

The Digital Map and AVLN system

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Abstract Automobile Vehicle Location and Navigation (AVLN) System is the integrate result of the technology of Spatial positioning and Map. Thus, the composition of GPS, GIS and modern communication technology influents the technique constitutes of the AVLN system directly. The navigation software is composed of disposal of location data, display of digital map, analysis and query of information and digital communication. Now, the major difficulty of the AVLN system spread and applied is lack of digital map and timely traffic information .the production, exchange, selling and secrecy disposal of navigation data are very important to the AVLN system.

Keywords AVLN, GPS, GIS, Traffic-GIS, The Digital Map

Automatic vehicle location and navigation system, utilizing special space location means , such as GPS , inertia navigation system, and etc, is a providing vehicle's real-time Location and surroundings system that shows background and correlative geography information. AVLN system is widely applied in traffic, transport, police, finance, railway and tour department. The development of AVLN system is closely linked with space location and cartography technology. In later seventies, the appearance of the United States'GPS and Soviet Unions GLONSS secondary planet location technology, provided technologies and means for AVLN system including accuracy, all-weather and free-terrain's limitation, and greatly impelled the development of AVLN system.

Navigation depends on maps. In sixties, the application of the computer technologies in cartography gave birth to a new type of map—digital map. People can use computer to integrate space location information and digital map conveniently ,thus , realize AVLN in deed. Along with the advance of the computers'capabilities in managing figures and data, cartography scholars begin to research how to manage and reflect nature and social phenomenal's distributing, combination, relation, development and change. A new subject, namely GIS, formed step by step, and came into being roadway geography information system concerned in traffic. AVLN system's basis are established by modern space location technology, high accuracy, real-time roadway information system and modern communication facilities.

At present, dozens of corporations are undertaking the manufacture, exploitation and distribution of AVLN equipment basing on GPS. In actual application , AVLN systems are more matured in the United States, Western European, Japan and China Tai Wan, and large distinct roadway traffic's information systems and manage center are built there. AVLN equipment and digital map have been more mature merchandise. It began at later eighties that AVLN were widely applied in vehicle monitors. There are few more mature merchandise concerned in auto induct system. Because of the large market potentialities in traffic, tour, bank domain, AVLN system would have better future of application.

1. The compose of AVLN system

AVLN system has three types: 1. vehicle monitor system; 2. vehicle auto navigation system; 3. the above two mix system. A consummate AVLN system function mainly includes location system, digit maps, digit communication, vehicle carrying system and monitoring and commanding system. Picture 1 illusions the concept of a sort of AVLN system.

1.1 location system

GPS, which has better location precision, better location velocity, better location reliability and expensive mantle range, is one space technology achievement that have the highest applied efficiency (economical benefit). Allowing for military, the United States' government adopted SA and AS technologies that make location precision from 15~25 meters to down to 100 meters. For meeting timely location precision and weakening SA influence, people adopted difference GPS location technology. In recent years, the United States, Canada and Western Europe all devoted themselves to setting up all kinds of different stations and different satellites. At the same time, Russia and Western Europe also actively developed satellite location system, such as Russia's GLONASS and Western European's GNSS, independent with the United States' GPS. For exalting GPS set's property and precision, many GPS manufacturers all actively researched the application software combining GPS and GLONASS. GPS satellites' shoot power is about 20W, and the distant of satellites and users is more than 20 thousand kilometers. Therefore, GPS satellites' signals are very feeble, and their intensity commonly is lower than noise's intensity by 3~4 leverls. Thus, GPS signals liable to environment factors' influence. In cities' high story building distinguish, tunnels and forests, and under bridges, blind distinguish are inevitable when locating by using GPS. At this time, other means would be used, such as vehicle odometer, inertial guidance system (top), etc. Depending location data reckoned on navigate location, vehicle odometer can reinforce GPS and forms a more stable vehicle guidance location flat, When GPS can not work.

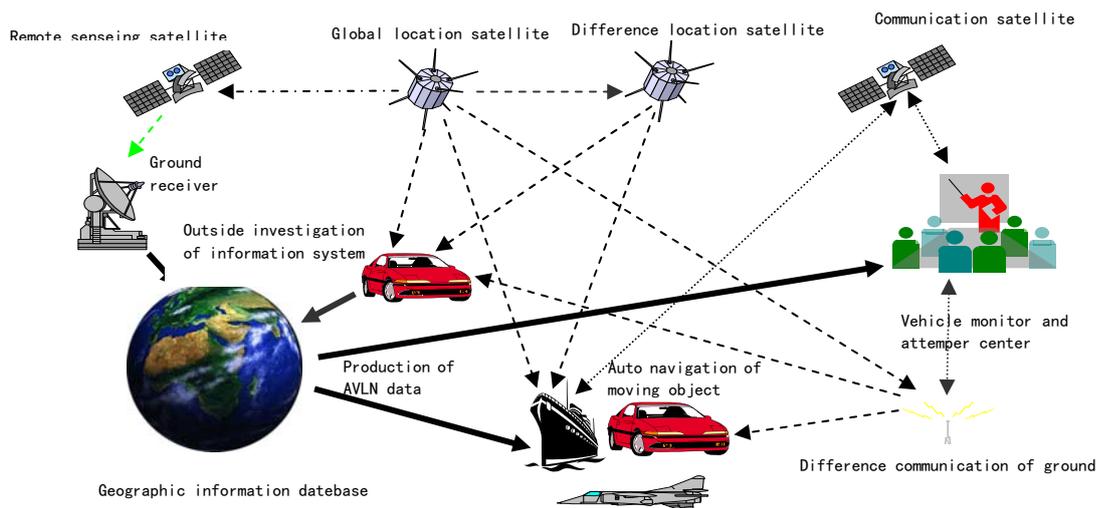


Figure 1 Composition of AVLN system

1.2 digit maps

Receiving vehicle space coordinates derived from location system, person can not know where he is and which direction he wants to go without digit maps or electronic maps (Digit maps are showed on screen, thus electronic maps are created). In order to realize AVLN system's perfect service, vehicle location, digit maps and correlative geography informations must be banded together. At the same time, in the interest of system's stable popularize and shaping up, we must retain real-time digit maps. A important means of regenerating traffic information base is traffic information outside investigate system and satellite remote sensing images.

1.3 digit communication

Communication technology is the key of realizing AVLN system. The request of communication is different to different AVLN system user. The far-distant vehicle trace system (such as line-haul vehicle) only need the least communication, reporting the location every a few hours. Conversely, emergent medical rescue serve needs continuous communication between command attemper center and vehicle to assure that each order-control dictate, run-guide information , occasional-attemper dictate ,etc ,can be supplied to vehicle driver and ambulanceman timely . There are several kinds of communication if we classify it according to region . The one is local communication .for example, city vehicle administer and attemper system only communicate in city and around the city. The other one is district communication ,like province and interprovincial AVLN serve . The third one is international communication . It is mainly used in AVLN serves between countries . Different region has different communication measure . At present , the main AVLN communication measures are satellite communication , wireless data system , mobile telephone communication , beaconing and signpost broadcasting station . Wireless data system is a local communication measure that is adopted comprehensively.

1.4 Vehicle carrying system

Vehicle carrying system is composed of location unit , information disposal unit , display unit and communication unit . They are combined according to the kind of the application of AVLN system . For example , vehicle auto navigation system is composed of location unit , information disposal unit , display unit . (like figure 2) Vehicle monitor system is composed of location unit and communication unit . (like figure 3) . Vehicle monitor and auto navigation system are composed of the above four units .

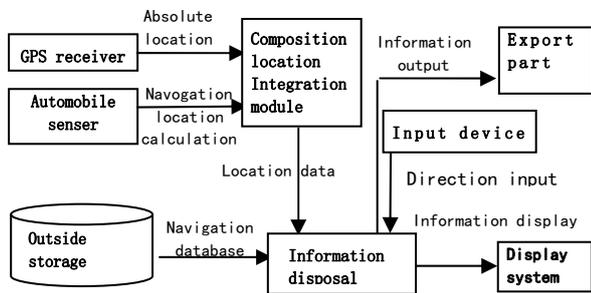


Figure 2 Composition module of auto navigation system

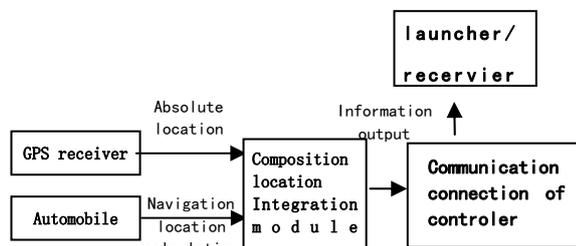


Figure 3 Composition module of vehicle commander system

1.5 Monitoring and commanding system

The main function of monitoring and commanding system is to follow the moving vehicle dynamic timely and to send the object's location and other information to main control center , displaying it in the monitor after map matching in the main control center . (like figure 4)

The main control center can inspect and inquire the parameter of moving vehicle's nicety location ,velocity ,state, and etc , in order to attemper and manage effectively and improve movement efficiently .

2 Traffic geography information system and production of AVLN data

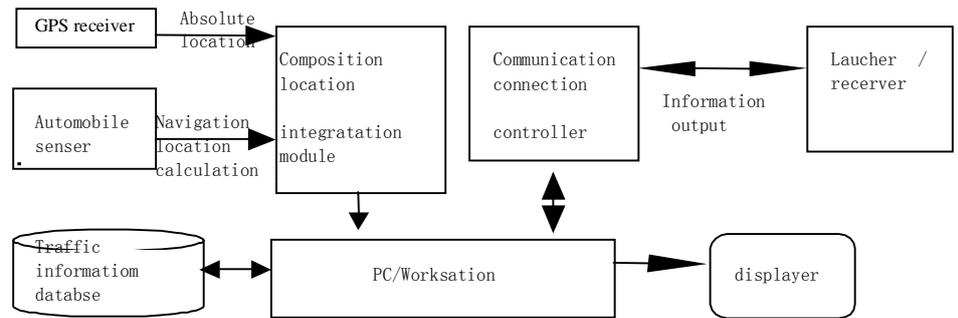


Figure 4 main control center device of vehicle monitor system

2.1 Traffic geography information system

Traffic geography information system is an important branch of GIS. By using hardware, software and network technology, it realizes the input, storage, inquiry, searches, disposal, analysis, display and update of various spatial and non-spatial data and information. It also disposes various spatial entity in corresponding with traffic. Besides road, administer region, land covering and using, road bridge and culvert, railroad, water system, traffic attachment, serve establishment, public vehicle, etc. are the main contents of traffic geography information system. The main information source to build traffic geographic information system is paper map. The most economical and effective means of building and updating local traffic information database is outside investigate system supported by difference GPS. We may adopt remote sensing satellite and navigation photograph to product and update big area traffic information database. No matter what data source are adopted, building and maintaining big area digital road information database is a huge geographic information project, which needs huge fund and effective production organization.

2.2 production of AVLN data

Emphasizing the function of input, storage, inquiry, searching, disposal, updataing and supplying application data, traffic geographic information can't satisfy the AVLN's demand. For satisfying quick inquirement and orientation, AVLN requires the synthesis of traffic geographic information, spatial continuity and establishing orientation index in physical organization. So, people can rebuild traffic information based on traffic information system, creating navigation data facing to AVLN analysis and appliance serve.

3 Navigation software system

BY using navigation software, people can use road information effectively. When devising navigation software, we must dispose the contradiction of huge road information and limited display interface. We divide AVLN software into several modules.

3.1 Figure display module

Figure display module provides the basic function to display figure, like figure's magnifying, shrinking and cruising. Considering the continuity and velocity of figure display when vehicle is moving, we may adopt the admixture of grid data and vector data.

3.2 Information inquire module

Information inquiry is a main function to AVLN system, and it is a essential means for user to acquire information . Inquiry can be classified into inquiry query and non-sort inquiry, faintness matching query and precision matching query. Moreover, considering the user, the system also provide a measure to inquire a object that is nearest the current location ,like gas station that is the nearest to the current vehicle . The distance not only means shortest beeline distance , but also combines with shortest path and makes the traveling distance along the road shortest .

3.3 The module for disposing GPS location data

The core function of the system is to acquire the current location of a vehicle . The disposal of GPS location data can be divided into acquire of GPS data module, filtrate of abnormal data module ,coordinate conversion module ,projection conversion module ,map matching module ,line confirm module ,navigation information prompt module ,etc.

4 Tag

Now , the main difficult in our country to popularize AVLN system is lack of digital map . Traffic geographic information ,navigation data that AVLN need are not production . The standard and criterion of the product should be set down under the leader of some department to make traffic information production and exchange ,exploitation of internet application effectually . Considering country's safety , country 's department limit the digital map's production ,that is the core of AVLN . The secrecy of AVLN is under study and discuss . Current GIS data module is hard to perfect describe GIS data model on geographic spatial information of traffic domain for traffic information's dynamic and complex character ,linear distribution ,network topologic character ,spatial solid intercrossing distribution .The technique and theory of GIS data model based on traffic geographic information is under discussion . At present ,AVLN system is based on static traffic database , but the traffic information is changed dynamic . So ,it is realistic AVLN system that can timely receive digital traffic information and automatically combined with model analysis software .