially, especially for a huge relational network.

Dynamic network analysis: the structure of the map changes with time, and these changes themselves can also be related to the target information. Unlike the way of focusing on the current semantic analysis structure without considering the change of the map structure itself with time, dynamic network analysis observes the structure of semantic analysis at time t and time t + n. if the map structure (or part of the structure) changes obviously, it always implies the potential target information.

3.2 Fault Cluster Analysis

In the risk assessment model of fault location, the core of fault map is the maintenance BOM of equipment. It is a functional topology oriented to maintenance and extends six dimensions: basic data, real-time operation data, production and quality consumption data, environmental data, fault data and maintenance history.

Use real-time parameter change to detect the risk degree of the part (risk degree): use the fluctuation stability of the parameters associated with the part for superposition and evaluation, and the results are used as the risk degree index of the part. Automatically evaluate the health degree of the whole equipment and parts.

Support the pre control of quality defects, conduct correlation and real-time analysis of quality defect related parameters, output risk points and change trends, and provide direction and focus for machine operation and maintenance.

The atlas is automatically updated and optimized through association rule algorithm, which supports the disambiguation and link of fault defect atlas through knowledge fusion, enhances the logic and expression ability in the knowledge base, and updates old knowledge or supplements new knowledge for semantic analysis of equipment management manually or automatically.

Assist in knowledge reasoning, deduce missing facts, and automatically complete the output of equipment fault and quality defect diagnosis and treatment suggestions.

4. Practical Application Scenario

4.1 Knowledge Retrieval Application

The fault encyclopedia includes all equipment fault databases. Using the fault encyclopedia, equipment faults can be found in various ways such as model, location and occurrence frequency. The system finds all fault related results through semantic analysis technology, ranks the most likely results in the front, and associates the possible location, fault cause, impact, treatment measures and prevention suggestions through fault phenomena, And the probability of current failure and which machines in history have such failures.

Realize BOM visual parts navigation based on two-dimensional drawings, help the workshop build a perfect model drawing management system, organize equipment knowledge points with equipment BOM as the main line, and connect the control principle, working components and maintenance data through the display of two-dimensional drawing models from the whole machine to the part level, so as to make the drawing management of various types of equipment in the workshop orderly, Provide rapid skill training and auxiliary maintenance learning platform for equipment maintenance personnel, greatly reduce the consulting time of paper drawings, guide daily maintenance operations and rapid maintenance, and quickly apply for spare parts and replacement parts, so as to improve the efficiency of on-site equipment maintenance.

The user uses the mobile app to ask the system questions related to equipment faults, and the system automatically performs intelligent word segmentation and semantic analysis. In the structured / unstructured equipment semantic analysis library, according to the intelligent algorithms such as multi-mode matching target and semantic similarity, the user finds the answers with high possibility, and presents the best answers to the user according to the preset rules, so as to realize intelligent question and answer, Help users solve problems on site and realize rapid and accurate maintenance.

Realize the formation of explicit knowledge and implicit experience (such as equipment failure, maintenance cases, two-dimensional drawings, operation instructions, technical manuals, operation manuals, equipment BOM, component instructions, maintenance standards, QC topics or scientific and technological projects related to equipment) in the production of all factors of equipment into a soft asset achievement database, and use semantic analysis technology to understand user requirements according to intelligent semantics, Realize online fast retrieval and browsing of all elements of equipment.

4.2 Big Data Analysis and Application

On the designated model zj116 / zb48, use data modeling to analyze the status of parts, and analyze the correlation between data label points and parts by analyzing the maintenance and replacement records of equipment modules, analyzing the historical data in the real-time database, and combining expert experience. In the semantic analysis, the relationship between a variety of easily worn parts

and their highly correlated data acquisition points is established to form the feature vectors of these parts. Taking the historical real-time data of the feature vectors as the input, the deep learning model algorithms such as clustering, classification and decision tree are used to train and adjust the component anomaly prediction model and output the probability distribution of component anomaly state. When a component has an abnormal state, the component abnormal prediction model is used to predict and infer its abnormal occurrence probability, and the component abnormal prediction model is automatically updated according to the real-time data. Then, through the fault diagnosis technology, it can quickly match the abnormal causes and handling measures in the semantic analysis, and push them to the equipment maintenance personnel in the form of messages.

Using artificial intelligence, semantic analysis and other technologies, the experience of a group of equipment maintenance experts is moved to the online. According to the relevant entities and relationship contents such as equipment series fault location, shutdown events, phenomena, causes and measures, the system is based on Bayesian network algorithm, constructs a refined and efficient Bayesian diagnosis network, and puts forward the fault detection and diagnosis process based on the Bayesian network. In case of equipment shutdown or difficult problems, it can effectively and quickly detect and diagnose the fault of production equipment, quickly locate the root cause of equipment fault, assist business personnel to solve equipment fault problems, and greatly reduce the equipment fault shutdown rate of production line.

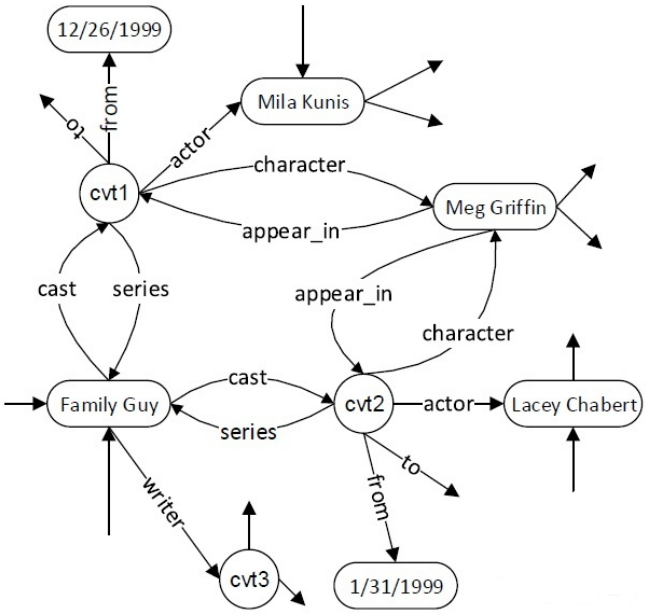


Fig 3. Schematic diagram of atlas

According to the historical data of spare parts replacement at the equipment location in the process of equipment maintenance, and based on the life threshold of the spare parts and their own relevant data, the spare parts replacement prediction cycle model is constructed by using the time series prediction and analysis technology. After the current equipment is replaced, the next replacement time of the spare parts is quickly predicted to realize the life prediction of equipment spare parts. Combined with the factors such as spare parts replacement history, inventory consumption, fault trend and so on, Conduct comprehensive evaluation and decision-making to provide data support for spare parts inventory reduction.

The system evaluates the equipment from the four dimensions of energy consumption, material consumption, process quality and operation status. The evaluation results can be given in the form of health, sub-health and deterioration. The evaluation results can provide data support for the arrangement of rotation maintenance plan. Define and follow various equipment reliability evaluation indexes of the four evaluation dimensions, build the equipment reliability evaluation model according

to the relevant historical data of the equipment, combined with machine learning algorithms such as clustering and classification, continuously train the evaluation model to improve the accuracy of the equipment reliability evaluation model, and comprehensively evaluate the equipment by using the equipment reliability evaluation model, so as to find problems in time and make maintenance decisions, Finally, we can really ensure that all equipment is in good health.

According to the basic information of spare parts, spare parts replacement information and spare parts demand information in the daily operation and maintenance process of the equipment, select the appropriate evaluation index, use the fuzzy neural network algorithm to build the comprehensive performance evaluation model of spare parts, and select the appropriate spare parts with high comprehensive performance evaluation score to make the decision of applying for and purchasing spare parts. If there is a deviation between the current spare parts inventory and the safety inventory, At the same time, the system outputs the auxiliary scheme of spare parts requisition and purchase decision.

According to the evaluation level output in the equipment reliability evaluation, the abnormal fault items or treatment measures output in the auxiliary of component abnormal prediction and diagnosis and fault maintenance, as well as the corresponding decision tree strategy rules, it is provided to the equipment personnel to quickly make auxiliary decisions for maintenance, repair, item repair or overhaul, so as to ensure the healthy operation of the equipment and reduce the maintenance cost and resource consumption.

5. Conclusion

Synchronously study and establish a practical and operational system, explore the dynamic fault diagnosis model of the pilot model based on spectrum technology, and explore the correlation of fault semantic analysis with real-time state data to form a data-driven visual analysis platform of fault diagnosis spectrum. Provide cases and reference specifications of technical architecture and data exchange standards for the industry.

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