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Preliminary Study on the Remote Vehicle Behavior Analysis Based on G/S Model and 3G

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Abstract

It is possible that spatial information integrate into social life applications as the rapid development of spatial information technology. G/S model is a new network service model of spatial information. This paper expounded a preliminary theory for analyzing behaviors of remote vehicle, which is based on G/S model and third-generation mobile communication technology (3G) and realizes the application in the System of Intelligent Vehicle Scheduling. It gives a test case of the system at last and validates its feasibility.

Keywords:G/S model; Intelligent Vehicle Scheduling; vehicle behavior analysis; Location Based Services;

1.Introduction

With the "Digital Earth" from concept to successful application and the development of "Smart Planet" Concept, the construction of urban intelligent traffic is imperative. In the intelligent traffic system, it's essential to do some analysis of vehicle behavior for making a reasonable vehicle scheduling strategy. Since the mobility of vehicles, the interaction between vehicle terminal and the platform data is urgent need particularly. Traditional analysis of vehicle behavior mainly store data locally or set up monitoring equipment at a fixed point to do behavioral analysis. Second-generation mobile communication technology(2G) can only transmit pictures or low-frame-rate video, which resulted in their applications have many limitations. As wireless communication technology development, the bandwidth of 3G network doubled to meet the needs of high-frame-rate and high-image-quality video data transmission. The traditional ways of video-based analysis of vehicle behavior are developing to the real-time, systematic, networked.

The combination of migration computation and wireless devices promoted a new type of application program— Location Based Service(LBS) emergence and development, which made it possible to obtain

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the precise location of individuals whenever and wherever. Through the LBS, users can obtain real-time vehicle location and the information of the location. The development of the Internet of Things provided more extensive space for the applications of the LBS, while allowing a substantial increase in the amount of spatial information data. However, the traditional-based B / S or C/S structure of the network service model still exist so many problems in dealing with massive data storage, computing, access. It would be a major problem facing in the future to process these massive data. The new network services architecture system which based on G/S model can process the spatial data on the Internet well, such as efficient organization, management, visualization and analysis and so on.

2.The new network service model of spatial Information—G/S model

G/S model, named Geographic information Browser/ Distributed Spatial Data Servers model, was a new concept firstly raised by Professor Miao Fang who is a PhD supervisor in Chengdu university of technology. G/S model combined the "aggregation" concept of grid computing and cloud computing and the existing spatial information network service model. The framework of G/S model , shown in Figure 1, consists of Hyper Geographic Markup Language(HGML), Geographic information Browser(G) and distributed spatial data servers(S). Geo-Browser is the query and display platform of spatial information which achieve high-speed transmission and multi-dimensional display in the support of distributed server cluster and HGML. HGML, as the standards of data organization, management, display and exchange, based on the XML syntax and file formats which provides a unified standard to descript and visualize the various spatial data on the Internet. Distributed spatial data server cluster is built by the approach of cluster which is responsible for data storage, processing and transmission.

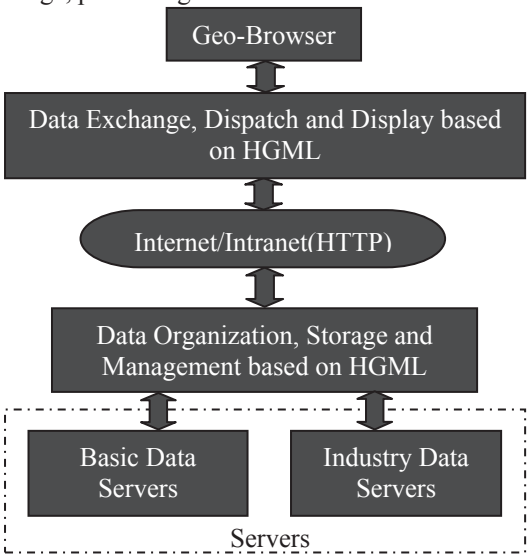

Figure 1. Framework of G/S model

3.Vehicle behavior analysis theory based on G/S model

The theory of vehicle behavior analysis based on G/S model through the terminal which integrate multiple functional modules return the data of real-time vehicle status, such as the audio and video inside and outside the vehicle, GPS, speed and so on. Servers process the received data. HGML is the standard that the data's organization, management, exchange and display. The analysis results are intuitive displayed on Geo-Browser which on the mobile device or monitoring center platform. Then the remote vehicle behavior are determined accordingly. The theory of vehicle behavior analysis which based on G/S

model can process spatial data which distribute on the Internet and the data which collected by the vehicle terminal, such as analysis, organization, management and visualization. The client aggregated data and resources which services needed through the work mechanism of "request—aggregation—service". It can realize dynamic access to spatial information, three-dimensional display, query and analysis. That is effective in improving the existing network service model of spatial information in mass data storage, computing, access and other problems.

3.1. Processing of the Vehicle's Audio and Video Data

In the theory of vehicle behavior analysis，which based on G/S model, the capture terminal of vehicle's audio and video data convert analog signal to digital signal firstly and then compress the digital signal according to H.264 coding algorithms. The data are stored locally or uploaded via wireless network on demand. The users can control remotely the video image resolution, stream, frame rate and image quality and so on. When the Geo-Browser send request of data access, the data are processed by streaming media server and spatial data server cluster and then converted to HGML standard format data which transferred through the internet. The Geo-Browser receives HGML standard data and then analyses the data. The data was displayed intuitive in the Geo-Browser so that the users can achieve the status of the vehicle and the information around it at anytime, anyplace. The vehicle's audio and video processing is shown in Figure 2.

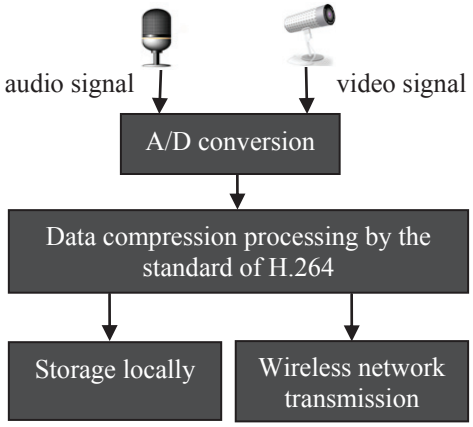

Figure 2. Processing of the vehicle's audio and video data

3.2.Processing of the Vehicle's GPS Location Data

GPS module sent the vehicle's real-time position information to the control center at intervals and then display its location in the Geo-Browser of the control center. The monitoring center can get the information of the vehicle's driving route, driving speed and driving direction and so on. The servers received the GPS data and then stored them according to specific way. The user can qualitative analyze a period data. An important application of GPS data in the vehicle behavior analysis theory which based on G/S model is that real-time calculate the best path from current location to the destination location according to the characteristics of urban road network. The algorithm of finding the best path have a direct impact on the efficiency of the navigation system especially when the number of nodes of the road network increasing substantially. Dijkstra algorithm is used here which basic idea is that find the best path from starting point to all other nodes until it reaches the destination node.

To calculate the shortest path, we must abstract real-life road network entities to the network chart firstly and then achieve the shortest path through the network analyses theory. In practical applications, the representation of road network is digital vector maps which is abstracted to the graph structure according to

the relationship between nodes and arcs in order to efficiently carry out the shortest path analysis. The original road map was preprocessed to establish the corresponding network topology which was stored in a file. The system extracted the road network topology construction directly from the file and then loaded into memory when calculated the shortest path. If the geographic information is updated, the system just need to recreate topology file. The processing of the vehicle's GPS location data is shown in Figure 3.

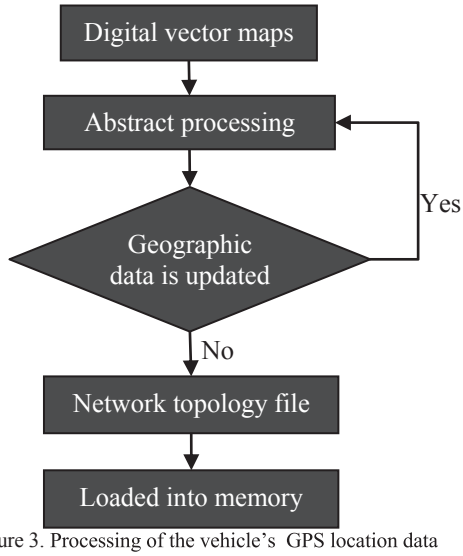

Figure 3. Processing of the vehicle's GPS location data

4.Intelligent vehicle scheduling system based on G/S model

One of the important applications of the theory of vehicle behavior analysis which based on G/S model is intelligent vehicle scheduling system. Intelligent vehicle scheduling system is a set of global positioning technology, geographic information technology and modern communication technology. It sent the real-time status information of dynamic target, included location (longitude and latitude), time and so on, to the control center through wireless communication technology. The moving target trajectory can be displayed on the electronic map with geographic information inquiry function. And the user can inquiry many other vehicle status parameters which they interested in, such as velocity, movement direction and so on.

4.1.System Framework

The intelligent vehicle scheduling system based on G/S model included the follows: infrastructure, system support technologies and service objects. Intelligent vehicle scheduling system infrastructure including: the necessary network, hardware, software and the necessary standards and security policies which ensure the system successful construction, smooth operation and continuous improvement. The system support technologies including: "3S" technology (RS, GIS, GPS), communication technology, distributed computing, database technology, data mining technology and so on. The system service objects including: fire fighting, security patrol, maritime rescue, taxi company, logistics transportation etc. Framework of the intelligent vehicle scheduling system is shown in Figure 4.

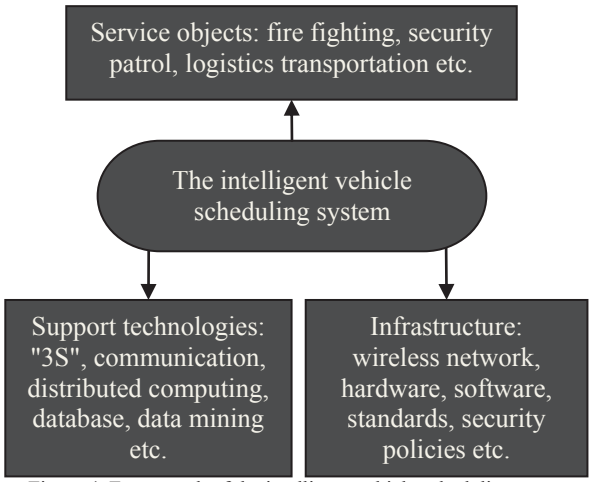

Figure 4. Framework of the intelligent vehicle scheduling system

4.2,Building System

The intelligent vehicle scheduling system based on G/S model combines the benefits of current scheduling system with the G/S model service framework. The outstanding advantages that the theory of vehicle behavior analysis based on G/S model in the application of society are embodied. HGML is the system's standard of data display, exchange, organization and management. A large amount of data is stored and processed by the distributed server cluster. The Geo-Browser is installed in client. The users can query various forms data which are provided by vehicle scheduling system in order to make the appropriate scheduling policy timely.

The frame diagram of intelligent vehicle scheduling system which based on G/S model is shown in Figure 5. Spatial data server cluster based on spatial information database which include remote sensing image database, basic geographic maps database, three-dimensional models database. It published data and provided information services on the Internet by data exchange standard—HGML. The scheduling system database server cluster stored and processed the real-time data which is returned by vehicle terminal equipments. These data is transmitted through 3G network. The data is stored and processed by particular way. The data server cluster published data to the Internet and provided information services for the vehicle scheduling center via HGML data standard. The information browsing device may be desktop computer, laptop or mobile devices supporting GPS. They are generally equipped Geo-Browser which support data exchange standard—HGML.

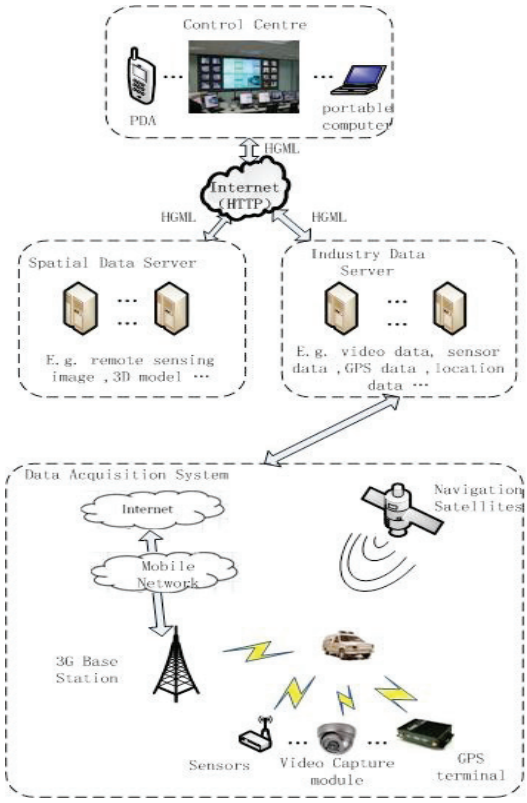

Figure 5. The frame diagram of intelligent vehicle scheduling system based on G/S model

5.System Testing

For the testing intelligent vehicle scheduling system, the Geo-Browser based on Google Earth which visual display cities' geosciences information, vehicle static information, conditionally locating, track playback, vehicle speed and other data of the vehicle. Vehicle terminal is a integration equipment of multi-functional modules. The data operations, such as collection, processing, storage and display, are completed by the Google Earth servers and local distributed server clusters. In this test, the terminal equipment is fixed in the bus. The main purpose is that observe the data, such as video data, GPS data, speed, processed effects during normal operation of the bus.

The test required software and hardware configuration shown in table 1. If user want to receive a better effect, can adopt higher configuration.

TABLE I. PLATFORM INFORMATION

software and hardware configuration	
Browser	Geo-Browser based on Google Earth
OS	Microsoft Windows XP
CPU	Core 2 Duo E7400
Memory	2 GB
video card	NVIDIA Quadro FX 3500
3G bandwidth	CDMA2000 3.1 Mbps

The effect of video is shown in figure 6. The video windows show the vehicle's inside and outside video image when the vehicle normal operation. The blue line in the figure is vehicle trajectory which is the system drawn on the electronic map according to the vehicle's GPS data of a certain period of time.

The vehicle speed data is shown in figure 7 which is returned by vehicle terminal every 3 seconds within 1 minute. The system can dynamic generate the chart. It means that user can choose time by himself. Vehicle terminal can set speed alarm value. If the vehicle's speed overstep the value, the alarm reminder will be given.

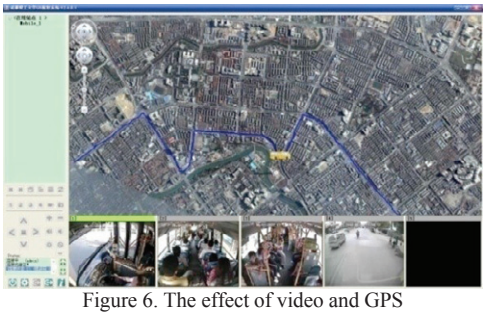

Figure 6. The effect of video and GPS

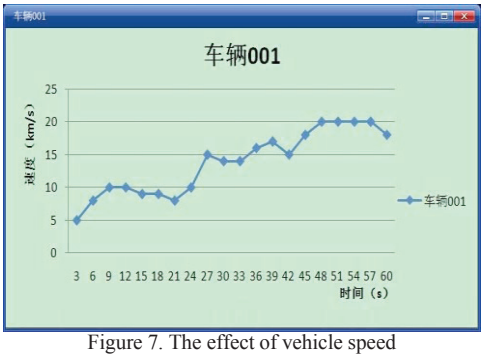

Figure 7. The effect of vehicle speed

6.Conclusion

G/S model is a universal network access model of spatial information. The symbol is massive remote sensing data and geographical information data. With the 3S integration technology, it display global physiognomy by three-dimensional virtual performance. G/S model has broken the past mindset of the spatial information technology. It plays an important role in the industry applications, geographical applications, social applications etc. Combine the concept of service the public with advanced technology. G/S model not only provides a new architecture to different scale application systems of spatial information but also offers a new solution to public application of spatial information service .

G/S model has been introduced to the intelligent vehicle scheduling system which built a theory of vehicle behavior analysis based on G/S model. In practical applications, the theory allow users to get the information of vehicle behavior more directly which provide decision-making reference to many emergencies. However, due to many industries, such as bus operations, security patrol, which need to introduce the application of intelligent vehicle scheduling system is still in the exploration and development stage in the information technology field. So it's still need to continuing exploration to establish a commercial intelligent scheduling system with full functions.

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References

[1] MIAO Fang, YE Cheng-ming, and LIU Rui, "Discussion on digital earth platform and the technology architecture of digital China," Science of Surveying and Mapping, vol. 32, pp. 157-158, November 2007.

[2] Tan Li, Miao Fang, Guo Xi-Rong ,Shi Hong-Yu, "Research on the performance testing of the new spatial information network access G/S model," Proceedings of the sixth International Conference on Wireless Communications, Networking and Mobile Computing, pp.231-236, September 2010.

[3] YU Xiao, "Spatial information management—research of G/S model," unpublished.

[4] A1 Core. Digital Earth, "Understanding our planet in the 21 st century" [M] 1998.

[5] Guo Xirong, Miao Fang, Wang Huajun, Liu Rui, Wu Yuxiang, "The Research on Digital Tourism Services Platform Based on G/S model Archietecture, " Remote sensing technology and application, vol. 24, August 2009.

[6] Xu Kaihua, Chen Mi, Liu Yuhua, "A novel embedded intelligent in-vehicle transportation monitoring system based on i.MX21," Proceedings of the fourth International Conference on Intelligent Computing, pp. 628-635,Septemper 2008.

[7] Lin Yongjie, Pan Shuliang, Jia Lei, Zou Nan, "A bi-level multi-objective programming model for bus crew and vehicle scheduling," Proceedings of the eighth World Congress on Intelligent Control and Automation, pp. 2328-2333, July 2010.

[8] Deng Hongtao, Zhu Xu, Chen Zheng," An efficient implementation for H.264 decoder," Proceedings of the third IEEE International Conference on Computer Science and Information Technology, pp. 41-44, July 2010.

[9] Xu Tian-Lai, Cui Ping-Yuan, Cui Hu-Tao," Method of land vehicle INS/GPS integrated navigation aided by road network constrains," Control and Decision, vol. 24, pp. 398-402, March 2009.

[10] Zhang Jiangshui, Hua Yixin, Feng Tao, "The embedded GIS technology in LBS," Proceedings of the eighteenth International Conference on Geoinformatics, June 2010.