

Reflections on the application of electronic fence in navigation aid maintenance ships

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Abstract

With the recovery of the global economy and the continuous growth of international trade, the transportation and logistics role of the shipping industry has become more and more obvious. Because of the development of the marine fishing industry, the high density of sea navigation and the interweaving of commercial and fishery, it has become prosperous.

Introduction

The traditional navigation safety pre-judgment and guarantee methods are mainly through visual, auditory, navigation equipment, radio calls, etc., to communicate in advance to avoid navigation accidents. Although these methods are simple and convenient, they are relatively passive, and it is difficult to actively discover the behavioral dynamics of the target and cannot make correct predictions. Therefore, from the perspective of ship navigation safety, in addition to maintaining a formal lookout, intelligent and information-based means are used for early warning, which complement each other and play a role in jointly ensuring the safety of ship navigation.

1. Risk of safe navigation of ships

Judging from the actual situation of ship navigation, the objective factors that cause the risk of ship navigation mainly include the following aspects: The first is the natural environment, which is bound to be restricted by the natural environment during the navigation of the ship, so the navigation of the ship needs to be considered. Natural factors, such as meteorological conditions, tidal hydrology, underwater structure, etc., and then make corresponding preparations; on the contrary, if the ship lacks the review of relevant factors before sailing, it is easy to threaten its own safe navigation, and the safety of relevant personnel. Life safety and property safety will cause hidden dangers. The second is the navigation factor. As an important part of transportation, the process of ship navigation must be affected by traffic factors, and in most cases, such influences come from waterways. For example, if the actual channel is too narrow, it is easy to cause the collision of sailing ships, and if there are too many ships in a single channel, it will also affect the safety of navigation. For port areas with high tidal level and high navigable density, small boats that are accustomed to relying on tidal currents will travel smoothly, and the density of small boats will be very large, so the safety risk will be greatly increased. Third, the ship's own factors and the comprehensive quality of the crew will also affect the safe navigation of the ship. The ship's machinery and equipment, navigation aids, hull structure, cargo stowage, crew's professional level and basic ship skills will all affect the safety of navigation. Therefore, during the actual navigation of the ship, the consideration of various objective factors should be continuously strengthened, and corresponding preventive measures and emergency plans should be effectively taken.

2. Function, architecture, key technology and application scenario design of electronic fence system

2.1. System function

Send temporary warning information to ships in specific waters. The waters of the water operation site are temporarily delineated as warning areas due to the needs of construction operations. In order to prevent ships from entering these specific waters by mistake, electronic fences and AIS virtual navigation marks can be set up

to warn ships approaching such waters by sending AIS short messages.

2.2. system architecture

The electronic fence system is an extended application system developed on the basis of traditional AIS data application. It consists of two parts: AIS broadcast base station and application software system.

2.2.1 AIS broadcast base station.

The functions of the AIS broadcast base station are data reception, data processing and data transmission. The AIS broadcast base station will preliminarily process and store the received AIS station broadcast information and then forward it to the application software to realize the presentation and application of the data; the application software will send the data information to be sent to the base station management server through the network, and the base station will send the AIS station to the AIS station. Broadcast AIS data.

2.2.2 Application software system.

The electronic fence application software system is a management system based on the browser/server model (B/S architecture) developed using the object-oriented development method and the concept of microservices. The system uses the AIS broadcast base station to draw an electronic fence area and a warning line on the water. When the system senses that the ship enters the electronic fence area or crosses the warning line, the AIS base station will send a short AIS message to the ship to remind the ship.

2.3. Key Technologies

2.3.1 Adopt object-oriented development method.

The design and development of the electronic fence application software system is based on the visual (Rational Rose) modeling tool based on the UML (Unified Modeling Language) standard. The modeling tool defines graphical models such as use case diagrams, class diagrams, object diagrams, state diagrams, activity diagrams, sequence diagrams, collaboration diagrams, component diagrams, and deployment diagrams of the system from different application perspectives, and describes the system from different perspectives. .

2.3.2 Microservice application architecture.

The microservice application architecture adopted by the electronic fence application software can make the operation of the system easier, only need to expand a single component without the need for the entire application stack to meet the service level agreement, and can be updated faster, which will be more beneficial to the subsequent system Function expansion and secondary development.

2.3.3 Adopt B/S architecture.

In order to fully meet the requirements of the electronic fence application software system in terms of security, cross-platform, easy expansion, easy maintenance, etc., an advanced 3-layer application system architecture is adopted: the first layer is the client, which is the interface between the user and the entire system. The application program is reduced to a general browser software; the second layer is a web page (Web) server, which dynamically generates hypertext standard language (HTML) codes and corresponding data response and access processing; the third layer is a database server, which coordinates various Web servers. The request to the database is issued, and the database is managed. The electronic fence application software developed based on B/S architecture can be easily accessed and applied on a web browser.

2.4. Application Scenario Design

2.4.1 Electronic fence area settings.

Set up a warning line and an electronic fence area composed of autonomously delineated polygonal line segments on the control terminal, and realize the setting of the warning line on the chart layer through human-machine friendly interfaces such as latitude and longitude drawing, dragging and drawing lines, etc. After a route crosses the warning line, AIS short messages can be broadcast to it; AIS short messages can be broadcast

for ships entering the polygonal enclosed electronic fence warning area, and the designated ships can also be compared and matched according to the preset data imported from the background. AIS short message broadcast.

2.4.2 Query display of ship data.

Based on the AIS information, the static information and dynamic information of the AIS data of a single ship can be queried in real time, and the group AIS ship data information can also be displayed in real time in the form of lists, bar graphs, and graphs.

2.4.3 System broadcast mechanism.

On the broadcast control terminal of the electronic fence system, the repeat broadcast time interval can be flexibly set, or it can be broadcast manually and immediately. When multiple AIS base stations are networked, the base station to be broadcast can be manually designated, or the base station to be broadcast can be automatically selected according to the "nearest principle" of base stations and ships according to the electronic fence area.

2.4.4 Base station configuration monitoring software.

Through the application software system, the basic information configuration, control and various work data monitoring of the AIS broadcast base station can be realized.

2.4.5 Very high frequency (VHF) voice broadcast.

The electronic fence warning area is set up. When the ship passes through the warning area, the regional VHF voice information can be sent through the 16 channel of the VHF base station as required.

2.4.6 Mobile phone short message service.

Three communication operators, China Mobile, China Telecom and China Unicom, provide coastal mobile phone short message services. The system uses third-party interface components and develops public network mobile phone short message modules respectively. Once the ship passes through the electronic fence, the system will not only broadcast warning information through AIS short messages. In addition, it also broadcasts short messages to the mobile phones of ship-related personnel through the mobile phone short message service.

3. The development prospect of electronic fence for beacon ships

3.1. Advantages of electronic fence for beacon ships

Under the background of the mature development of electronic fence technology, the application of electronic fence in navigation aid ships also has good adaptability. With the development of electronic fence technology, by combining electronic fence and traditional security methods, the safety of navigation aids can be improved to a greater extent. The electronic fence can well realize its own advantages in the operation of navigation aid ships to ensure the safety of itself and the passing ships, mainly reflected in the following aspects:

3.1.1 Rapidity of response to alarm events

When the suspicious ship is too close to the beacon ship itself, timely remind the personnel on board to pay attention to the specific situation, whether emergency avoidance or other emergency measures are required, and uninterrupted work can effectively prevent safety hazards caused by errors caused by human factors.

3.1.2 Dynamic Configurability of System Parameters

According to the changes of the actual situation around the navigation ship's operation, set up single or multiple polygonal restricted areas to dynamically guarantee the safety of the navigation ship. In order to make good use of the electronic fence technology, on the premise of meeting the original navigation needs, how to make good use of the electronic fence on the navigation aid ship to further ensure the safety of the navigation aid ship itself and the passing ships during the operation of the navigation aid ship, which requires further research.

3.2 Problems that may be encountered in the application

With the gradual popularization and application of electronic fences, it has a certain degree of foundation in wind farms, shared bicycles and other fields, but the application on beacon ships is a brand new field that needs to be explored, and it is also compared to other already put into use. Electronic fences, electronic fences on beacon ships also have some problems:

3.2.1. Scope of electronic fence settings

Existing offshore wind farms, fish farms, farms and other places have relatively fixed locations and ranges, so after the electronic fence area is delineated, there is no need to make too many adjustments. The navigation aid ship needs to work on different navigation aids, and the surrounding environment and channel conditions are constantly changing. It is impossible to use a fixed area to deal with all scenarios. Therefore, it is necessary to switch and adjust to delineate different ranges of electronic fence areas.

3.2.2 Information broadcast and reception delay

If the broadcast and reception of information encounters a bad communication environment, or is affected by the interference of other equipment, the receiver itself, etc., it may cause the information to be not received in time, and the early warning broadcast may be delayed.

3.2.3. Channel resource occupation

After setting the electronic fence warning area, when the ship passes through the warning area, it can send the regional VHF voice information through the 16 channel of the VHF base station as needed. And channel 16 is a channel number that all seafarers know, and the ship call information from the bridge of the sea-going ship is usually released on this channel. If the range of the electronic fence is set unreasonably, it may cause the problem of occupying a lot of channel resources.

4. Conclusion

The electronic fencing of the navigation aid ship is a technical means of using modern information technology to ensure navigation, which can help ensure the safety of the passage of ships, and at the same time ensure the safety of the ship and personnel during the operation of the navigation aid ship, so as to facilitate the personnel on board to improve the control of the current sea area. At present, the main points of the implementation of the electronic fence of the beacon ship are the changes in the setting range requirements, the delay effect of the electronic fence itself, and the restriction on the use of the ship-intensive area. In the future, based on this situation, we will further optimize the application of electronic fence in navigation aid ships, and strive to achieve its wide application in navigation aid ships. This technology can be further extended to the application of all engineering series ships.

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