

Research on Navigation-aids Information System

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Abstract

This thesis researches on the application of computer, modern communication, GIS, GPS, AIS and World-Wide-Web in the field of navigation-aids information system, and has realized an integrated system consisted of navigation-aids information GIS platform, navigation-aids monitoring system and navigation-aids information distribution system. This system has strong integration capability, and has realized navigation-aids information distribution based on WEBGIS at the first time. It strongly promotes navigation-aids daily management and maintenance, and this system provides technique guarantee for ships and marine departments to acquire navigation-aids information in time, by rule and line expediently.

1. Introduction

Navigation-aids is the very important navigation assistant equipment of ship safety navigation, is an important approach for channel smooth of marine traffic transportation, and is also the indispensable part of navigation safety guarantee system. Therefore, navigation-aids work condition should be monitored and maintained in time. To use all kinds of methods to transmit navigation-aids data change to nearby ships under sail in short time, to build an integrative foundation of navigation-aids information system addressing from automatic monitor and maintenance to in-time publishing, is quite necessary. The development of navigation-aids technique is valuable for marine traffic transportation, ocean resource exploitation, fishery capture, national defense construction and national dominion maintenance.

With the development of marine traffic transportation, ships tend to be bigger and faster, the number of ship and dangerous goods loadage tend to be increased, marine traffic accident and economic loss also increase, all of which influence and threat ship navigation safety and marine ecologic environment^[1]. Therefore, new technology should be explored and implemented, to enhance marine traffic safety, ocean environment protection^[2].

2. The general object and constitution of Navigation-aids Information System

The object of Navigation-aid Information System, including navigation-aids information GIS platform, navigation-aids monitoring system, navigation-aids information distribution, is to realize real-time dynamic monitoring and management of navigation-aids and information publishing. The system frame is shown as Fig 1.

Navigation-aids information GIS platform is the platform which complies with the International Hydrographic Organization (IHO) S57 (Third Edition) standard digital chart database and S52 standard digital chart information displaying^[3]. This platform can realize functions such as plug and play accessing of S57 format chart, navigation-aids layer edition, graphics and properties two-way query, chart spatial measure analysis, graphics copy and print in any chosen area^[4].

Navigation-aids monitoring system uses GPS/DGPS to monitor position and work state of navigation-aids, and realizes remote measure and control of it through communication technologies, such as GSM/VHF/AIS, etc, to construct communication chains.

Navigation-aids information WEB/AIS distribution system publishes navigation-aids information via Internet or AIS communication platform to provide in-time, accurate and convenient information service for users.

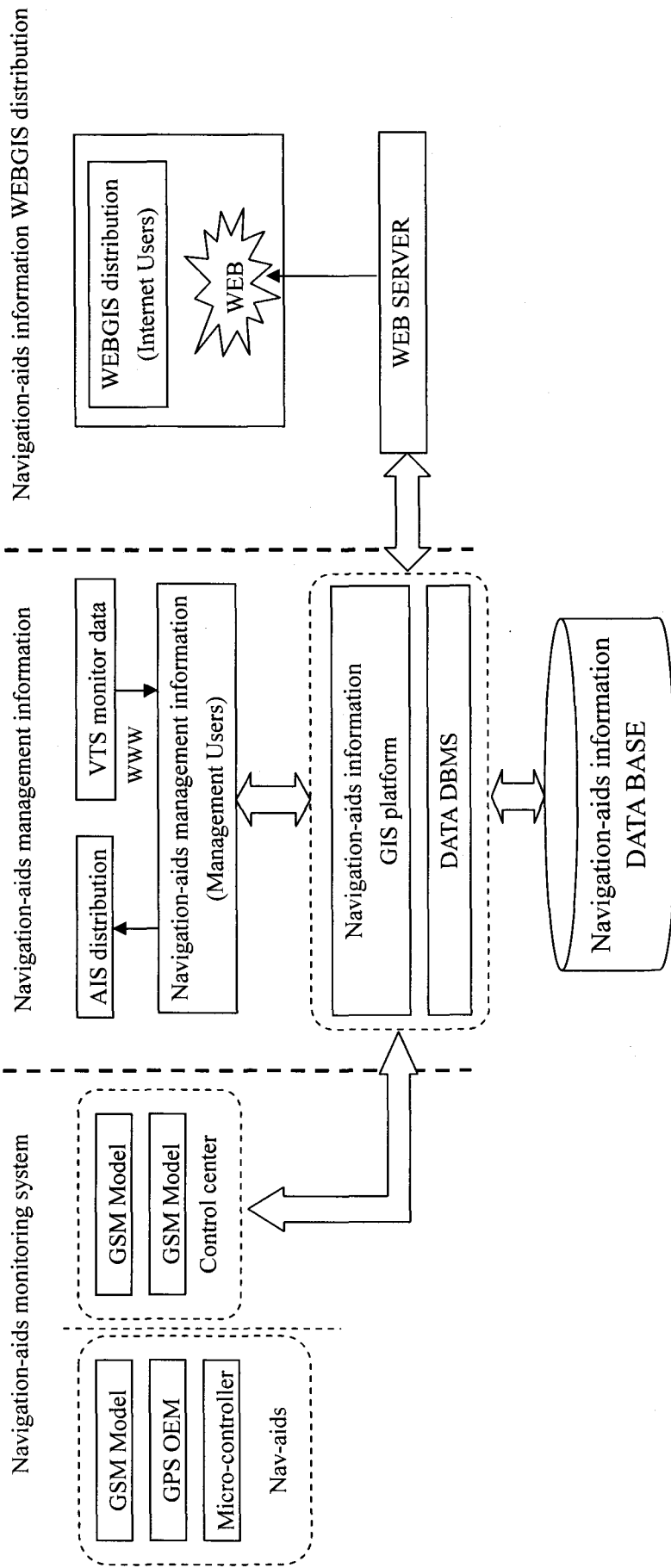


Fig.1 The system frame

3. The technique design of system

3.1 The network structure of system

The network structure of system includes background maintaining computer, database server, application server, network server, I/O interface, navigation-aids station, and so on, as shown in Fig 2, in order to realize common affair management for interior users and navigation-aids information sharing based on network environment.

The task of background maintaining computer is to achieve input and edit of data and graphics, data refresh and setting, safety management, and so on. Network sever is responsible for communication between chart sever and Internet users by transferring request from Internet users to chart sever, and return results to user browser from server as well^[5]. Application sever is responsible for controlling data access, providing map service, decreasing access congestion, and elevating operating efficiency. Database server, which consists of four parts, background maintaining computer, network sever, application sever, database load and manipulation, responses web sever request and returns the result to web sever. LAN interior users have their own Client to take charge for real-time dynamic monitor of all kinds of navigation-aids within controlling area. Internet users adopt browser for chart displaying and manipulating, information query, which is used to deliver users' control demand to Web sever and to display processing result in an apprehensible way, like Internet Explorer, Netscape Navigator, etc.

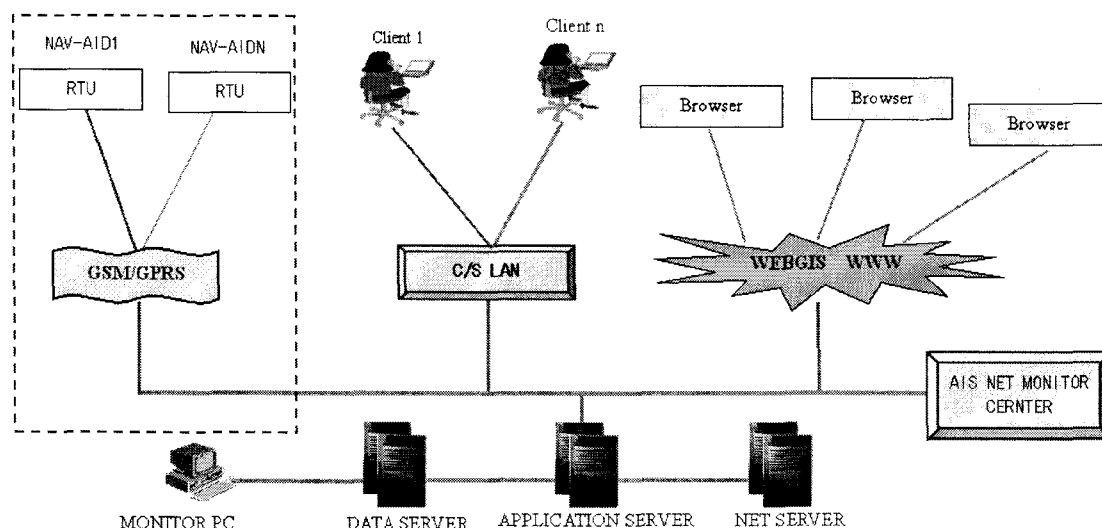


Fig.2 Network structure of system

3.2 Navigation-aids information GIS platform

This platform serves for navigation-aids information integrated management, with main functions including chart data access control, chart display, navigation-aids layer management, I/O interface, etc. The chart data access, adopting internationally popular data load operation (Plug and Play), aims at S57 standard digital chart data format. Any S57 format digital chart existing in the catalogue of chart can be invoked and displayed. The display pattern is single map display or automatic multi-map connection. And the platform also support functions such as zoom in, zoom out, zoom, display by layer and graphics information searching, etc. The zoom-in/zoom-out functions can work to user defined scale, which can be set by designated center point, drawing rectangle or any point. The chart roam function can realize any position roam by left click, and up and down, or left and right pan. As to layer display function, including basic display, standard display, full display, and customized display, users can choose any layer to display. The chart information query can display symbol information of designated position in tree and list combined pattern^[6]. Point, line, polygon and water depth adopt different icons to denote.

Navigation-aids layer management can realize navigation-aids monitor, navigation-aids query and searching,

produce a string of code automatically with built-in processing result and return to Client browser. If this request submitted by Client includes data access, WEB sever is needed to work with database to complete this process. The third layer is database sever, whose task is to harmonize different requests from WEB sever. The B/S pattern simplifies the Client application software^[8]—users just need to install an universal browser, like Netscape, IE, etc. Therefore, it is very fit for web information publishing, applicable for any system, and it can connect diverse systems into a seamless network.

WEB sever is composed of these following functional modules: media flow processing, to produce multimedia data flow; chart data processing module, to read chart requested, to produce graphics for browsing, as well as to accept users' requires, such as data query, spatial measure analysis, and so on, then return results to users, other information processing modules are designed to deal with text information or other requests from users^[9].

The main function of application sever is to accomplish text and graphics transmission between background database sever and file sever, and to cooperate data I/O processing of users' request^[10].

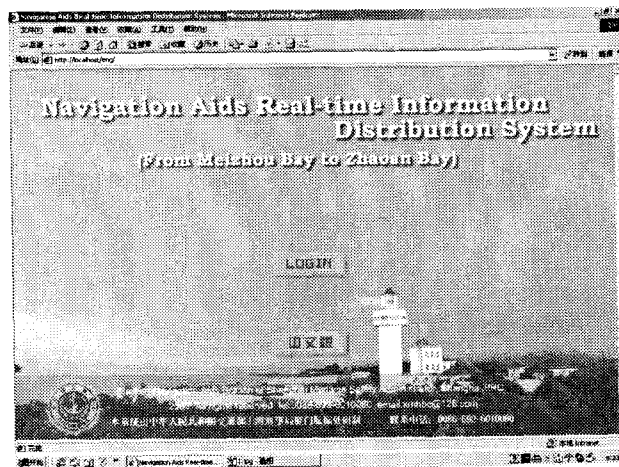


Fig.5 The main interface of navigation-aids information WEB distribution system



Fig.6 Dynamic query of navigation-aids information

3.4 Navigation-aids information AIS distribution

AIS, which is the product of the application of modern information technology in navigation-aids system, provides a technique guarantee for marine traffic safety. With the implementation of AIS, it is necessary to research AIS application in navigation-aids system. The navigation-aids distribution system adopts AIS as communication platform to publish real-time navigation-aids information. Through connecting with AIS equipments, this system transmits navigation-aids information to AIS equipment according to AIS

communication protocols, and the information will be broadcasted outwards broadly via AIS system, which provides a new way for ship to capture real-time information and build a technique platform for AIS navigation-aids realization as well.

4. Conclusion

Intelligence and information is the main issue of the twenty-first century marine traffic transportation, which use high-technique methods to improve safety and efficiency of marine traffic transportation, and to decrease its infection on environment. The construction of guarantee system of marine traffic safety has been concerned for a long time. International Marine Organization (IMO) set down some treaties to bring forward rights and interests, obligations and responsibilities of navigation safety marine countries. All of these countries should make use of modern technologies to build quick, reliable and safe marine traffic system. The research of navigation-aids information system based on information technology, computer network technology and modern communication navigation technology is quite necessary for the modernization of navigation-aids monitor and management, for navigation-aids information accuracy, for convenient information capture, and ship safety.

Navigation-aids information is the most basic and important information of marine traffic safety. The construction of navigation-aids information system based on modern information techniques will provide powerful support for navigation-aids digitalization, will be the developing direction of navigation-aids system, serving as the indispensable part of marine digitalized traffic.

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