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Research on Integrated Information Navigation System Based on Chemical Sensing and GIS Location

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The main function of geographic information system (GIS) is to collect, store, manage, retrieve, process and analyze geospatial data. The function of GIS depends on the acquisition of location information, and the integrated navigation technology can provide more accurate navigation and positioning information. In this paper, combined with GIS positioning and fluorescent chemical sensor, the debugging software of upper computer is designed and implemented. The positioning information of the navigation panel is transmitted to the computer through the serial port. Further analysis and research will help to provide feedback on the navigation controller and improve the design. After the design is completed, the integrated navigation system will be put into application. Based on the research of GPS navigation technology, map matching technology and traffic flow, this paper explores the navigation system which can meet the traffic characteristics from the technical point of view.

1. Introduction

The navigation system is divided into two categories: autonomous and involuntary navigation. At present, the most widely used autonomous navigation systems are celestial navigation and inertial navigation system (Atia, et al., 2015). Non-autonomous navigation system is a satellite navigation system that relies on radio signal transmission navigation system. In all navigation systems, satellite navigation and inertial navigation are the most mature and widely used technologies (Blazquez and Miranda, 2014). Due to their own characteristics, a single navigation system often has an insurmountable disadvantage (Carrel, et al., 2015). When using a single navigation system, the error of positioning information will be increased in some special situations. It reduces the precision of navigation (Dawood, et al., 2016). For example, the principal component of inertial navigation is the gyroscope and accelerometer, which is used to measure angular acceleration in the motion of an object. The accelerometer is used to measure the acceleration in linear motion. By using the output of the two, the attitude and position information of the object are calculated. However, the manufacturing process limits the accuracy of component measurements, and the results of the solution will have some error. These errors will continue to accumulate in the process of running the system (Huang, et al., 2017). If it is navigated for a long time, the accuracy of inertial navigation will be reduced (Qin, et al., 2014). Its initial alignment is long. By increasing the inertial components of the work to reduce the error, it will greatly increase the cost of investment. However, for satellite navigation systems such as GPS, satellite signals will be greatly attenuated in the shade of indoor or tall buildings. The receiver often cannot capture and receive satellite signals. Moreover, satellite navigation is a non-autonomous navigation. It needs to receive data from the outside, which is susceptible to interference. For many pharmaceutical products, chemical sensors have a strong signal amplification. This provides a better signal positioning guarantee for the satellite signal inconvenience or important special products (Rose, et al., 2014). To a certain extent, the emergence of integrated navigation technology overcomes the defects of single navigation, such as error accumulation and lost signal. The navigation information of different navigation systems is processed by information fusion technology, which

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makes the different navigation systems can learn from each other and promote each other (Wood and Pearson, 2016).

2. The composition of the integrated navigation system

2.1 The role of GIS in navigation

The GIS navigation system is a vehicle-mounted electronic system that directs the current location and displays a map in the vehicle, which guides the car to its destination (Van, et al., 2014). Based on the basic GIS function, it plays the following role in intelligent navigation: (1) display map and data storage; (2) intelligent navigation; (3) locating and correcting information; (4) choose the best route.

2.2 The composition of the integrated navigation system

The integrated navigation system is mainly composed of a chemical sensor (polystyrene acetylene-like molecular wire polymer and signal processing circuit and its signal processing circuit), a GPS unit (GPS receiver board, GPS antenna and RF coaxial cable), a navigation control board, a microprocessor (at least one) and a navigation computer (Yeh, et al., 2017), as shown in Figure 1.

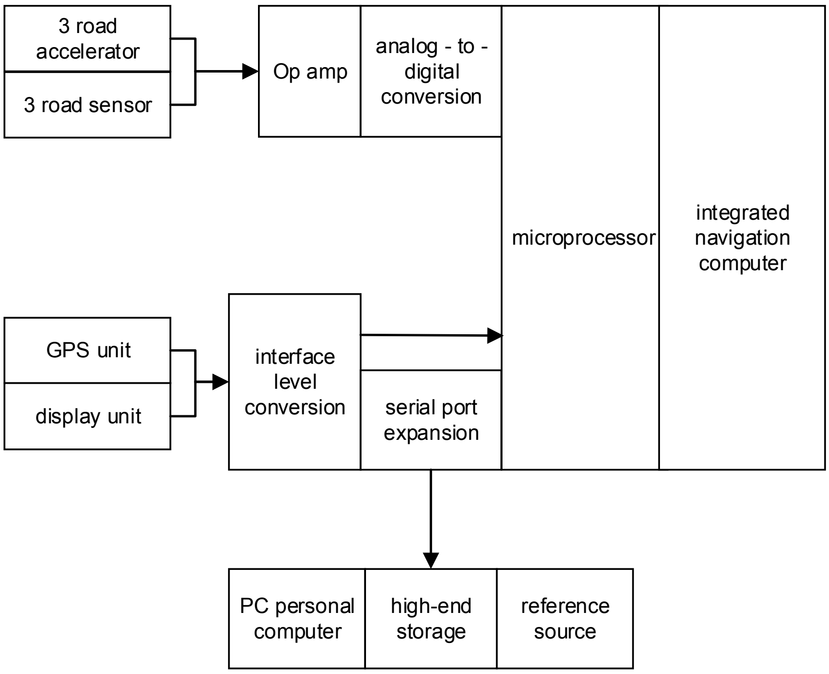

Figure 1: The consist of GPS/INS integration architecture

Six sensors output signals. After the adjustment of the op amp process, it is input to the analog-to-digital converter for matrix transformation. The data is transferred to the system microprocessor for Kalman filtering. At this point, the microprocessor receives the message of the GPS positioning unit in the system, and analyzes the current position and velocity information of the carrier.

The processor extends the serial interface data storage module to store the original data and the final data, and the interface is reserved for the initial access to the initial position of the carrier. In addition, it can transmit the real-time data of the system to the notebook computer for real-time display. The microprocessor is connected to it via an interface.

The data of the attitude angle, pitch angle, roll angle, and three axis magnetic field intensity received by the microprocessor IMU are transmitted to the integrated navigation computer. The navigation and settlement unit converts all the sensors into the output position, attitude and other information, and sends it to the display unit through the serial port.

3. The overall design of the system

The overall design flow is shown in Figure 2.

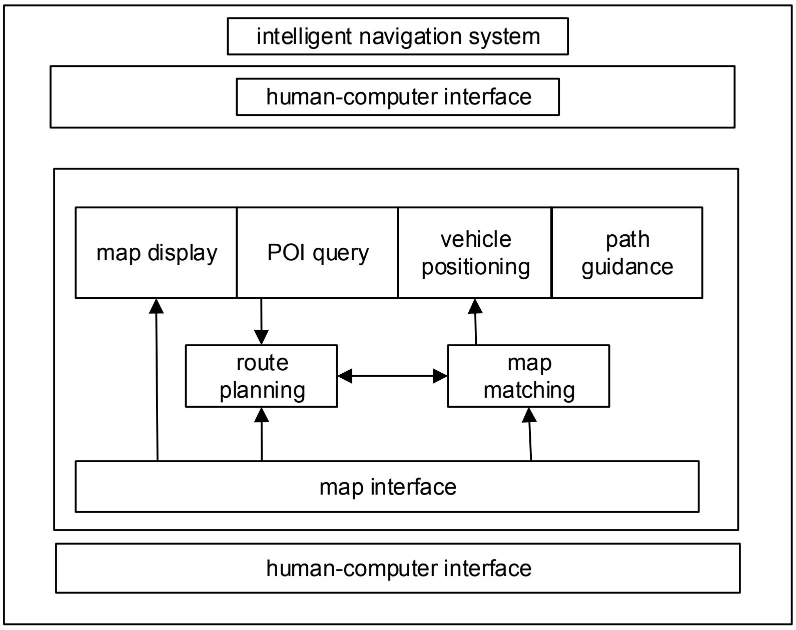

Figure 2: The overall design flow of intelligent navigation system

The basic architecture of the system is C / S architecture, which is divided into servers and clients, and the architecture diagram is shown in Figure 3. In the user database, the data tables are: user rights table, user group table, different user's content table, user-role-assignment table. In this system, it mainly includes four different sub modules: vehicle information acquisition and navigation module, communication data transmission module, monitoring control and scheduling module and server data storage and processing module.

(1) Vehicle information acquisition and navigation module. The intelligent navigation system provides the corresponding location information, while providing data and processing support for the back-office server. In addition, the module will provide the driver with path planning and navigation functions and services.

(2) Communication data transmission module. It is the transitional medium of this intelligent navigation system. This module provides the necessary communication protocol performance, security, scalability and other performance assistance to the system.

(3) Monitoring side control and scheduling module. This module is responsible for the intelligent navigation system information exchange. It can provide the administrator with user information, driving information, location information, while providing a valid interface for the system.

(4) Server data storage and processing module. It is the foundation and key of intelligent navigation system construction. Both the monitoring terminal and the vehicle terminal need it to provide the necessary support. In addition, the module also provides a variety of data storage and management for the operation of intelligent navigation systems.

When the map matching is started, first, the road identification is performed to determine the travel section of the vehicle. Second, it is necessary to locate and determine the exact location of the vehicle in the road to be identified, that is, the location of the vehicle matching process. Matching errors may also occur during the matching process. This is mainly due to the positioning of the vehicle data or map matching theory caused by the error. In this case, the map matching method must be able to detect the wrong positioning data, and to ensure the overall positioning accuracy of the algorithm, as shown in Figure 3.

The premise of this program is that the vehicle can run smoothly on the road, and the accuracy of the digital map is high enough. When the GPS system for initial positioning, the received GPS signal is a valid signal. Therefore, after the completion of the initial positioning, it is not necessary to ensure the effective of the GPS signal.

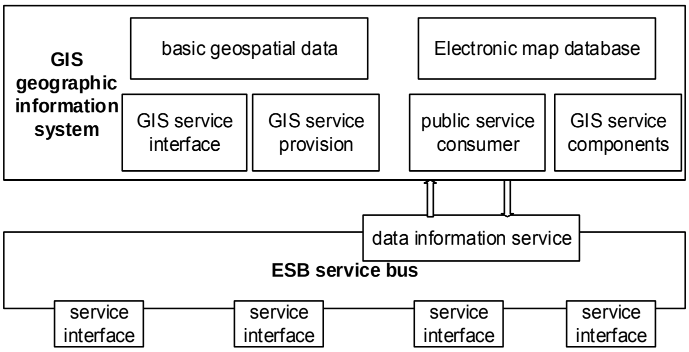

Figure 3: The structure of GIS geographic information system

4. The design of the system module

The system data storage and processing module is divided into five processing sub-modules: TCP / IP port monitoring sub-module, monitoring port processing sub-module, data information processing sub-module, TCP / IP sending queue sub-module and data operation sub-module. The relationship between the various modules as shown in Figure 4. In the vehicle terminal data information processing sub module, the GPS signal received by the vehicle is given the corresponding scheduling, while performing a unified consideration and analysis. If the data is requested at this time, the GPS data is required to be written to the database. If the GPRS data is related to the scheduling and control instructions, it will feedback the success of the message command, and the server will return the success of the message to the corresponding database, in order to provide a guarantee for subsequent applications.

4.1 Server data storage and processing module

The system data storage and processing module is divided into five processing sub-modules: TCP / IP port monitoring sub-module, monitoring port processing sub-module, data information processing sub-module, TCP / IP sending queue sub-module and data operation sub-module. The relationship between the various modules as shown in Figure 4. In all sub-modules, the purpose of the supervisory command processing sub-module is to take into account the type of instruction request on the supervisory side. The service request can be reflected in Figure 5. The personnel authentication and the authority information stored in the database are read and determined. After the result is obtained, the authentication result and the authority need to be sent to the monitoring terminal through the TCP / IP sending queue sub-module.

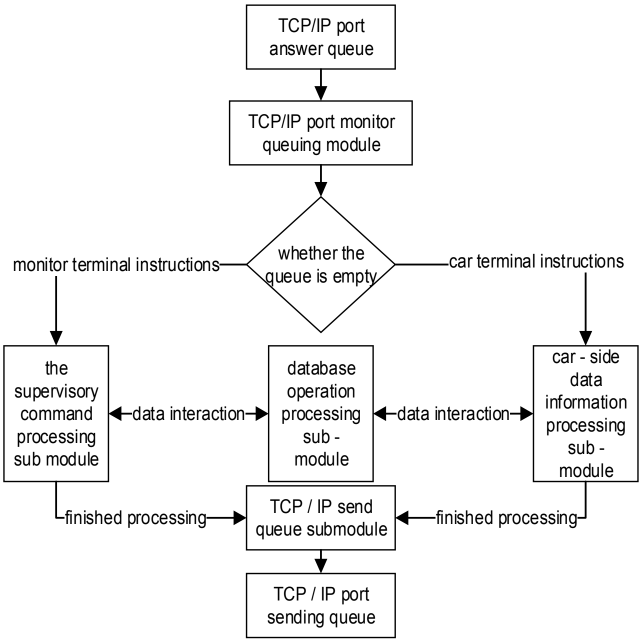

Figure 4: The relationship between server data storage and processing sub module.

In the vehicle terminal data information processing sub module, the GPS signal received by the vehicle is given the corresponding scheduling, while performing a unified consideration and analysis. If the data is requested at this time, the GPS data is required to be written to the database. If the GPRS data is related to the scheduling and control instructions, it will feedback the success of the message command, and the server will return the success of the message to the corresponding database, in order to provide a guarantee for subsequent applications.

4.2 Vehicle positioning

This section analyzes the location of the vehicle, which is the location of the vehicle in the road in the specific location. The location of the vehicle on the road is determined, it is possible to accurately locate the position of the vehicle. The positioning process is shown in Figure 5.

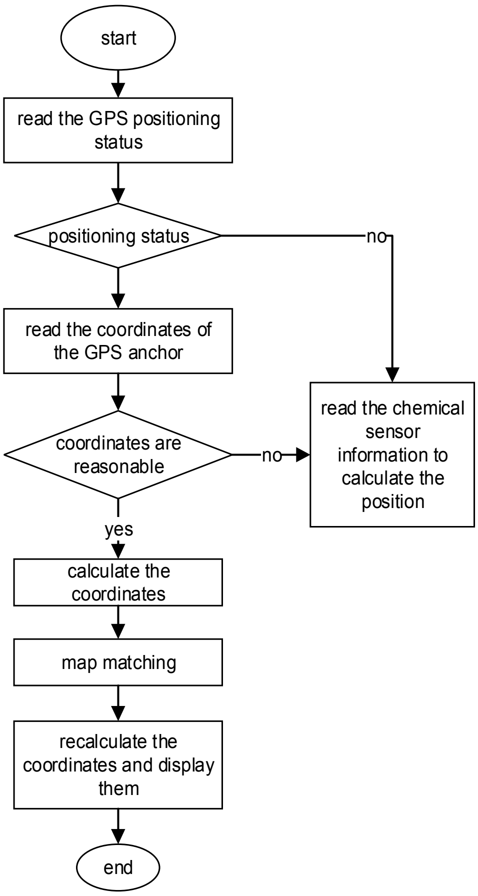

Figure 5: The positioning of the vehicle matches

A reliability check is performed during the map matching process, so that the vehicle can be in the corresponding road network. An exact check of the matching error is required during the integrity check. If the GPS signal is in a valid state, the integrity check is not necessary. However, in the case where the GPS signal is inactive, the positioning error will be large. DR can use this match to complete the next map matching process until the system receives the GPS signal as a valid signal. Therefore, in this process, the integrity check is very important for the vehicle positioning system.
If an error match is detected, the initialization process is called again and the road segment is re identified according to the position of the vehicle.

5. Conclusions

This paper discusses the topic of GPS / INS integrated navigation system based on GIS. Based on the original GPS technology and inertial navigation technology, we developed a combination of navigation products, and completed some functions by using Kalman filter to combine the two navigation technologies. In this paper, some key problems or technologies are analyzed and discussed in depth, and some achievements are obtained. The test and application of the auxiliary integrated navigation system are summarized.

(1) The information of GPS navigation board is binary code. The output of the information will be difficult to understand without operating. Serial host computer debugging software is a good solution to this problem. The mechanism of the software is to enter the computer through the serial port GPS navigation board information to decode, and convert it to floating point or hexadecimal number, and displayed according to the demand. At the same time, to achieve a more intuitive display, the three chemical sensors and three accelerometer positioning information were drawn into six curves. It provides a convenient tool for researching the performance of a combined navigation product.

(2) It prepares for the subsequent work of the integrated navigation system, such as the map matching algorithm. Based on the original map matching algorithm, this paper proposes the use of GIS buffer function to map matching. This method is suitable for greatly reducing the amount of calculation of the computer when the vehicle is traveling on a separate road. At the same time, the integrated navigation system has a higher and more stable positioning parameter, which implements the map matching based on the buffer analysis. However, buffer analysis is not suitable for complex situations where multiple paths intersect.

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