

A Review on the Introduction and Application of Spatial Big Data

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Abstract

This review starts with the introduction of the concept of spatial big data, and briefly introduces the source of spatial big data. It also expounds the technology of spatial big data and illustrates its application in urban construction with examples. They are the application of GPS in the planning of urban bus lines, the application of artificial intelligence in social security, and the application of spatial big data product in the construction of smart city. Finally, the paper briefly introduces the development trend of spatial big data in urban construction.

Keywords

Spatial Big Data; Applications; GPS; Artificial Intelligence; Smart City.

1. Introduction to Spatial Big Data

Increasingly, the size, variety, and update rate of spatial datasets exceed the capacity of commonly used spatial computing technologies to learn, manage, and process the data with reasonable effort. We refer to these datasets as Spatial Big Data. A 2011 McKinsey Global Institute report defines traditional big data as data featuring one or more of the 3 "V"s: Volume, Velocity, and Variety [1]. Examples of emerging SBDs include temporary detailed road maps that provide traffic speed values per minute on every road in the city, GPS trajectory data from mobile phones, and measurement data for engine fuel consumption and greenhouse gas emissions. It provides commuters with more accurate travel time estimates. Location-based services enable the city to check the usage patterns of bicycle lanes. Spatial big data is an important part of the emerging field of urban informatics that promotes the intersection of people, land and technology [2]. Spatial big data brings challenges to existing spatial computing systems to store, process and analyze such large data sets. These challenges have created new opportunities in many areas of computer science research, such as spatial data mining and spatial database systems. Therefore, spatial big data seems to be far away from our lives. In fact, in the development and construction of cities, it is inseparable from the application of spatial big data.

2. Acquisition of spatial Big Data

Under the background of the current explosive growth of data, through the acquisition and processing of Internet big data, the data results will be better applied to urban planning research, in order to fill the gap of data mastery in traditional urban planning. The research on

the theories and methods of geographic data fusion with different data sources, different data precision and different data models is of great significance for reducing the production cost of geographic data, accelerating the update speed of existing geographic information and improving the quality of geographic data [3]. In the information age, the spatial and temporal elements and the changes of mobility need to understand the emergence and development of smart cities from the perspective of geographic space [4]. The acquisition of city data through the Internet is mainly divided into three steps. Firstly, the static or dynamic page is analyzed. Then it will go through the coordinate format conversion, coordinate conversion, text into vector data, point, line, surface data conversion, so as to achieve the fusion of a variety of data. Finally, with the combination of professional models in the field of urban planning and management, a modeling analysis of a certain field in urban management is carried out, such as through spatial interpolation analysis, 2d and 3d integrated display [5].

3. Applications of Spatial Big Data

The concept of spatial big data is very broad, and its products are widely used in each corner of urban construction, constantly promoting the construction and development of cities. This review will discuss the following technologies related to spatial big data and their applications.

3.1. Application of GPS Positioning Technology

GPS positioning technology is one of the most important components of spatial big data. GPS trajectories are quickly becoming available for a larger collection of people due to rapid proliferation of cell-phones, in-vehicle navigation devices, and other GPS data-logging devices [6], such as those distributed by insurance companies [7]. GPS traces allow analysis of people for a number of urban informatics use-cases. For example, the bus track in the city is made, and different scholars combine the GPS positioning technology with the IC-card swiping data of residents to explore.

In 2008, Jianmin Xu once again combined the GPS positioning data of urban public transport and IC-card swipe data of residents on public transport, and studied the integration of these two kinds of data to build the OD model of urban public transport, which provided reference ideas for the research of urban bus network optimization and bus operation evaluation [8]. In 2011, Zixiao Wu and other scholars built a combined model of urban bus OD generation and passenger flow demand prediction based on the two data of GPS positioning and IC-card swiping of city buses, and studied the possible application of the model in urban public transport planning [9]. In 2012, Shaohui Chen combined with GPS positioning data bus and city bus IC-card data, set up the matching constraint relations between city bus stops. And the heuristic algorithm was used to solve the established matching model, finally he realized the passengers IC-card transaction records and the accuracy of the matching between city bus stops [10]. In 2015, Zhengjiang Wang based on GPS technology city bus IC-card swiping data to predict passenger flow, and urban bus scheduling and route arrangement optimization, and finally successfully applied to the actual [11].

GPS positioning technology and IC card data to plan the bus route is the cross application of spatial big data. By GPS positioning technology, it can obtain the location of the travelers, charge quantity determines the number of the location, and plan out optimal bus lines.

3.2. The Application of Artificial Intelligence in Public Safety

The concept of Artificial Intelligence was first proposed in the mid-to-late 1950s. Therefore, artificial intelligence technology can also be regarded as an important part of the application of spatial big data. It enables computers to deal with problems in the way of human thinking, in

which big data technology, image recognition technology, language recognition technology. In modern society, artificial intelligence has been widely used in the construction of urban public security.

3.2.1. The Application of Artificial Intelligence in Traffic System

Firstly, the application of artificial intelligence technology can timely obtain the information of intersections. For the sudden phenomenon of pedestrians crossing the road, the intelligent traffic signal and other control systems can scientifically dispatch passing vehicles. This pre-determination method can not only protect personal safety, but also avoid causing harm to others. Secondly, the application of artificial intelligence technology in the field of traffic safety also includes auto environment identification system. In the process of driving, the auto environment identification system senses the changes of the surrounding road conditions and selects the best driving speed by the intelligent control terminal [12].

3.2.2. The Application of Artificial Intelligence in Medical Field

According to the 2017 Internet trends report by Mary Meeker in Wall Street Internet: healthcare and wellness have reached a digital inflection point [13]. More than 80 percent of consumers use health data such as wearable devices, and this structured health data will be used as a data source to help consumers manage their personal health. That is, artificial intelligence can be used to help diagnose diseases. AI assisted diagnosis transforms data into knowledge, which can be roughly divided into five steps from the perspective of data flow: data set, data processing, knowledge mapping, knowledge calculation, and interaction design.

3.2.3. Application of Artificial Intelligence in the Field of Fire Protection

With the continuous acceleration of the construction of "digital cities", most buildings already have digital maps. If a fire accident occurs, firefighters can retrieve the building information from the network platform and use infrared imagers to record the temperature in the building. When the situation changes, the computer analyzes and sorts the data collected, and combines with the digital structure of the building to select the best fire extinguishing point [14]. At the same time, various sensors on the firefighters can transmit the fire site information to the remote control terminal through the wireless network, and the computer can perform pre-judgment analysis based on this, thus guiding the firefighters to carry out rescue work scientifically [15].

3.3. The Application of Spatial Big Data in Building Smart City

"Smart city" is not a time-honored topic. IBM proposed "smart city" in 2008. The core of smart city is the process of providing information intelligent service. The core of information intelligent service is not a simple technical application, but a process of reflecting wisdom in information management, and a process of realizing intelligence in the collection, processing, analysis and utilization of information [16]. In fact, in the construction process of smart city, the application support of spatial big data is indispensable. For example, the above-mentioned GPS positioning technology and artificial intelligence applications are part of the construction of smart cities. Besides, there are other aspects of smart city construction and application related to spatial big data. This review will elaborate through the actual cases of different cities.

3.3.1. Infrastructure Construction of Smart City

In 2015, Shanghai adopted a series of measures to promote urban infrastructure construction. It will strengthen the construction of the Internet, with using advanced information technology, communication technology, sensing technology, control technology and computer technology to promote the full deployment of sensors and expand the coverage of sensing monitoring networks including sensing, location sensing, video sensing and environment sensing. The city

has established a unified information security technology system and a centralized information infrastructure information security management platform covering the perception layer, network layer, platform layer and application layer, which can provide a real-time comprehensive guarantee [17]. For example, in terms of front-end perception, Shanghai has installed 550,000 front-end perception devices in five fields, including bayonet, street, online community and building to comprehensively perceive various risks in the field of public security. In the field of bayonet, the intelligent bayonet system has been built in 123 passageways into city, with the inspection and control efficiency increased by more than four times. In the street management level, the high-definition and intelligent transformation of video surveillance equipment was promoted in an all-round way, and the number of cases in the covered area was reduced by more than 50%. In the network field, the real-time monitoring and protection of 130,000 important information system sites and 1080G bandwidth.

3.3.2. Logistics in Smart Cities

The rapid development of logistics industry in modern society, but the degree of informatization is relatively low. So each city has begun to take countermeasures gradually. To build a smart logistics system, the largest sharing of logistics information can be realized through broadband network, call center, wireless communication network, computer terminal browser, smart phone and customized vehicle terminal. Under the network coverage, all the work of logistics enterprises can be moved anytime and anywhere, which can realize real-time monitoring of each link in logistics. These measures can fundamentally reduce the management cost of logistics enterprises. And through the Internet of technology, it will realize the interconnection of information and share the city's public information resources to achieve the purpose of reducing the internal system construction of resources [18]. For example, Xueyuan road street in Haidian district of Beijing cooperated with "Cainiao wrapping" to realize the application of unmanned driving, unmanned warehouse, unmanned distribution, logistics robot and other cutting-edge fields as a pilot project of distribution promotion. Taobao big data generation life map, sports map, travel map for positioning frequent haunts of people to establish a warehouse. [19-21]

4. Trend of the Spatial Big Data

In summary, the application of spatial big data has been closely related to urban construction. Future development trends will focus on data fusion and model building. Achieving cross-department multi-dimensional data fusion is the core technology for building smart city big data centers. Achieving cross-department multi-dimensional data fusion is the core technology for building smart city big data centers. It needs to realize cross-department, cross-organization and cross-domain data association, segmentation and fusion, create object digital space as a key grasper, break through multi-dimensional data fusion as the core technology and establish a holographic view of data sharing across organizations. It is used to uniquely identify the management object as the index association to fuse various state information belonging to the same spatio-temporal object to solve the problem of information fragmentation, realize the fusion of multi-service state information of one management object and the fusion between multiple management objects, and provide users with sharing On-demand service of information, distributed storage, calculation and mining analysis of massive data.

Domestic experts have researched and analyzed the concept of spatial data and implemented key technologies for spatial data support platforms, proposed Task Space models related to tasks and Eorespae models related to data and applied them. It will use big data, Internet of Things, cloud computing, spatial data technology as important methods for data acquisition and data management, and use spatial data technology to organize big data to achieve multi-level and

multi- dimensional big data mining and establish targeted models by targeted Integrate effective data. These are the future trends of spatial big data.

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