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Application of GIS in Internet of Vehicles

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Abstract

The Internet of vehicles is an essential branch of the Internet of things, as well as a major role of the Internet of vehicles system. It is of great significance for automotive intelligence, data collection and spatial analysis; With the growing maturity of GIS technology, the trend of the combination of GIS and Internet of vehicles technology is unavoidable. It can not only realize the establishment of traffic information database, but also provide more flexible technical applications for future traffic management. This paper gives a brief overview of GIS and Internet of vehicles technology, and summarizes some important applications of GIS in Internet of vehicles technology.

Keywords

Internet of Vehicles; GIS; Application.

1. Introduction

Geographic Information System, abbreviated as GIS technology, is an intelligent computer processing system that combines data information with three-dimensional geographic images, and combines many mainstream disciplines such as geography, computer science, [1] and statistics. At the same time, GIS is also one of the spatial information systems, which is a technology of data processing and analysis based on three-dimensional space. Therefore, computer hardware and software systems are the premise and background of GIS system application. According to the computer system, it can collect, store, calculate, analyze and use the relevant geographical distribution data and related information. In practical work, staff need to process geographic information such as topographic maps. At the same time, it can also transform the spatial information of the ground into two-dimensional and three-dimensional images, and can also be stored in the form of files such as grids or vectors, providing more practical data support for the application and management of subsequent databases [2]. In short, GIS is an important technical means that combines the unique visualization effect of map with the spatial data analysis function, and has powerful spatial data analysis function.

1.1 Function:

1.1.1 Management Function.

Geographic information system has the functions of information visualization and real-time information exchange. GIS can effectively store all kinds of information in the database for effective management, so applying GIS to practical work is not only conducive to realizing the digitalization and intelligence of urban geographic information, but also can improve the level of data sharing and management.

1.1.2 Prediction and Planning Function.

Prediction planning is mainly reflected in the data analysis function of GIS. According to a large amount of data in the GIS database, managers can predict the layout of cities, summarize the current status of urban planning and management, and predict its development trend and potential capacity

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through the algorithms in the GIS database, which provides a more reliable reference for urban planning such as later planning scheme, land use, industrial division, etc.

1.1.3 Analysis and Evaluation Function.

Staff need to establish data model and auxiliary decision support system based on urban geographic information. [2]

1.2 Structural Composition:

Different classification methods GIS will have different classification results. From the perspective of academic disciplines, GIS is roughly composed of four main disciplines, namely computer science, geography, statistics and big data processing. From the perspective of system theory, GIS is generally composed of four subsystems, namely, computer system, database system, application management system, and actual system management personnel.

2. Overview of Internet of Vehicles:

2.1 Definition:

The main body of the Internet of vehicles is an interactive network composed of various vehicles, accompanied by a series of information such as path path, location, driving speed, and driving route generated by vehicles in the process of driving, which is a more intelligent, efficient, and more informative vehicle-network joint technology. Through RFID, laser radar, camera, sensor, millimeter wave radar, image processing and other electronic equipment in the sensing layer, the information of people, vehicles and roads can be collected; At the same time, it complies with certain communication network protocols to conduct wireless communication or information exchange. [3] It is also considered as the core component of the future intelligent transportation system. The arrival of the 5G era has greatly accelerated the communication capability, which has also greatly enhanced the transmission capability of the Internet of Vehicles technology and shortened the transmission time. At the same time, with the development of society and economy, the number of vehicles owned by residents has gradually increased, which will also make the Internet of Vehicles technology become one of the practical technologies with broad application prospects. It is also one of the effective intelligent technologies to improve the current traffic and pedestrian safety, vehicle congestion and other phenomena, and is also an indispensable technical means to achieve automatic driving and driverless driving.

2.2 Structure:

The structure of the Internet of Vehicles system is roughly divided into three layers from bottom to top: perception layer, network layer and application layer.

2.2.1 Perception Layer:

In short, the perception layer is to sense all kinds of data. Through various sensors, collect the sensed data, collect the traffic information of vehicles, roads and people, such as driving speed, traffic flow distribution, population distribution, route and so on, so as to comprehensively analyze the operation of vehicles and pedestrians through vehicle sensor network, road sensor network and other networks, store the traffic information and road information, and lay the foundation for future applications.

2.2.2 Network Layer

The network layer, as its name implies, is to sort out the information collected by the sensing layer, form a data network and database system, play a transitional role between the application layer and the sensing layer, and then transmit information for the later application layer through 5G communication technology, vehicle communication and other technical means. [4]

2.2.3 Application Layer:

The main function of the application layer is to analyze and apply data, that is, use cloud computing and other algorithms to calculate, process and analyze perceived data, so as to provide users with rich and practical Internet of Vehicles applications [5]

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3. Key Technologies:

3.1 RFID Technology

Radio frequency identification (RFID) technology is a technology that realizes object recognition through radio frequency signals. In addition to the function of sensing the position of objects, it can also sense and track the moving space status of objects in space. RFID technology has been widely used in the field of intelligent transportation, and in most cases it will be used in combination with wireless communication technologies such as database, cloud computing, fog computing, etc. [6].

3.2 Sensor Network Technology

Sensor network is the network processing of the information collected by sensors, based on the support and application of data, and the analysis, processing, collection and storage of various sensors. Different sensors are uploaded to the group data acquisition system through the acquisition system to dynamically and real-time collect various intuitive data required by the Internet of Vehicles service, such as vehicle speed, conventional route, dynamic track, traffic information, etc. Currently, sensors have evolved from a single or several sensors to a sensor network composed of a large number of sensors, and can be customized according to different services. Provide data source for the server, and provide high-quality services for vehicles as various business data after analysis and processing. [6]

3.3 Satellite Positioning Technology

GPS system provides accurate space services for vehicle positioning, navigation and path planning, which makes it an important part of the technical basis of the Internet of Vehicles technology. With the completion of the Beidou navigation system in China, the Internet of Vehicles technology can not only rely on GPS, but also rely on the Beidou navigation system independently developed by China, which also gives the development of China's Internet of Vehicles a new direction of development and gradually realizes localization. [6]

4. Application:

4.1 Application of GIS in Perception Layer:

The most important application of GIS in the perception layer of the Internet of Vehicles is the convenient collection of geographical data and the establishment of a database, so as to realize the visualization of map data and spatial data analysis. The file and data types of GIS include dem, grid, vector, etc. The characteristics of these data are different from the traditional database types. They can not only flexibly modify all kinds of information in the spatial map, but also display data in the form of various visual maps such as traffic planning map, location topographic map, etc., to realize the visualization and synchronous matching of data and map. In addition, the spatial analysis function of GIS is also an important core function of GIS. It can put the traditional two-dimensional plane data into the three-dimensional space for analysis, which is more in line with the actual situation of our three-dimensional space life, and this is also the main reason for applying GIS to various fields. At present, GIS has become the core technology of the Internet of Vehicles, and its application in the Internet of Vehicles system is a landmark development of transportation and geography. [7]

4.2 Application of GIS in Network Layer:

The application of GIS in the network layer is mainly used in data processing and integration. At present, the most extensive application is map matching. Map matching refers to the process of positioning the human-vehicle-road through GNSS, GPS Beidou navigation system, and comparing the measured positioning and path results with the database built by GIS [8]. The biggest integration of GIS and transportation is the use of maps, so the matching degree between maps and actual conditions is crucial. The progress of location acquisition and mobile computing technology has produced spatial trajectory data, which reflects the movement regularity of various real objects, and plays a vital role in many fields such as real-time path planning, road network update, travel law

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discovery and so on. After the completion of the GIS database construction, during the vehicle driving process, it is necessary to determine the position of the vehicle in the map according to the accuracy of the sensor information, so that the theoretical spatial data and the actual spatial location coincide with each other, and complete the map matching.. However, there are still some problems: (1) The algorithm matching time is not only related to the route track, but also closely related to the actual traffic and road conditions. The higher sampling rate and road complexity bring more time-consuming calculation process; (2) At complex road sections such as intersections, because moving objects usually move at a low speed, the distance between track points is smaller than that of other areas, which is also easy to cause incorrect matching [9]. Therefore, GIS has better accuracy and convenience in data processing and integration, and GIS database is more efficient and easier to store and share than traditional database.

4.3 Application of GIS in Application Layer:

The main application of GIS in the application layer is to carry out spatial analysis of data to assist in path planning and facilitate real-time dynamic update of data. The main goal of path planning is to find the shortest path, and provide the best path for vehicles based on the expected values of the shortest travel time, the lowest operating cost, and the shortest distance. Traditional classical algorithms include Dijkstra algorithm, ant colony algorithm, etc. However, these traditional algorithms are not widely used in today's society with huge amount of data, and the calculation time is long. GIS database can effectively integrate these data to find the shortest path.

Real-time dynamic update of data refers to the update of traffic flow information, population travel demand, route allocation and other required information over time. The importance of real-time data updating lies in the inevitable error between actual life and theoretical prediction. For example, the roadside conditions of the medium highway will usually be caused by some force majeure factors, such as various traffic accidents and other factors, which may lead to complex road conditions and changes in driving conditions. If the vehicle still drives according to the previous route, it will lead to reduced traffic efficiency and longer queuing time. With the rise and arrival of the fifth generation of communication technology, with the help of 5G technology and GIS technology in the future, vehicle driving data and traffic system data closer to the actual situation can be collected more conveniently and effectively [9].

5. Conclusion and Prospect:

GIS is a comprehensive technology for intelligent processing, flexible storage and rapid analysis of traffic data and terrain data. It is an organic combination of spatial data and spatial geography. It is also an important achievement in the development of computer technology and geographic information technology. With the continuous improvement of modern science and technology and economic conditions, people's functional requirements for vehicles will not be limited to simple mobile vehicles, but to strengthen the intelligence of vehicles. This requires us to use GIS to establish dynamic data that is different from traditional databases. Therefore, the combination of geographic information system and the Internet of Vehicles is an important trend in the development of intelligent transportation in the future, which can not only facilitate the collection and storage of traffic data The comprehensive and intelligent evaluation of the analysis, processing and traffic planning scheme can also be of great help to solve various urban traffic problems such as traffic congestion, car accidents, and low travel efficiency.

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