Research on Component Architecture Technology in Component GIS Software Development Based on Big Data

Jing Han

Shandong Light Industry Vocational College, Zibo City, Shandong Province, 255300, China

Email: 25486525@qq.com

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Abstract: The era of big data has come. Big data, represented by mobile phone signaling, GPS, sensors, mobile APP and so on, naturally carries spatial location information, while general IT big data technology does not consider and has the capability of spatial analysis and computational mining. Due to the complexity of the GIS system itself, in order to improve the efficiency and quality of software development. Based on the introduction of GIS theory and software component technology, this paper proposes a component architecture technology for building GIS software in big data. This paper systematically analyses the technical system of component GIS development, and establishes the frame structure of component GIS, which solves the drawbacks of great closeness between component GIS at present, and provides a new development idea for domain-oriented reuse of GIS components.

1. Introduction

With the rapid development of computer network technology, network geographic information system has gradually become the research direction and hotspot [1]. With the increasing scale and complexity of software systems, the structure and specifications of the whole system become more and more important. In component-based software systems, the most important technology is how to organize many components organically to reduce the complexity of the system [2]. The development of computer software technology plays an important role in promoting the development of GIS software. At present, the various forms presented by the GIS software development research institute are almost all the results of the development of computer software technology. When data acquisition is no longer a bottleneck, data mining technology is used to extract useful information from massive data, find corresponding rules and associations, and guide subsequent decisions, becoming an increasingly indispensable capability of organizations and enterprises [3] . Like other software, GIS software is undergoing a revolutionary change, that is, all the systems provided by the past manufacturers or software with secondary development functions, and the transition to the direction in which the components are redeveloped by the users themselves. Focusing on big data and artificial intelligence, we are moving from the IT era to the data technology era.

2. Requirements for GIS in Big Data Era

2.1. Spatial big data requirements for GIS

No matter the traditional surveying and mapping methods, or the new surveying and mapping methods including tilt photography, laser point cloud, street view, etc., the data generated are also getting larger and larger, and new technologies are needed to support them [4]. In a cloud environment, data may be stored on different disks, different machines or even different locations. Existing distributed file systems, data indexing and query methods have limitations. Through the data acquisition of map scanning, format conversion, field mapping and other methods, to use various advanced database technologies to store and manage the data, to use computer graphics, cartography and other comprehensive visualization technologies to display the data [5]. In addition,

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the monitoring and real-time processing of massive dynamic targets has also raised higher and higher requirements. All of this requires GIS software to take the initiative to embrace the era of big data. Therefore, for data partitioning of spatial big data, memory-based indexing, history, current and future spatio-temporal index concurrency control, and concurrent multi-threaded continuous query are still in need of further research.

2.2. The combination of GIS and general big data technology

For the storage, analysis, mining and processing of general big data, a software ecosystem with Hadoop and Spark as the core has been developed. However, this universal big data processing system does not consider and support the analysis and processing of spatial data. . From a narrower perspective, it is mainly due to the wide range of data sources and the needs of different applications. Although multi-source heterogeneous data is also a classic proposition in GIS, it is more challenging to have more and more unstructured data, such as real-life pictures/street scenes, 3D models, videos, etc. [6]. For a small amount of data or applications in individual fields, data conversion, manual sorting and other methods can be used to standardize the data and unify the data structure to meet the storage requirements of traditional relational databases. Traditional GIS hardly involves unstructured data, and common relational databases are also difficult to manage and use unstructured data [7]. The support of GIS for spatial big data is not to reinvent the wheel and build another set of big data software system from scratch, but to embed GIS into the existing big data technology system to increase its analysis and processing capability for spatial data.

3. Component, Software Component Architecture Technology and Component GIS

Component software development can be divided into two levels, i.e. standard component development and system assembly development using standard components. This requires various technical supports. Formal models, concepts and analysis and development tools based on architecture specifications have gradually developed. Architecture descriptors are mainly considered from the perspective of formalization. Assuming that the developed application can be constructed quickly through the existing reusable components, the production efficiency of the software can be greatly improved. Secondly, program developers can obtain operable components and meet the needs of application development [8]. Software components must be able to recognize their properties, access methods, and events, which enable the development environment to seamlessly combine third-party software components. Component interface standards are the basis for component collaborative work and the basis for component software development [9]. Research on component assembly mechanism based on component model. It includes source-level assembly and run-level assembly based on component object interoperability. Compared with static and limited data sets, big data GIS data storage management system needs to be scalable. To handle the storage and query issues of dynamically infinitely growing data.

The inherent nature of software is volatility, so when considering a component-based software development model, we should take into account the overlap and recursion of the different stages of development. Although different phases may overlap, they are still divided into four phases: system analysis, domain engineering, system design and system implementation. Figure 1 below.

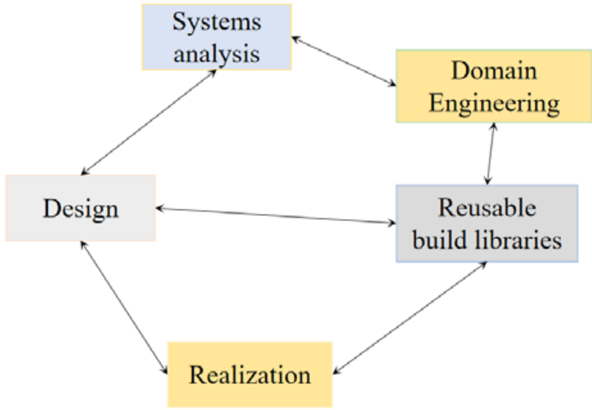

Fig.1. Component-based software development model

GIS data storage technology has an important impact on the rapid processing of data, including data transmission, query, high concurrent access, spatial analysis and other aspects, such as storing data in the database as BSON format, can omit the sequence of data transmission And deserialization steps. It enables processes in the operating system to manipulate, share, and access methods and data provided by other processes. Component architecture is similar to the composition, structure and interrelation of parts of an industrial product. It is based on the analysis of common structures and functions in the field, the division of reusable basic components in the field and their interrelation. This kind of component provides an interface, and points out the conditions and preconditions for use. When assembling this kind of component, it will cause resource conflicts, overlay and other effects, which need to be tested when using, such as various classes in the class library. Compared with tradition, servers provided by the Internet are separated from users in two parts, which brings great convenience for software developers to manage those databases that store massive geospatial data. It provides a relatively complete language model to organize and describe the corresponding software architecture. It is also the main means of understanding and understanding software architecture.

Two key technologies in software component architecture are domain analysis and software component technology. When the user directly develops the map application system on the GIS development tool, although the user is concerned about the business function and process realization of the system. Systematic analysis does not involve the detailed functions of the system, nor divides the consideration function into several subroutines. It only considers mapping the system to several components. It defines two roles: the caller and the callee, and provides a binding relationship: the two roles are connected with the component client and the component server respectively, thus forming a complete call process [10]. This architecture divides the network application system into three layers of clients, application servers, and databases. Such components can be replaced with versions. If the original component is modified incorrectly or new features are added, the replacement of the component can be achieved by re-packaging or rewriting the interface. These GIS components have most of the basic functions of GIS software, such as reading data in multiple formats, layered display, editing, scaling of graphics, roaming, multiple ways of querying, simple drawing, etc., and some buffer analysis, Address matching and other functions. The componentized GIS platform provides centralized spatial data management capabilities and can be connected to the database system in a flexible manner. At the same time, the dependence on specific languages is very strong, which makes the transplantation of the architecture itself more troublesome.

4. Component GIS Component Architecture Technology Based on Big Data

With the continuous advancement of big data application and the continuous development of mobile internet, internet of things and cloud computing, geographic information system is also developing at a fast speed. Based on domain analysis and supported by component/framework library, application system development is mainly characterized in that common problems of various systems in application domain have been generally recognized in domain analysis, and through component and framework development. The types of data that each system can store and the capabilities it can provide to the outside world are roughly the same. The difference lies only in its overall performance, supporting tools and commercial services. Although the dispute about non-relational database has always existed, non-relational database has become one of the spatial data storage and management methods coexisting with relational database. Different distributed storage systems are suitable for storing specific types of data from different technical perspectives, each with very obvious technical features and advantages. On the basis of analyzing the traditional C/S computing mode and the current emerging B/W/S mode, the application's transparent access to multiple data sources and adaptability to heterogeneous computing environments are fully considered. Architecture modeling is a software solution based on the first two analysis results to build component reuse in domain applications. Its main goal is to reasonably divide the common component components in domain applications.

GIS is essentially a geospatial database management and analysis system. All its analysis and application functions are based on spatial database. The data flow and control flow in operational analysis are two aspects of a process. Control flow is a process of operation implementation from outside to inside, while data flow is a process of operation support from inside to outside and data update from outside to inside, as shown in Figure 2.

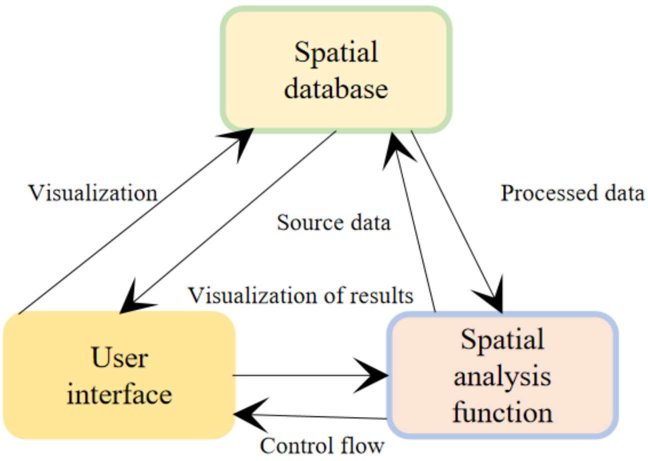

Fig.2. GIS data flow and operation flow

Appropriate Abstraction of the functionality of GIS and its use as a component for developers has many advantages that traditional GIS tools cannot match. The implementation repository is a running repository that provides information about the server's classes, instantiated objects, and their identities. In many applications, there is a timeliness requirement for real-time data processing. If it is not processed after a certain period of time, the data loses its effect and meaning. With the support of big data technology and mobile internet, the terminal application of mobile GIS can obtain sufficient data support. At the same time, mobile GIS can obtain various GIS services through network and cloud services. Therefore, every important advance in computer technology will strongly push forward the development of GIS technology. For example, the emergence of network technology drives the development of network GIS, and the software development idea of component reuse promotes the component development of GIS software. Its input information includes domain knowledge, domain expert experience and technical information of existing systems. Through domain analysis, domain architecture and reusable component requirements knowledge are generated. The advantage of this strategy is that the server can perform many complex operations and calculations which can not be processed in the client, and the application system is easy to maintain and update.

The difference between GIS and other information systems and electronic maps lies in the ability of spatial data management, spatial analysis and map-based data visualization. Software

Architecture Description Language (SADL) is not a compilable and executable language. At present, the main implementation strategy is to establish the transformation process from description language to implementation language based on framework model. In the era of big data, the connotation of geospatial information science has not changed, but its content and form are more abundant. Each system has some special problems to solve. The software components to solve these problems are also made into components, but they do not require reuse, so they are called special components. In this strategy, the data and calculation are both on the server side at the beginning, the user downloads the data locally, and the client is responsible for performing different operations. Component description is based on component model, describing the structure and function of components to enhance the usability of components. On the premise of ensuring the function, the system is compact and flexible, and its price is only one tenth of that of the traditional GIS development tools, so that users can obtain or develop GIS application systems with better performance-price ratio.

5. Conclusion

GIS involves a wide range of technologies, including spatial data organization, multi-dimensional GIS data representation, GIS data interoperability and so on. This paper starts with software component technology, combines GIS technology with software component big data technology, and puts forward a GIS software development model based on big data. The use of big data analysis can summarize experience, discover laws and predict trends, all of which are manifestations of value. As an application of computer technology in the field of geospatial information simulation, analysis and application, GIS software development will also follow the development of software development technology. Component GIS is one of them. This paper proposes a component-based framework technology based on big data-based component GIS software development, which has proved to be effective, but it needs to be tested in the implementation of multiple application systems. Further optimization of the architecture system needs further the study.

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