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GIS-Based Electric Service Resource Management System

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Abstract. With the increasing investment in railway construction, China's railway transport network is now very sound, the number of operating miles is growing, and the operating speed has also made a qualitative leap. At the same time, the safety and reliability of the operation of railway signal cables and other electrical equipment has also put forward higher requirements. At the present stage, the management of railway electrical services equipment mainly relies on manual management, which is cumbersome, inefficient and unsuitable for multi-user sharing. At the same time, the structure of railway electrical equipment is complex, and the components of the equipment are prone to aging, which can easily cause equipment failure. How to professionally manage electrical service equipment and improve the safety and reliability of electrical service equipment has become an urgent problem for railway electrical service departments. Geographic Information System (GIS) architecture uses spatial data layering technology to achieve multi-level and proportional display of equipment and facilities, which can provide visual display of professional facilities such as railway engineering, electricity and power supply, and carry out multi-source and multi-temporal intelligent analysis of data, provide geographical information service interface for various professions of engineering and electricity to meet their own functional requirements. Knowledge mapping is a key technology for acquiring knowledge and building a knowledge database in the era of big data. In order to explore the hidden information between railway electrical resources, integrate seemingly independent data into the knowledge base and apply them. In this paper, we design a GIS-based electric service resource management system in combination with knowledge mapping that can make data complete and well-structured after processing scattered and redundant information, and analyze and discuss the system's architecture, functional requirements, key technologies and development prospects.

Keywords: GIS, electrical service resource management system, data layering, knowledge graph, cloud-side collaboration

1 Introduction

Railway electrical system is the brain and nerve center of railway transportation, with the two main branches of communication system and signal system, which is a necessary system to improve normal transportation, the efficiency and the safety of traffic. In order to complete its transformation and upgrading in the new era, combining GIS technology, artificial intelligence, big data and other new technologies has become a major trend. How to build an intelligent electrical resource management system to solve existing problems and meet the growing demand is an important basis for building a railway corridor and constructing a modern railway network with extensive coverage of the driving area and various levels of service.

Although China's railway electrical system equipment and technology has advantages, with the various needs and requirements continue to improve, there are also varying degrees of problems that need to be solved. For example, the low degree of digitalization and intelligence, the limited level of intelligent perception and the incomplete coverage restrict the intelligent application and intelligent auxiliary decision-making; the traditional way of integrating equipment and systems, the computer interlocking equipment only stays at the logical level and still maintains the use of a large number of relays in the execution and representation part. The relative independence of the train control system and interlocking system has increased the equipment and interfaces, aggravated the system construction cost and maintenance cost, and also reduced the reliability of the system; the standard is not unified, there are many kinds of software and hardware, operating system database, and the problem of repeated investment is prominent; some of the system architecture is old, which leads to the application of new technology and flexible expansion difficulties; due to the restricted bandwidth, broadband mobile access is difficult;

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the electric service professional communication, signal Two systems vertical management operation and maintenance, there are a large number of information islands, poor openness between the systems, resulting in poor interoperability between the systems; high integration system so that the railway construction peak period to face the construction of a large range of impact, equipment failure to affect the scope of the problem. To solve these problems, we first need an excellent performance electrical resource management system to achieve the detection and management of various equipment and resources.

GIS is a discipline developed with the development of geographic science, computer technology, remote sensing technology and information science, which organizes computer hardware, software, geographic data and system managers to efficiently acquire, store, update, manipulate, analyze and display any form of geographic information in an integrated manner. In real life, up to 80% of information is related to geographic location, and much of the information contains geographical features, such as electrical information, logistics information, railway information, capital flow information, etc. Using GIS, we can more efficiently manage various systems that are closely related to geographical location.

The electrical service resource management system has to manage a large number of equipment, lines and instruments, and these objects are installed in specific geographical locations. The previous scalar data storage cannot visually display their spatial distribution, which hinders the development and application of spatial data. With the spatial data management solution provided by GIS, the map attribute data of various signal equipment and communication circuits can be superimposed on the corresponding geographic layers, providing easy and intuitive analysis and visualization of spatial data and attribute information. For example, the status of various management objects can be marked in the electronic map and updated in real time according to system reports, showing lines and equipment in normal or faulty condition in different colors. By counting the frequency of faults, it is possible to identify fault-prone locations, analyze their external environment and related factors, and formulate reasonable repair plans, effectively improving work quality and reducing maintenance costs.

This paper designs a GIS-based electrical service resource management system based on the functional requirements of the current railway electrical service system, based on a service-based GIS architecture, combined with a knowledge map that can make data complete and structured after processing scattered and redundant information. The system uses spatial data hierarchy technology to achieve multi-level and proportional display of equipment and facilities, and is able to provide visual display of professional equipment and facilities for railway engineering, electrical services and power supply. At the same time, the system also carries out multi-source and multi-temporal intelligent analysis of the data, and provides geographical information service interfaces to each profession of engineering and electricity supply to meet their own functional requirements. All geographic information data and equipment can be unified and managed through this system.

The paper is structured as follows: the first part introduces the defects of the traditional electrical management system, the concept of GIS, and the important role of GIS in the electrical resource management system, the second part introduces the development history of GIS technology, and the related work of other domestic and foreign researchers that inspired this paper, the third part proposes a new architecture of GIS-based electrical resource management system, the fourth Part IV introduces several key technologies, and Part V summarizes the current work and analyses the possible future development prospects of GIS in electrical systems.

2 Research Status

GIS (Geographic Information System) is a special and important part of the spatial information system [1]. GIS is a comprehensive subject, which is based on the discipline of computer science, with the help of database, encompassing all the properties of information systems. The GIS is dependent on the computers, and the GIS enables the recording and processing of spatial data, which differs from other information systems in the research process of spatial data storage and management, making it valuable for planning strategies, forecasting results, interpreting and analyzing events in various fields and units. GIS technology was introduced by the Canadian surveyor Roger Tomlinson when the applications of computer started to become widespread, and GIS was then used for plan and management of natural resources. In the mid-1970s, GIS was given much attention after competing over other application management systems, and its enormous potential was slowly explored. Former US Vice President Al Gore at the time believed that GIS would take a leading role in data management and visualisation technologies in the IT industry, and since that time GIS has been used in various sectors of economic construction and life services, and international and intercontinental GIS on a wide range of topics have been established in some developed countries [2]. In the 21st century, developed countries such as the United States, the United

Kingdom and Germany have invested a lot of financial resources to establish professional GIS in various aspects such as land resources development, urban planning and construction, government management, transportation, natural resources and environmental protection management, so that the system can play a more important role in human-computer interaction, data processing, spatial analysis, map editing and input-output. GIS has become a necessary part of the development of the information society. GIS based on Internet technology has developed into an effective and new spatial information carrier, and GIS technology is used in almost all economic and productive activities, such as intelligent mapping, population and hundreds of other industries in nine categories.

The traditional network management system for electric services uses spreadsheets and database as the basis for unified control of all aspects of the network, which is difficult for us to know the spatial topology, with some disadvantages in the process of unified control [3]. Given the specificity of network management in terms of spatial performance, it is necessary to establish a GIS-based electrical services resource management system to facilitate the management of the network. The operation of GIS is to process and record the information and data of the network under a spatial topology with the help of database tools, and then use graphic tools to visualize these data in the form of graphics. The network market in China is currently in a period of rapid development, and the electric resources industry has found this to be the case and has concluded that putting the interests of users first and promoting efficient management of the network is important to succeed in the market. The GIS-based management system is not only able to process some special data to record and express the network spatial topology, but also to conduct comprehensive analysis of other relevant data.

2.1 Current Status of GIS Research

The application of GIS is mostly reflected in the extension of epistemology and the exploration of methodology. In terms of epistemology, feminist GIS and critical GIS attempt to combine the methods of GIS with the research perspective of cultural geography in depth. In terms of methodological exploration is reflected in the further development of new GIS which is more adapted to the new needs of the discipline. Further exploration of GIS research provides more ideas for the research of communication technology, including drones, 3D city New data collection systems such as drones and 3D city models are used in conjunction with GIS, as well as further exploration of the concept of digital visualization [4].

With the rapid development of computer and geospatial data acquisition technology, how to overcome the impact of large amount of data on GIS has become the mainstream direction of research in the field of GIS, and the progress and results of its research have been paid more and more attention. In 2015, Chenghu Zhou [5] made an outlook on full spatial GIS from geospatial to cosmic space, from outdoor space to indoor space, from macro space to micro space and from small data to big data respectively. In 2017, a paper by Guonian Lü [6] and other researchers pointed out that the definition of geographic information has been gradually expanded under the basic framework of “space + attribute” map information, and the development has gone through four different stages: map GIS, semantic GIS, spatio-temporal GIS and big data GIS. However, it still cannot meet the analysis and application needs of spatio-temporal big data. He proposes a definition covering “spatial positioning”, “semantic description”, “attribute characteristics”, “geometric form”, “geometrical form”, “geometrical data”, and “geometric data”. The model of six elements of geographic information, including “spatial location”, “semantic description”, “attribute characteristics”, “geometric form”, “evolutionary process” and “element interrelationship”, is proposed.

At the same time, GIS is not only developing itself, but its application in various industries is also very extensive. In 2018, Yansheng Wang [7] and other researchers have combined GIS with agricultural parks and designed a panoramic GIS digital system for agricultural parks, which has improved the quality of management of agricultural production and operation in the parks. In Germany, the UK, the US, Japan and other developed countries, network management systems based on GIS technology have been widely used in many fields. For instance, GIS has found a whole new way for radio and television practitioners to better transmit their programs and get more viewers to agree with them. It is a comprehensive analysis of maps and other data, and by relying on data provided by spatial location to conduct research, it provides effective research information for planning and managing the subscriber information being served by radio and television networks, even for discovering new subscribers, substantially improving the Radio and television network operators’ management efficiency, of which the more typical are ESRI’s ArcGIS Engine, Maplnfo’s MapX, and Intergraph’s GeoMedia and other GIS technology for radio and television management systems [3].

The combination between GIS and big data can significantly increase the amount of data handled by GIS, providing a new feasibility for the application of GIS in various business management systems. In addition to having the function of monitoring the progress of the operation of computers and other machines, it is also possible to complete the adjustment of the working status on the electronic map at the first time, which helps the backstage operators to find the problems as early as possible and deal with them in time, and the backstage operators can greatly improve the working efficiency through the monitoring and analysis of the GIS system. But the existing GIS method in dealing with geospatial and spatial big data there are still efficiency, reliability and other defects, need to consider the computer or other fields of technology integration into the field of GIS to solve these problems.

2.2 Application of GIS in Railway Electrical Management System

The application of GIS in railway electric resource management systems is mainly distributed in Europe, North America and developed countries such as Japan in Asia, for railway infrastructure management, engineering, electric service, signal, operation and scheduling, survey and design, railway passenger and freight e-commerce, simulator trainers, passenger coaches and station passenger real-time information services. Among them, the railway infrastructure management system is most widely used [8].

The German railway line data management system, which unifies the management of infrastructure data across Germany, meets the requirements for modern analysis and graphic display of line data. The “Innovative Railway and Database” system developed by the German Federal Railways with the support of INTERGRAGH and CADIS Systems is of this type. The main objective of the system is to provide large companies with up-to-date information to ensure that they can react quickly to market changes, using the DB-GIS system to store Deutsche Bahn’s data relating to regions and lines in one system for a wide range of applications. These data include the line network, the strand network, ground fixtures, real estate, and topography, which contains graphical information on the general layout of railway stations, specialist maps and summary maps represented on cards and planograms.

The decision support system developed by the European Rail Institute allows for the management of works facility data, while the application of expert system technology and the creation of a rule base for facility maintenance and renewal can provide optimal management and decision support for works facility management, maintenance and renewal, as well as equipment diagnosis, optimization of resource allocation, technical and economic analysis of infrastructure to promote the use of public works equipment.

Research in this area started late in China. After several years of development, some examples of electrical management systems for railways have been successfully developed. The application of railway electrical management systems has culminated in recent years, and to varying degrees the concept of GIS has been introduced to integrate existing railways. In recent years, the Ministry of Railways has set up a project to develop a geographical information system for railway works management. It is mainly for the railway engineering department of bridges, tunnels and other graphic information vectorization, layer, the establishment of bridge piers, beams, railway car lines and other general graphics library, can quickly according to user needs to generate beautiful equipment graphics. However, the system simply uses the map mapping principle of GIS, the lack of attribute information description of the equipment and other RGIS systems combined with the use of more difficult.

The construction of the digital railway basic spatial data framework project proposed by Mr. Qi Hua of the School of Civil Engineering of Southwest Jiaotong University integrates high technology such as high-resolution satellite earth observation system, GPS global positioning system, broadband data transmission network, massive database management technology, high-performance GIS platform and virtual reality technology, etc., from the digital railway basic spatial data framework, railway spatial data interaction network system The construction of basic spatial data for the construction of digital railway is studied in terms of the framework of digital railway, railway spatial data interaction network system, data standards and spatial data coordination and management mechanism, and propose the feasibility of adding information related to spatial location or information management system on basis of this.

The joint research of Beijing Jiaotong University and Harbin Railway Bureau on “Design and Implementation of GIS-based Railway Station Signal Equipment Management System” analyses the current situation of railway station signal equipment management and explains the necessity and feasibility of introducing GIS in the railway industry [8]. Based on the study of the characteristics of signal equipment, the GIS-based signal equipment management system is proposed using an object-oriented analysis method, and the basic structure, detailed design model and implementation approach of the system are given.

3 Architecture of GIS-based Telecom Resource Management System

The architecture of the GIS-based power resource management system consists of five functional modules, as shown in Fig. 1. The functions of each module are introduced in turn below.

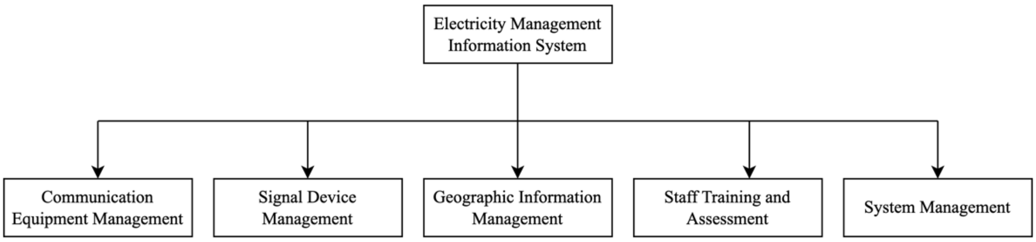

Fig. 1. Telecom resource management system framework

(1) Communication Equipment Management:

The good condition of railway communication equipment directly affects the safety and efficiency of railway transportation. Communication equipment needs to be fully integrated with the safety and efficiency of railway transportation in terms of driving safety, transportation efficiency and railway access communication equipment to achieve good monitoring and management of railway communication equipment and establish a good railway communication department. Organizational building systems. The communication equipment management module is responsible for managing all communication equipment, such as transmission equipment, switching equipment, network equipment and so on. Through the communication equipment management module, the operation status of each equipment can be detected and managed in real time to ensure the smooth flow of train communication signals.

(2) Signal Device Management:

During the operation of railway trains, railway signals are an important basis for ensuring the safe operation of trains. At present, there are defects in the design of many railways signal equipment, so that once an unexpected situation occurs, the signal machine in the red-light section will be wrong. For example, after being struck by lightning, the signal in the red-light section is wrong, and the display is green. At the same time, during the maintenance and overhaul of railway signaling equipment, due to more or less problems in the maintenance and overhaul management system, the equipment may malfunction and fail to ensure the safe operation of the railway. The maintenance and repair management are not refined and modern enough, which also makes the maintenance and repair efficiency lower. Signal equipment management is mainly responsible for managing important equipment such as signal lamps and microcomputer interlocks on the railway, so that these equipments can operate normally. When the signaling equipment fails, the signaling equipment management module can immediately give an early warning to ensure the safety of the train.

(3) Geographical Information Management:

The geographic information management module provides users with geographic information data, GIS functional services, information release and other modes to meet the needs of different businesses for geographic information services. At the same time, according to business development and changes, the geographical information data and GIS functional services are continuously enriched.

According to the main functional requirements, the detailed design of the modules of the entire GIS is carried out, and the research and development of the geographic information management module is designed into two modules, one is the geographic information service module, and the other is the operation and maintenance module. The detailed module division is shown in Fig. 2 Show.

Among them, geographic information service is divided into three sub-modules: online map, service resource and development interface, and geographic information operation and maintenance is divided into four sub-modules: resource management, system monitoring, log management and statistical analysis. The following is a brief introduction to each sub-module in turn.

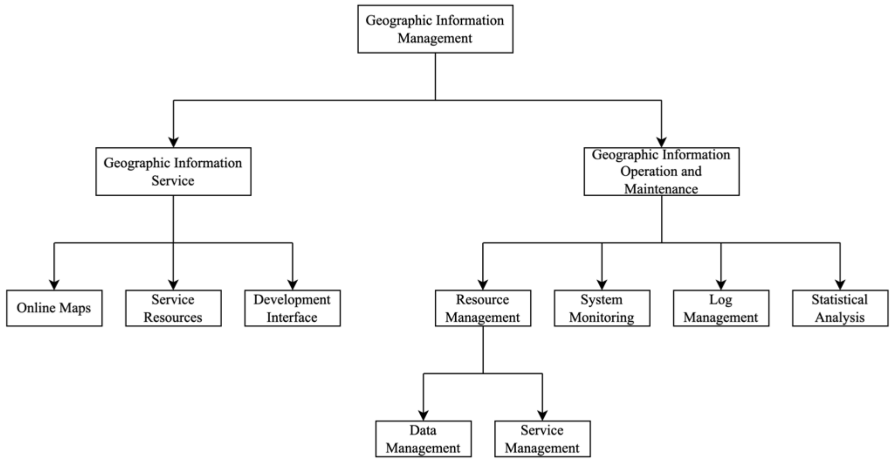

Fig. 2. Geographic information management module

Online Maps: The online map interface is mainly composed of six parts: title bar, search bar, function bar, tool bar, quick navigation bar and map display area. The search bar can search for map content by entering keywords; the main functions of the function bar include map search, routes, services, etc.; the toolbar provides various map operation tools; the quick navigation bar provides navigation links to quickly enter other column pages; the map display area displays Basic map (configurable vector map, image map, topographic map) and functional analysis and result display, including map switching, eagle eye and scale. Enter a keyword in the search bar to find the content of the map, select the search result and its specific location will be marked with a red icon on the map.

Service Resources: The service resource catalog provides the display, retrieval, map browsing and application functions of geographic information services. In the service resources, users can check the detailed information of each resource at any time, such as name, description, creation time, access times, REST call address, SOAP call address and other information. If users have permission, they can also comment on service resources. When a resource is selected, the user can not only preview the map service, but also view information such as the spatial reference, initial range, and full range of the map service, so that the user can use the service resource more conveniently. If the user likes a certain service resource, he can apply for the resource, and after the operation and maintenance administrator reviews it, he can obtain the permission to use the resource.

Development Interface: The development interface is divided into four parts: online application map API, service interface, development example and terms of use. The development interface provides users with an online application map API. In the development example, users can view the usage of various interfaces. Under the premise of complying with the terms of use, users can choose the service interface they need to use.

Resource Management: The resource management module is mainly responsible for managing data and services. The data of this system include various spatial data such as various professional equipment and facilities, buildings, and jurisdictions such as railway works, power supply, and electric services. The sources of these data are complex, with various formats and contents. They mainly come from fixed asset information, equipment ledgers, equipment and facilities technical resumes, and technical files of various majors. After the data is acquired, relevant corrections, errata, processing, production, and generation of two-dimensional spatial data are performed on the acquired data.

System Monitoring: The system monitoring module is mainly responsible for comprehensive perception and analysis of the operation status of various professional equipment and facilities such as railway works, power supply, and electric services in various regions, and is combined with related equipment or systems on the measurement and control network platform to realize safety fire monitoring, environmental monitoring, and power monitoring. Monitoring and operation assistance, maintenance assistance, operation status monitoring, early warning and other system linkage control. This module can ensure the stability of the management and operation of important facilities such as substations, improve the operation efficiency of the distribution network, and lay the foundation for the safe operation of the distribution network.

Log Management: The log management module is responsible for saving the records generated by the operation and changes of the system, equipment, and software. Since the power system includes a variety of different security devices and different data transmission networks, according to the source of traffic log information, power system logs can be roughly divided into: network device logs, safety detection device logs, host (server) logs, application system (database) and business system logs, etc. By analyzing and managing logs, the ability of enterprises to deal with security risks can be improved.

Statistical Analysis: The statistical analysis module will perform statistics and analysis on data resources, service resources, system logs and other information in real time, and monitor the status information of all devices and interfaces under the system. This module can be combined with big data and data mining technology. Through data mining, the system can analyze the potential economic benefits and security risks in certain areas, which is convenient for managers to make timely responses and adjustments.

(4) Staff training and assessment:

The function of the employee training and assessment module is to train the skills of the employees, and then conduct an assessment after the training is over, so as to ensure that the employees can correct the necessary knowledge for their work. Among them, the training function is constructed based on the knowledge graph to ensure that employees can fully learn the necessary knowledge in a relatively short period of time. The assessment system will count the duration and content of the employees' learning, and conduct online examinations for the employees. Only after the employees pass the assessment can the employees be formally employed.

(5) System management:

The system management module is mainly composed of account management and authority distribution. If users want to use this system, they first need to register an account through the system management and set a password, and they need to log in with the account every time they use the system. Initial users have relatively limited permissions. If you need to obtain more permissions, you need to apply to the administrator, and the permissions can only be raised after the administrator assigns permissions. The administrator can view the permissions of all users and some non-sensitive information, and can change the permissions of all users as needed.

4 Key Technology Research

4.1 Telecom Information Collection Architecture Based on Cloud-Edge Architecture

In order to realize the electricity information collection system based on the cloud edge -end -end integration, build a cloud -edge -end -side -in -end integration electricity information collection system at the main station of the electricity information. As shown in Fig. 3, the architecture includes the electrical information station of the cloud, the edge computing part on the edge of the edge equipment and the data collection on the device side [9].

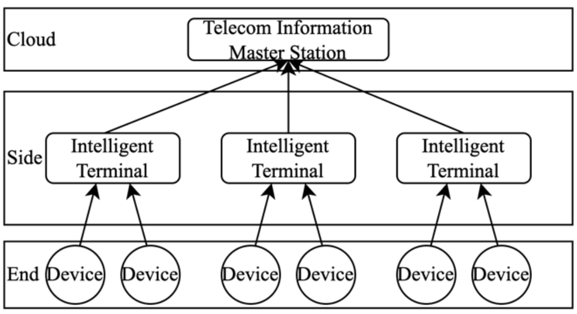

Fig. 3. Information collection system based on cloud-edge-end integrated architecture

The new type of cloud -side -end collaboration architecture is different from the traditional "cloud" architecture. The calculation and processing of edge devices can be added to the edge of the edge to process and calculate, reducing the communication and calculation load of the traditional architecture and the delay of response delay. Essence The cloud is responsible for controlling the smart terminal at the edge end, and realizes the data storage and pre -processing analysis of data; And transmitted to the edge side for calculation processing; the three -terminal service can use AI training to achieve efficient data transmission and calculation processing. The specific functions of the cloud -edge -end collaboration architecture used in the electricity information collection system in this article are as follows [9]:

(1) Cloud. The cloud is mainly running on the main station of electricity information collection. The edge service management terminal equipment is used to realize efficient information transmission between clouds, so that the data is transmitted to the edge side for calculation and processing. Cloud services are mainly realized data storage functions, and use emerging technologies such as big data algorithms and AI training to achieve data analysis, and real -time calculations are achieved on the edges.

(2) Side. The edge side is mainly running on the terminal device, and the data is connected to the main station of the electricity information collection through the cloud side. After the cloud computing center completes the big data analysis, the results and data storage to the cloud computing center or the business rules and models that optimize the output and output through the core network to the edge computing center through the core network, from the edge computing center down the edge network down the edge network down the edge network. Transfer the calculation results to the terminal device to achieve data pre -processing and real -time calculation services.

(3) End. The device is mainly mobile or local device. The user protocol is connected to the edge end, transmit the collected data to the edge, and link the event processing capacity on the edge side to achieve low -delay real -time response requirements.

4.2 Construction of Electronic Affairs Knowledge Graph

Figure Database Introduction (Fig. 4). The knowledge graph can be stored using a new NoSQL database—graph database. The diagram database is based on graph theory as the theoretical basis. The main elements in the map theory are nodes and edges, and the corresponding in the diagram database is entity and relationship. The diagram database has many advantages compared to relational data.

(1) The traversal efficiency of the database is high. The basic structure of relational data is the table, and the relevant data is stored in the table, and the tables and tables are linked through the external key. It uses global indexes, which makes it a lot of calculation costs during query. The basic representation of the diagram database is a attribute diagram with nodes and relationships. It has the attributes of the exit -free neighbors. That is to say, you do not need to consider all nodes and relationships. You only need to know the nodes or relationships you want to query. So its traversal efficiency is high.

(2) The relationship between the database of the database is strong. Relational databases are mainly stored and read through database tables and fields. The expression of the relationship is more complicated and difficult to analyze. The diagram database is mainly based on graph theory and concept maps, which can express multi -level relationships between various entities, and also facilitate the analysis of correlation between data.

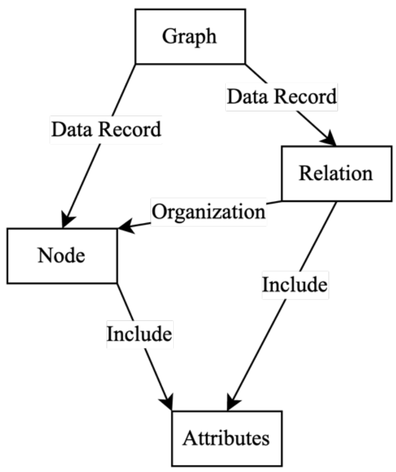

Fig. 4. Graph database storage model

Now, there are many diagram database systems, the mainstream is Neo4j, Arango DB and Orient DB. Due to the characteristics of Neo4j itself, its query efficiency is high, so it is the highest map database. Neo4j is mainly composed of nodes, relationships, attributes, and labels. Nodes and relationships are essential elements. The attributes are used to describe nodes and relationships. The node can be divided into a group by the same label. The relationship has a relationship type, which is mainly expressed by the direction of the arrow. The data in Neo4j can be created, deleted, and queried using the Cypher statement [10].

Construction of Knowledge Graph (Fig. 5). To build GIS -based electricity resources knowledge graph, we first need to analyze GIS -based electricity resources data to divide related concepts and terms. Targeted the second screening of these concepts and terms, and adopt the principles of main primary and secondary elevation to eliminate some concepts of poor correlation and redundant. After analysis, sorting and determining the entities, attributes, and relationships in the knowledge graph. The high degree of correlation, accurate and complete GIS -based electricity -based knowledge graph conceptual collection is completed.

Extracting knowledge entities from corpus is the basis for the construction of the knowledge graph, and the initial data is marked with the BIOES labeling method. Construction of GIS -based electricity resources knowledge graph is mainly manually identified some content results analyzed the content of all structures based on GIS. By analyzing the composition of the data structure of the accident, finding the entity owned by each piece of data, and the extraction will be extracted. All the structure content of the structure is sorted into a ternary group structure <entity, relationship, entity> category result of the classification of the accident data and the type of accident data according to the classifier. The purpose of semi -automated construction of knowledge graph. This process can seizure the messy and irregular railway electrical accidents semi -automated into structured data. It will effectively use railway electricity accident data and save a lot of time and human resources.

Because the traversal efficiency of the graph database is high and the ability to express the relationship, it is applied to build a successful knowledge graph. In order to achieve the intuitive and vivid and visual effect of electrical data, the content of all structures is analyzed. CSV file storage. Because the ternary group is the general expression of the knowledge graph, after pre -processing, it is transformed into the form of the Triple Group into the database of the graph. The subject and object of the ternary group correspond to the predicate. The knowledge graph is essentially a semantic network. Its nodes represent the entity and the semantic relationship between the entity. Therefore, the subject and objects in the ternary group are entities, and the predicate is the relationship between entities. I can import all files into the database of the graph to view the knowledge graph of railway electrical affairs. At this time, each data is independent. At the same time, the relationship with other entities is used as the arrow key to describe the relevant information description with other entities with other entities stand up. At this time, the data is no longer a scattered distribution, but is closely linked together [11].

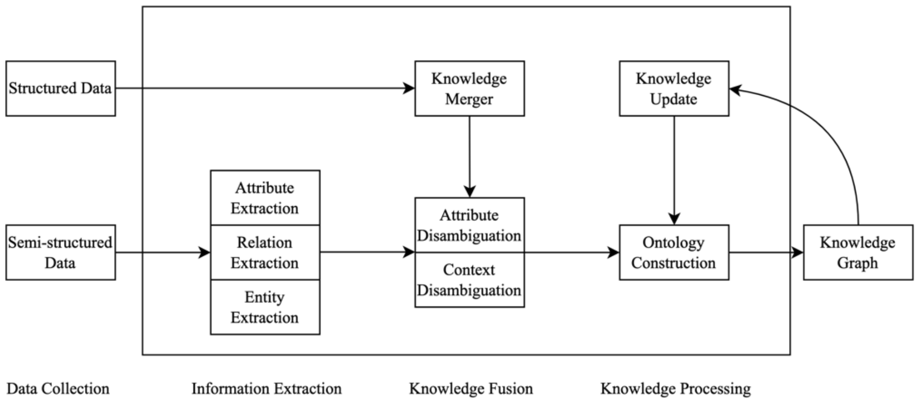

Fig. 5. Complete knowledge graph construction process

4.3 Electricity Training System

The electrical training system designed by the text mainly conducts training management of different authority users, combined with actual electrical scheduling, and uses the constructed knowledge graph to connect different modules of the training system to uniformly manage electrical resources through the background database. The training system mainly includes modules such as training resource management, training process information management, training plan management, online learning, system management, online exercises, online investigation, message management, learning forums and other modules. The overall architecture of the system is mainly the browser/server system (B/S) structure, which stores various management information in a professional background database. The model mechanism is shown in Fig. 6 [12].

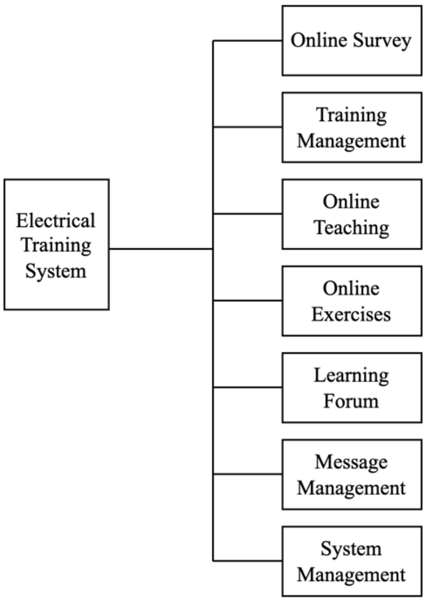

Fig. 6. Training system model structure

Created with the B/S structure, all users can access the system through the browser, and connect the database services with network application services through websites such as ASP and other technologies. Users with different authority are browsed through a unified access address. The system administrator will open different authority functions for users of different levels, and users can perform system operations according to their own authority.

Among them, the online survey module realizes different types of functional surveys to manage the investigation needs; training management is to design the compilation, review and record of the training plan, and send the information of the training record to the back end of the manager for statistical analysis, for subsequent follow -up System optimization; online teaching modules to realize resource training management and provide the role of online learning platform, preserve key resources to facilitate subsequent viewing; online practice modules provide basic electrical management exercises to help consolidate the training system presentation effect; message The management module is to realize the communication between different users, including the functions of sending, reading, deleting, and reposting; system management is to design the management of basic information of the system and distribute it through the role of the user; The platform for different users to share experience and achieve more effective management of electricity resources [12].

Different modules of the entire electricity system have a huge amount of data. Because the physical relationship between each module is unknown, the value relationship is implicit, and the effective information can be extracted. Express, dig out potential value connections, realize the intuitive and vivid visual effects of electricity data, closely linked the system, optimize the electrical training system, make it more efficiently with the background database, improve system understanding, optimize users Use details.

5 Summary and Outlook

With the continuous development of the railway industry, the requirements of the electrical services sector for the management of electrical resources are becoming stricter. The traditional management method is labor-intensive, cumbersome and inefficient. This paper designs a GIS-based electric service resource management system to manage electrical services through geographic location information, which can effectively solve the existing problems of the traditional management methods. At present, GIS technology is developing rapidly and has a broad application prospect. It is expected that in the near future, the GIS-based electric service resource management system will become more real-time, networked, constructed and intelligent.

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