Simulation application of three-dimensional GIS based on full-scenario intelligence in power grid company transmission line planning

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Abstract. Traditional data collection and review methods in power grid planning have always had the problems of time-consuming, poor real-time performance, and cumbersome processes. The application of mobile GIS solves the problems of data collection and review methods and makes more efficient use of mobile GIS terminal collection. The data of the mobile GIS solve the urgent problems that need to be solved since the popularization and application of mobile GIS. This system implements functions such as storage, transmission, and review based on mobile GIS data, which will greatly improve the efficiency of data collection by mobile terminals and reduce the cost of data collection. Realize the planning simulation of the power grid under the intelligent cycle of the whole scene.

Keywords: GIS; data management; power grid planning; full-scenario intelligence cycle.

1. Introduction
The promotion and application of the grid GIS (geographic information system, geographic information system) platform provide a good opportunity for the development of mobile GIS. Power grid planning and preliminary staff need the support of grid GIS when conducting project site surveys. However, the existing grid GIS platform adopts B/S mode and can only be run and viewed on a computer connected to the company’s intranet, which cannot meet the requirements of planners’ site surveys. Therefore, the extension of various business application systems to the field will be an inevitable development direction of the power grid information system in the future, and more efficient management and utilization of the data collected by mobile GIS terminals will be an urgent problem to be solved.

With the development of computer technology, the power grid planning method adopted has also changed to varying degrees. Scientific decision-making or planning methods are gradually recognized by people, and they have begun to have a great interest in geographic information systems and mobile GIS technology, and are widely used [1]. Power grid planners combine mobile terminals and power grid GIS platforms so that GIS technology has made great progress in power grid planning. Using GIS technology as the basis of power grid planning has achieved good results in scientific and technological
research. Such as power line maintenance, field surveys, etc., grid planners must go to work outdoors to better complete power line maintenance and surveys, so there is an urgent need for a mobile GIS terminal.

In this context, mobile GIS has emerged in recent years and has been rapidly developed. However, unlike foreign countries that mainly face users and emphasize terminals, China has raised the application of GIS in electric power to a new level, emphasizing large interconnection from all aspects of the power grid. At present, domestic enterprises mainly apply GIS in power grid planning, design, production, emergency response, and disaster relief, especially in the application of production and emergency response [2]. Compared with foreign countries, the application of mobile terminals in power grid planning is relatively lagging. Therefore, the development of mobile GIS application research should be accelerated to provide theoretical and technical foundations for power grid planning and other functions, which will greatly improve the development of intelligent power grids.

2. Problems

2.1. Time-consuming data collection
The traditional method of data collection for power grid planning is to draw drawings after a site survey. Since the grid GIS platform can only be operated on the client-side, it cannot be carried to the site with planners to assist in the preparation of the planning feasibility study plan. This causes the grid planners to prepare the feasibility study plan. The solution is time-consuming and error-prone.

2.2. Poor real-time data collection
With the rapid development of modern cities, the rapid changes in geographic graphics data, and the poor real-time performance of data in traditional planning systems make it difficult to accurately draw and calculate survey data at one time, requiring repeated confirmation by planners, which greatly increases the workload of personnel.

2.3. The planning plan review process is cumbersome
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3. Overall architecture of 3D GIS
The overall technical architecture of the mobile GIS data management platform is divided into data storage layer, middleware/slice reader, GIS basic function SDK (software development kit), NBMap API (application programming interface). The data storage layer is the physical storage of various types of data; the middleware provides the basic SDK for reading and writing support for offline power grid vector data and road network data.

The slice reader provides the basic SDK for reading slices; the GIS basic function SDK layer is in the middle Provides basic GIS functions based on software and slice readers, realizes various functions of graphics management, and encapsulates various functions as services for various applications to call; NBMap API layer performs secondary encapsulation of GIS basic function SDK. Compare each lower-layer version and provide a unified and simple interface for upper-layer applications. The system architecture is shown in Figure 1.
4. GIS system function

4.1. Data Management

4.1.1. Data storage. The mobile GIS data management system can synchronously update the geographic information of the newly created data on the GIS platform. It can establish corresponding layers for different equipment types and different time points. The managers can superimpose various equipment graphics by setting the visibility of each layer. Visually analyze the planning plan formulated in the early stage and the later implementation situation, and it is clear at a glance whether the project implementation is consistent with the planning plan. It provides an accurate and reliable basis for the later evaluation of the project.

4.1.2. Data Transmission. Data transmission is divided into two functions: data upload and download. After the data is collected, the field staff transmits the data to the data server through a secure encrypted channel, and the server can also transmit the processed useful data back to the mobile GIS terminal to meet the basic data requirements necessary to collect data outside [4]. Among them, the mobile GIS data management platform provides the location information and grid structure of the current grid. The main function is to obtain the basic map data integration and the current grid location through the interface with related systems and strictly follow the applicable specifications of the State Grid Corporation’s mobile GIS data management platform. Data integration, current grid data (topology data) integration.

4.1.3. Data review. The system prompts the newly uploaded collection task on the mobile terminal and enters the program review module through the review button. You can view the device attribute list collected through the mobile terminal, and locate and display it in the GIS map. The reviewers combined the GIS map and the mobile collection information to conduct a plan review. After the review of the plan is completed, the reviewer can determine whether it has passed the review and fill in the revision comments.

Figure 1. Overall architecture
After the project is approved, the audit data will be stored in the planning project database, feasibility study reserve database, and other databases by the system according to the format, and will be later retrieved and incorporated into the investment plan. The review process is shown in Figure 2.

![Diagram of the review process]

**Figure 2. Review process**

4.2. **Planning query positioning**
Complete the query positioning function, the main functions include equipment query positioning, line equipment query statistics, equipment query between two points, and other related query functions.

4.2.1. **Device query positioning.** Provides spatial query, attribute query, space, and attribute combined query methods to query the equipment and facilities of the main network, and the results of the query can be geographically located in the graph.

4.2.2. **Line equipment query statistics.** The mobile GIS data management platform provides the function of querying and counting equipment by line. Select a line on the graph, query various types of equipment on the specified line, and classify and count according to the type of equipment. By calling the service of the production system, you can view the detailed information of each queried device.

4.2.3. **Device query between two points.** Select two points to determine whether the two points are topologically connected, and if they are connected, return to the device information list on the connection path. The detailed information of each device can be viewed by calling the service of the production system.

4.3. **Data Security Control**
According to the requirements of the mobile GIS data management platform for security protection, the mobile GIS data management platform is fully protected. Protection measures cover all parts of the mobile GIS data management platform, including border protection, network protection, host protection, application protection, etc. At the business application environment level.

It is designed in terms of identity management, identity authentication, access control, security auditing, data protection, etc., and has a complete authority control mechanism to ensure the high security of the platform. Develop terminal security management and control functions, store cached data
on mobile terminals, ensure that tablet data is safely connected to the intranet, reduce security risks, and ensure the security of company applications and data.

4.3.1. Access authentication. Set the power-on password of the mobile terminal to lock the terminal after multiple login failures to ensure the completeness of the terminal use process; use strong authentication, communication encryption, and other means to prevent network sniffing and man-in-the-middle attacks.

4.3.2. Authorization management. Set and check mobile terminal access permissions, control insecure terminal access to applications; limit the installation of illegal root and illegal software on mobile terminals, and ensure the security of corporate data.

4.3.3. Offline data protection. Safely encrypt the data stored in the mobile terminal to ensure the safety of local data. The schematic diagram of the data security structure system is shown in Figure 3.

5. Benefit analysis
The system is the most direct means of managing and planning power grid equipment. The successful application of this project provides a strong technical guarantee for the realization of high-quality and efficient services to power customers and has obtained good social benefits: driving the improvement of the planning level of the power system and changing the traditional power Planning management mode, thereby improving the efficiency of power planning management and maintenance; it can effectively drive the national urban power grid planning and management level, improve the emergency response efficiency of the city, and promote the development of smart cities and smart cities: improve the planning and management level of the entire urban pipeline network, Make full and reasonable use of current resources for grid planning resources.

Through the development of power GIS based on mobile devices and its application in power grid planning, accelerate the development of the integration of power GIS and mobile terminals, improve the quality of power grid planning, and maximize the application of mobile terminals in the power grid and break the fixed network, The shackles of wired interconnection, faster and more convenient processing
of the massive spatial information obtained, providing specific functional services and rapid processing results.

6. Conclusion
Through the design and application research of the mobile GIS data management platform in the power grid planning, the work efficiency and level of the preliminary survey, design, prediction, and evaluation of the power grid planning can be improved, so that the business person can grasp the topology, distribution, and equipment of the power grid at any time. Such attributes and real-time information greatly improve the efficiency and intuitiveness of equipment queries and statistics.

When the system enables various planning professionals at the scene, quickly and accurately view the equipment on-site information, spatial geographic information, topology information, electrical equipment, environmental information around the site, and the corresponding thematic map information, improves work efficiency and quality of work.

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