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Research on Spatio-temporal Data Construction of Library under the Background of Digital Humanities-Take the Northeast Anti-Japanese United Forces as an example

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Abstract: This paper from the perspective of multi-dimensional, relational, dynamic this data characteristics and knowledge reconstruction of library spatio-temporal data, Build a cloud service platform for spatio-temporal data of the library, based on the analysis of user demand then discussed its collection, processing, storage and the construction process of user service that provided with the spatio-temporal data. In the era of big data, spatio-temporal data, as a new type of resource, its construction and research enriched and developed traditional data structure relatively.

Keywords: Spatio-temporal date; Digital humanities; The northeast anti-Japanese united forces

1 Introduction

Spatio-temporal data of this article refers to a rich collection resources in the library and structured metadata record, on the basis of using big data, the semantic web, data visualization, modern information technology such as GIS, UGC[1], into the data of time, space, properties and characteristics change and development, the construction of the new data resources has the data update speed, strong correlation characteristics[2]. The development and construction of spatial and temporal data from the perspective of digital humanities not only enriches the original resource types of libraries, but also enhances the construction and service capacity of big data in libraries. Compared with other data, spatio-temporal data is multi-dimensional, correlated and dynamic (see Table 1: Comparative analysis of spatio-temporal data and other data types).

Table 1. Comparative analysis of spatiotemporal data with other data types

Data types	Describe objects	Data function	Data features	Data limitations
Temporal data	Time variable	Describe the variation characteristics of the same phenomenon or data at different time points or periods	linear	irreversibility
spatial data	Space variable	Describes the location, shape, size and distribution characteristics of spatial entities	three-dimensional distributed	Only express spatial entities
Metadata	Fragmented data	Describe, locate, search, evaluate and select relevant data	Relevance、semantic	Interoperability issues with different metadata formats
Spatio-temporal data	Massive data resources	Reveal the dynamic change characteristics of multidimensional and correlated data	Multi-dimensional、relevance、dynamics	Large amount of data、data relationship modeling is difficult

2 Previous work

The concept of spatio-temporal data was first proposed by American physicist C.Gregory, who proposed time as a new dimension to the traditional three-dimensional space in the field of physics[3]. In early studies, spatial-temporal data were divided into two different branches: spatial data and temporal data. Spatial data, considered as traditional data, focused on the representation, storage, processing and query of spatial data, while temporal data focused on the data changing with time[4]. Compared with the static and simple traditional data types, the spatio-temporal data of the library constantly collates and analyzes the dynamic and heterogeneous data, strengthens the correlation and visualization among the data, and can display the full life cycle sequence and global spatial layout of the information in an all-round way.

In recent years, spatio-temporal data modeling research has made more in-depth development in methods, technologies and field applications. In terms of modeling theory and technology, the structure, scale, significance of spatio-temporal information and storage and indexing mechanism of spatio-temporal model are further studied. In terms of application, space-time data has been widely used in land, transportation, public health safety, 3D modeling, intelligent driving, supply chain management and other aspects[5].

3 Methodology

The methods of knowledge reconstruction and visualization of spatio-temporal data in library are used to guide the library to reveal multi-dimensional heterogeneous data, to recombine the semantic representation of knowledge, to build the knowledge network, to realize the automatic mining and analysis of data through the information technology and methods such as concept map, knowledge map, virtual reality, etc., so as to provide more convenient, intuitive and predictable for users.

3.1 Knowledge reconstruction of Library spatio-temporal data

Under the background of Digital Humanities, users need information more simplified.Based on the result of traditional document indexing metadata, spatio-temporal data deeply excavates and analyzes the documents and establishes index mechanism from time dimension, space dimension and attribute dimensionto reveal the multidimensional information of events. The semantic representation of knowledge requires the understanding of literature not only based on subject analysis, but also on semantics, so that the computer can understand the retrieval content, and feedback the massive information which match the same or similar semantic retrieval results. Spatio-temporal data is screened according to concepts and relationships, and formed new concepts, relationships and attributes by establishing constraints. A large number of knowledge elements are acquired by clustering to form relationship sets of different attributes, and finally stored in the knowledge base through knowledge fusion[6]. Different knowledge units are connected by using data association, knowledge map and other technologies[7]. Association links are established between different knowledge units to form knowledge networks, and complex spatio-temporal semantic associations are established to derive new knowledge from original knowledge. Knowledge units are associated with knowledge maps and other technologies to establish cross-domain associations.

3.2 Visualization of spatio-temporal data

In digital humanities, visualization technology enables data to be presented more intuitively.

Therefore, the development of spatio-temporal data needs to be visualized by knowledge map, concept map, virtual reality and other technologies.

Concept map is a visual method to express and organize structured knowledge by using concepts and their relationships[8]. The process of constructing a conceptual map of a node is a process of knowledge representation and knowledge organization. Taking events as nodes, it reveals the relationship between events, realizes the data structure model of integrating knowledge structure and related resources, and expresses the spatio-temporal attributes of data. Knowledge map is mainly based on the analysis of high-frequency words and the use of visual software to generate high-frequency common words knowledge map[9]. The knowledge map can intuitively see the important keywords and the relationship between keywords and keywords, understand the distribution of keywords, facilitate the analysis of keywords from different disciplines and the development of research in related fields, and help users grasp the key points, hot spots and future research trends by using the center point and co-occurrence frequency. The application of virtual reality technology improves the retrieval efficiency and the quality of library service. At the same time, it also makes spatio-temporal data have the ability of "Scene reproduction" beyond space-time, which can better serve the development of Digital Humanities projects.

4 Construction of cloud service platform for spatiotemporal data

4.1 Spatio-temporal data cloud platform

The spatio-temporal data cloud platform is based on the achievements of digital library resources construction, with the help of advanced science and technology such as big data, cloud computing and Internet of Things. Based on the dynamic spatio-temporal information data set and guided by the complex, diverse and dynamic information needs, the information users need to build a rich information data, a variety of service functions, a wide range of social applications and a full range of cloud service platform. Based on the existing digital library resources construction achievements, combined with the historical geographic information system, the time characteristics, spatial characteristics and attribute characteristics are added, and the multi-dimensional data set is constructed. Finally, the multi-attribute, multi-scale and high-quality space-time data information database of spatial, temporal and attribute organization is formed, which provides data basis for the construction of spatio-temporal data information cloud platform. As shown in Figure 1: the structure of spatiotemporal data cloud service platform, according to different functions of the system, the spatiotemporal data cloud platform is divided into infrastructure layer, data layer, service layer and application layer[10].
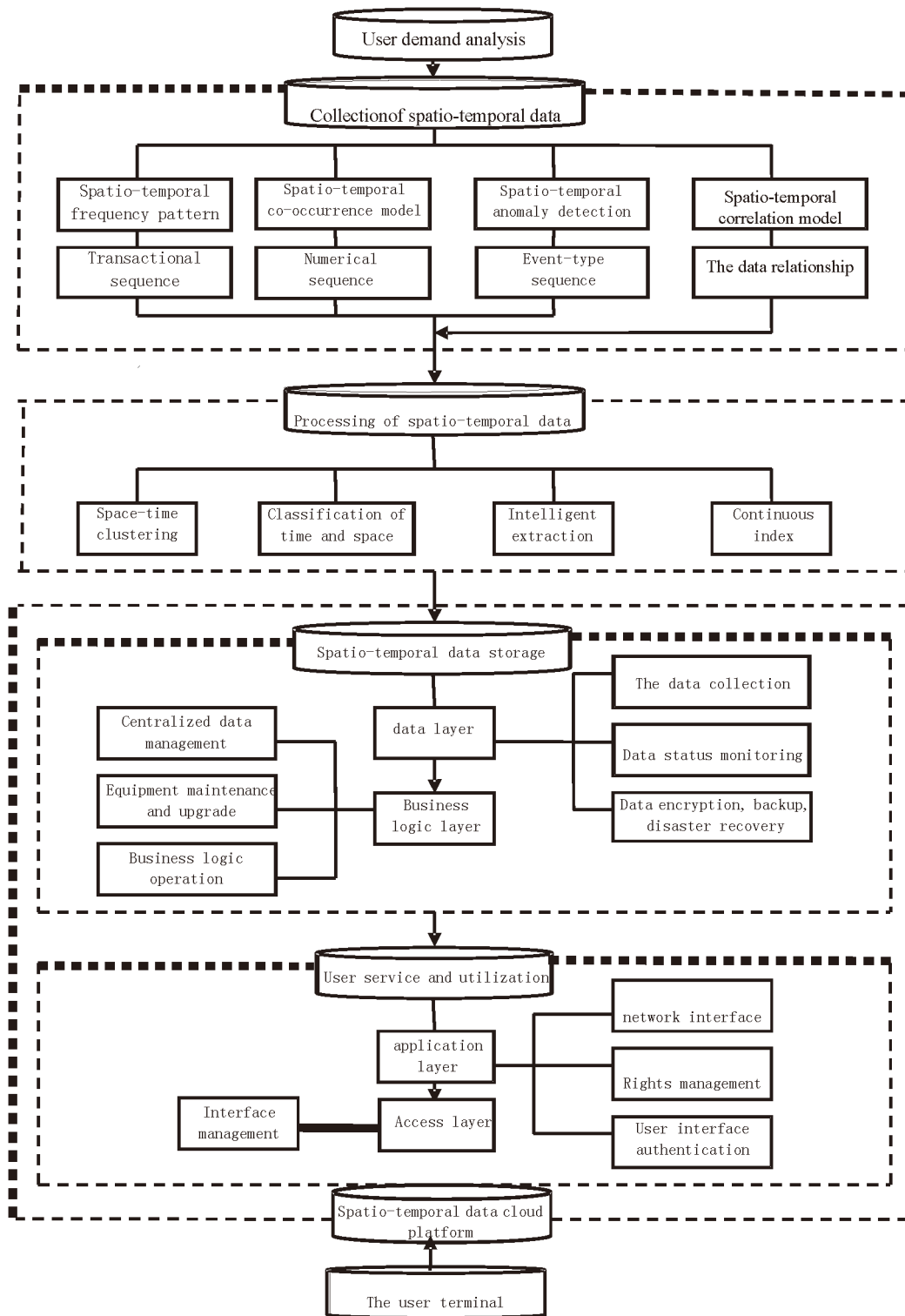
Figure 1. Cloud service platform for spatiotemporal data

4.2 Cloud maps of Spatio-temporal data

Users can access and retrieve the platform through websites or mobile clients, and they can also build their own spatio-temporal data sets on this platform. In the process of spatiotemporal data storage, first of all, the data layer is used to collect the spatiotemporal data. At the same time, the collected data are monitored, encrypted and backed up to facilitate the real-time updating of the data. A new multimedia data collection method is adopted to realize the integration of heterogeneous data. Then the collected spatio-temporal data are divided into different groups according to different scales. All the spatio-temporal data presented in the map can not only show the information needed by users, but also reflect the relationship between data in a visual way, which is conducive to the construction of Library spatial-temporal data, a new type of multidimensional heterogeneous data.

4.3 Spatio-temporal data cloud services

The spatiotemporal data service based on cloud platform presents the spatiotemporal data stored in cloud platform to users in the form of multimedia visualization according to the retrieval needs of information users. The library provides various services for users by means of data association, knowledge reconstruction and visualization technology; Information analysis service means that libraries make use of digital humanities technology to analyze the retrieval results, and further excavate and analyze the key points and hot spots of the retrieval contents. Knowledge application service means that libraries extract information according to users' information needs to provide services for digital humanities research. Users using space-time data cloud platform to retrieve, spatio-temporal data cloud platform to the user's retrieval requirements associated with platform in the data, the data matching and users for the retrieval results can choose different forms to display, such as virtual reality, concept map, namely the visualization of results, greatly improving the retrieval efficiency, service quality, achieve the retrieval of the "one-stop" services.

5 Conclusion

As a new type of digital resources, spatio-temporal data can not only meet the needs of more users for in-depth data, but also improve the big data processing and service capacity of the library. It can be predicted that with the deepening of all kinds of spatio-temporal data research and the application and innovation of intelligent data technology, the construction and service of spatio-temporal data in various disciplines will inevitably have more long-term substantive progress.

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