Research on Time-Space Behavior of Big Data City Based on Cloud Computing Concept

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Keywords: Cloud Computing, Big Data, Research Methods of Urban Temporal and Spatial Behavior

Abstract: understanding the movement behavior and spatial structure of urban population is of great significance to urban planning, traffic management and emergency response. As an important component of smart cities, smart travel can provide effective behavioral planning countermeasures for reducing urban traffic volume and optimizing travel time-space distribution, and provide effective technical support for optimizing urban planning and traffic planning theories and methods. This paper holds that the change of research methods of urban spatio-temporal behavior in the era of big data based on cloud computing mainly depends on the mining, processing and application of network or mobile information equipment data reflecting residents' spatio-temporal behavior. The application prospect of the new human-oriented urban planning and management based on time-space behavior guides the intelligent and sustainable development of the city.

1. Introduction

Big data was first considered as a large number of data sets that need to be processed or analyzed in batches at the same time to update the network search index, but later it does not merely express a concept of quantity. Big data has four characteristics: huge amount of data, complex types, low value density and fast processing speed. It can be divided into big data technology, big data engineering, big data science, big data application and other fields [1]. City is the center of humanities, education, science and technology, and politics in the region, carrying the mission of regional economic development and civilization inheritance. Its development directly affects the progress of china's productivity and economic level. The new urbanization strategy launched in the report of the 18th national congress of the communist party of china places more emphasis on people-oriented urbanization as the core and on enhancing people's sense of achievement and happiness. The network has become an indispensable platform for the economic and social development of cities, and has an overall impact on residents' activities, business operations, scientific and technological research and development and government management, thus making it possible to obtain a large number of network data reflecting the characteristics of urban spatial organizations and residents' behavior.

The research on social space pays more attention to the urban social spatial characteristics and structure, social events, social spatial differentiation, community issues and other topics, and there have been many researches and research methods are relatively mature. Based on a large amount of big data containing spatial and personal information, this paper constructs a human-oriented framework for intelligent city planning and management, which makes city planning and management more scientific and intelligent. Using cloud computing environment to deploy urban basic information base, giving full play to cloud computing virtualization [2], providing services on demand and other advantages, can strengthen the integration of information resources. With the deepening influence of the internet on the life of urban residents, network data has become the most important carrier to represent residents' social activities, and its application research has also begun to attract the attention of scholars in sociology, geography, management science and other fields [3].

  DOI: 10.25236/iiicec.2019.061

2. Data Acquisition and Processing Technology in Big Data Era

2.1 Mining Technology of Network Data

Network data mining is an important part of computer science research, including content mining, structure mining and usage mining. Traditional research methods of urban space mainly include quantitative analysis and qualitative analysis. Quantitative analysis mainly uses statistical analysis and econometric models to study urban physical space, while qualitative analysis focuses on the micro-mechanism and changes of urban social space through the method of induction and deduction. In the existing data acquisition technology, multi-source data are comprehensively analyzed, and spatial analysis, simulation prediction and other analysis methods are used. Firstly, it explores the application prospect in traditional urban planning and management. Secondly, based on the residents' individual behavior rules and decision-making mechanism, it constructs a smart urban planning and management model to study the user's activity status and characteristics. Structure mining is to analyze the link structure of web pages and to evaluate the amount of web resources. Generally speaking, it is easier to obtain the latest first-hand data for field investigation and questionnaire investigation, but there are some defects such as small sample size, strong subjectivity, high cost and long period, and the quality of the design of the investigation scheme or questionnaire content directly affects the scientificity of the research results. Therefore, the emphasis of traffic planning research has gradually shifted from the improvement of traffic carrying capacity to the study of resident travel demand management strategies and the development of application systems [4].

2.2 Collection and Analysis of Residents' Behavior Data

The collection and analysis of residents' behavior data is an important part of the research in the field of humanities and social sciences. Traditional research mainly obtains research data through questionnaires or interviews. The research cost is high, the sample size is small, the time span is short, and the questionnaire is subjective. From the observation of the investigators or the words and actions of the interviewees, it also includes the social experience of the investigators after entering the field, as well as some auxiliary secondary materials such as historical archives, personal activity logs, meeting records, etc. With the construction of cloud computing data center, some department business databases have been migrated to the cloud computing center, while other department business databases are still stored in the previous units. The rise of spatio-temporal behavior research has promoted the transformation of urban traffic theory. Activity-based traffic demand model and traffic planning have gradually become the development direction of western traffic research and traffic management policies. Travel demand originates from activity demand, and travel choice decision is based on activity [5]. Individual travel behavior is restricted by activity plan, time budget and activity spatial distribution all day long. Li yan integrates mobile information equipment (gps) with lbs function with network map, and obtains more accurate spatio-temporal activity data of residents in combination with family activity log [6]. Generally speaking, qualitative analysis focuses on the induction of micro-mechanisms that affect changes in urban social phenomena, taking into account the subjective feelings of individual residents and the key role of time. The research data are very detailed and time-sensitive.

2.3 Network Map Integration and Visual Development

Spatial analysis and visualization of data have always been the key to the research of map technology. The development and perfection of network map function have made a new breakthrough in this technology. Traditional urban spatial research also combines gis tools to carry out spatial analysis or visualization of data obtained by traditional methods such as social surveys, questionnaires, statistical data and interviews, including spatial query, spatial measurement, buffer analysis, overlay analysis, network analysis and spatial interpolation. According to the actual road conditions, a variety of relatively smooth, time-saving and short-distance navigation routes are given. At the same time of intellectualization of urban traffic data, various industries have accumulated a large amount of traffic data, providing data support for related research. Ke wenqian

and others have developed a software (map-tube) integrated into google map engine, which can overlay other maps on google map to make thematic maps, including google map maker, picture maker and picture overlay maker, and enable users to display and share information on the internet [7]. Entering the 21st century, with the process of urbanization and motorization entering a period of high-speed development, relevant researches have begun to think about how to fundamentally change the urban traffic mode and promote the coordinated development of urban traffic, urban social economy and spatial structure. Humanization, integration, informatization and intensification have become new ideas for the development of urban traffic planning [8]. Therefore, chinese scholars need to track, refine and upgrade the research frontier of international space-time behavior, and choose the starting point of methodology to provide reference for the construction of china's space-behavior interaction theory.

3. Progress in Research Methods of Spatial and Temporal Behavior of Big Data Application Cities Based on Cloud Computing Concept

3.1 Research Methods of Residents' Temporal and Spatial Behavior

3.1.1 Research on Residents' Temporal and Spatial Behavior Based on the Combination of Gps, Gis and Weblog

The relationship between the spatio-temporal behavior of crowd movement and urban spatial structure has always been the focus of human geography research. As shown in Figure 1, the spatio-temporal behavior of crowd movement can reflect and perspective the characteristics of urban spatial structure. On the other hand, the urban spatial structure will restrict and affect the movement of people in the city.

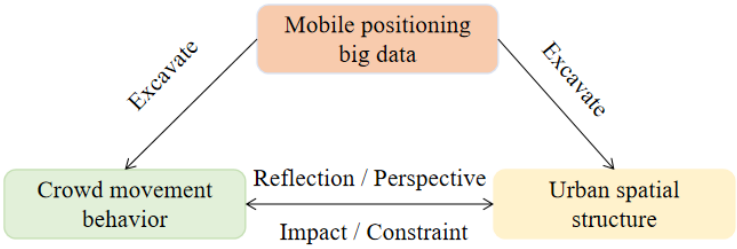

Fig.1 The Relationship between Temporal and Spatial Behavior of Crowd Movement and Urban Spatial Structure

Compared with the traditional questionnaire, GPS and weblog can timely reflect the content and changes of residents' activities, and with the continuous progress of GIS technology and webmap technology, the application of this kind of method gradually shows advantages. Using software to mine network data; Using GPS, LBS, smart card and other equipment, combined with GIS or network logs to collect and analyze the residents' behavior data; Visual development of the acquired data is carried out by using the network map. There is a difference between hot start and cold start when GPS equipment is turned on. Cold start is to put it for a long time before reuse. Compared with the traditional database deployment method, the deployment of the database in the servers of various departments, the deployment of the urban basic information base in the cloud computing environment has more efficient characteristics. Chen Zhen and others used GPS and web tools (which can record time, speed, distance, longitude, latitude and direction of movement) and combined with Google maps to simulate the movement tracks of 76 tourists in Sydney and Canberra, thus analyzing the characteristics of tourists' travel routes, transfer modes, travel obstacles and so on [9]. As an activity-based traffic demand forecasting method, activity analysis has become an important research direction in the field of urban traffic behavior analysis by analyzing the relationship between urban space and behavior and the interrelation between traffic behaviors. That is, space affects people's behavior and interaction in a unique way, while individuals change the existing spatial arrangement through interpersonal interaction and construct

new space to express their desires [10].

3.1.2 Based on the Data of Social Network, Mobile Phone and Smart Card, This Paper Studies the Spatiotemporal Behavior of Residents

Network data mining is an important content of computer science research, including content mining, structure mining and usage mining. Among them, content mining is the acquisition of web page text and media data, which is used to study user activity status and characteristics. Zhang Guangchao and others mined the Twitter data of 400,000 users in Leeds City in the United Kingdom within one year, combined with nuclear density analysis, judged the user's activity location and behavior according to the density or frequency of information released by specific Twitter users in different places, and constructed a residents' intelligent behavior model based on social network data and traditional census data [11]. The collection and analysis of residents' behavior information is an important part of the research based on spatio-temporal behavior data. It will become an important scientific issue of human geography and the main direction of theoretical innovation of behavioral school to carry out in-depth case anatomy and model analysis of the relationship between individual behavior and space, to construct space-behavior interaction theory and methodology, and to propose operable research paradigm and technical route.

3.2 Research Methods of Urban Space

3.2.1 Research on Urban Transportation

Urban transportation research is an important part of urban spatial planning, and also a difficult point in research, which has been paid attention to by scholars for a long time. However, as this kind of research is still in its infancy, the existing research on urban physical space at home and abroad only focuses on three aspects: urban hierarchy, urban transportation and urban functional zoning, while the research on urban social space also explores a few aspects such as urban characteristics and activities, social relations and major events. Zhou Shengli and others obtained anonymous call detail records (CDRs) of 20,000 residents in Moliis City in the United States within 2 months from telecommunication operators. The data include zip code, voice and short message content, and revealed the urban population flow and change through statistical and cartographic analysis [12]. Spatio-temporal analysis technology oriented to residents' behavior is applied to transportation planning, urban planning and policy formulation, and transportation supply factors such as urban space, public service facilities and transportation infrastructure are regulated through intelligent urban planning, transportation planning and public policies. Relevant foreign researchers have combined basic spatial information with Google software and GIS software [13] and deployed them on the cloud computing center platform. That is, the system is deployed in the servers of the cloud computing center through dynamic virtual mode, and the resources of a cloud computing center server are virtualized into a plurality of mutually isolated and non-interfering system environments, which can not only ensure data security, but also effectively utilize hardware resources.

3.2.2 Study on Urban Functional Zoning

The study of urban functional zoning is the common focus of urban geography and urban planning scholars. Urban geography attaches great importance to the formation mechanism of urban spatial structure and the discussion of its impact on urban development, while urban planning conducts functional organization and layout of urban space according to the needs of urban scale and development strategy. Yang Diehan and others classified the world's Internet cities according to the global Internet map, using the Internet domain name and the number of users, combined with statistical analysis [14]. Tang Jia and others, taking big cities in Britain as an example, added humanistic elements including residents' emotion and experience on the basis of distinguishing urban spatial geographic characteristics according to topographic map database, and proposed three methods for dividing urban central areas. Through the analysis of the relationship between urban space and travel, traffic prediction based on individual demand is realized, and an activity-based

traffic demand model is constructed [15]. Zheng Peng proposed the concept and framework of urban computing from the perspective of computer, and discussed the application of urban computing in urban planning, intelligent transportation, environmental protection, energy consumption and social entertainment. Considering the interaction between objective constraints and subjective initiative, he proposed that the more organized interaction theory of space and behavior will become an important direction of theoretical innovation in future time geography [16].

3.3 Research Methods of Urban Hierarchy

For specific research methods, descriptive statistical analysis, cluster analysis, factor analysis, gravity model, network analysis and time-space prism are more commonly used in traditional research methods or models of urban time-space behavior. Generally speaking, the current research on urban spatio-temporal behavior has obvious characteristics of using “new” data and “old” methods to study “update” and “more complex” problems. Its research scope has also expanded from the residential scale to the urban spatial and regional scope, and its dependence on GIS tools has gradually increased (Figure 2).

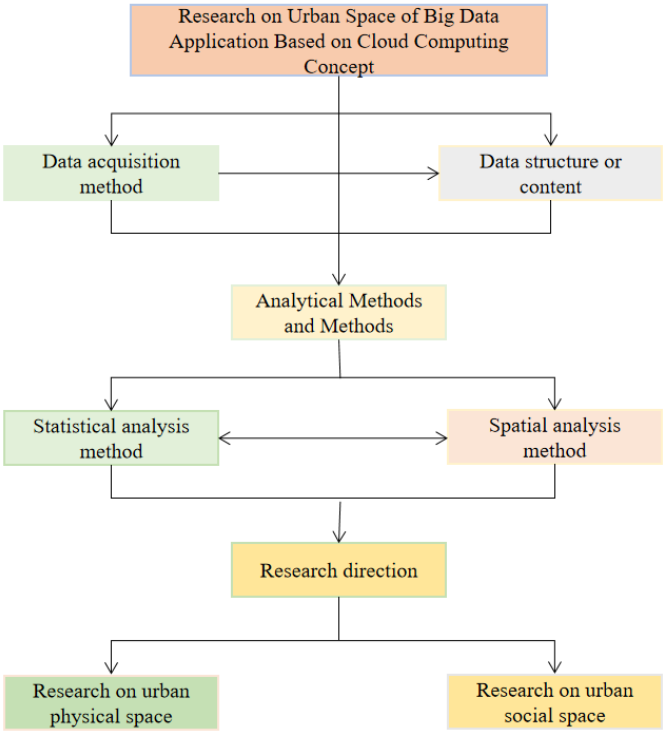

Fig.2 Framework of Research Methods for Big Data Application Cities Based on Cloud Computing Concept

3.3.1 Research on Urban Hierarchy Based on Social Network Data

Social networks not only reflect the virtual relationships and connections between residents, but also reflect the activities of urban entities in cyberspace. On the basis of selecting cities with strong economic strength and high information level, Su Guangzi and others used Sina Weibo website to count the number of microblog users, friends' relationships and their geospatial data in each city, and analyzed China's urban network system in the cyber social space using the research methods of world urban network [17]. Combined with the time series model, the characteristics and distribution of keywords posted on Twitter in different U.S. cities are analyzed. It is found that only a few cities can provide the information needed for keyword search in multiple periods of time, thus obtaining the network activity levels and connections between cities in the country. From this, we can see that social network data can reflect the relationship between residents in different cities, and then judge the relationship and hierarchical structure between cities, which can provide the basis for regional spatial structure research and urban system planning, but we need to pay attention to the

identification and processing of false social data.

3.3.2 Research on Urban Hierarchy Based on Mobile Communication Data

Mobile communication data among residents can also represent the connection and attraction between cities. Generally speaking, the larger the city's economic strength and scale, the stronger the communication connection between the city and the outside world. Wang Zhouxiu and others established the city's social network by analyzing the communication information of 25 million users provided by Belgian mobile phone operators and using the postal code corresponding to the user's mobile phone bill address. They also used gravity model to study the communication intensity and finally obtained the communication links and hierarchy between cities [18]. Lin Li et al. used 1.9 billion mobile phone records in Heilongjiang province within one month to build communication local area networks at the provincial and national levels, and combined with gravity model to measure the intensity of inter-city communication [19]. Judging from the existing research results, the research on the urban hierarchy system using user communication information is in its initial stage. The method is relatively simple and the data acquisition is difficult (coordination with telecom operators is required). Therefore, the research on data acquisition and measurement models of such methods needs to be strengthened.

4. Prospect of Research Methods on Urban Temporal and Spatial Behavior in Big Data Era

4.1 Promote the Cross-Cutting and Integration of Multidisciplinary Research

Information technology provides multiple and complicated data for the research of many disciplines and gradually expands the research scope of various disciplines. Although the research issues have different emphases due to the different nature of disciplines, the research methods tend to start with the application and analysis of “big data”. Therefore, the intersection and integration of interdisciplinary research methods will become the main trend of future development. Specifically, on the basis of existing technologies such as network data mining, collection and analysis of resident behavior data, and visual development of network maps, computer, mathematics, geographic information system and other disciplines need to be further intersected and integrated. The daily behavior information of residents should be combined with the basic spatial information, so as to see through the spatial and temporal structure of the city and better apply the spatial and temporal research to urban management. Commonly used time-space basic information includes remote sensing image data, traffic network data, land data, etc.

4.2 Pay Attention to the Mining and Application of Resident Behavior Data

At present, scholars at home and abroad are only involved in a small part of the content of entity and social space in the research of urban space based on big data application, and need to continuously explore new fields and new methods. Specifically, it is necessary to follow the “bottom-up” research concept, fully mine authoritative thematic network or mobile information equipment data, and focus on the study of residents' behaviors that characterize urban spatial characteristics and affect their changes. The research on urban space has seriously failed to pay attention to urban land use, urban spatial structure, urban spatial governance and other aspects in the era of big data. In the future, we can consider fully excavating the authoritative theme websites of cities. In terms of spatial analysis methods, the current three-dimensional visualization of urban space-time paths can already be simulated in GIS environment, and its research scope has also expanded from residential area scale to urban scale and regional scale, and relevant software algorithms are still continuously improving.

4.3 Guiding the Planning and Construction of Smart Cities

Smart City is recognized as a brand-new urban form under the influence of the depth of information and an advanced stage of urban development. For urban residents, information technology is accelerating to change people's life, residence, work and leisure styles, resulting in complex changes in spatial mobility. Making use of research methods such as urban characteristics

and urban space, and combining existing methods such as urban functional zoning, land use planning, and transportation planning, etc., to innovate concepts and methods of urban master planning, urban regulatory detailed planning, or urban special planning; Facing the individual behavior of residents, we will implement behavior guidance, assist residents to make intelligent judgments and decisions in daily life with the help of big data analysis, and guide residents to form healthy and intelligent lifestyles. Combining with the urban space research method system, develop new technologies or comprehensively utilize various existing technologies to carry out the development and construction of urban intelligent management information system.

5. Conclusion

At present, the construction and management of China's smart cities are divorced from the needs of residents' daily life and the concept of people-oriented urban development. On the research scale, it combines long-term behavior and daily activities in terms of time, analyzes the long-term change process of daily lifestyle, and explores the cumulative impact of social changes and life course on daily behavior patterns. Based on the study of spatio-temporal behavior, it is of great significance to construct personal behavior planning from short-term schedule, medium-term life circle to long-term life course, and to guide residents to carry out efficient, intelligent and healthy activities and travel from different time scales. In the future, it is necessary to integrate multi-source mobile location data to study the theory and method of spatio-temporal behavior analysis, enrich the semantic information of trajectory data, further explore the interaction rules between crowd movement behavior and urban spatial structure, and deeply understand the coupling relationship between the two.

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