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Maritime sector has always been influencing the global economy. Shipping facilitates the bulk transportation of raw material, oil and gas products, food and manufactured goods across international borders. Shipping is truly global in nature and it can easily be said that without shipping, the intercontinental trade of commodities would come to a standstill.

Recognizing the importance of research in various aspects of maritime and logistic sector, IIRE through its Journal of Maritime Research and Development (IJMRD) encourages research work and provides a platform for publication of articles, manuscripts, technical notes, papers, etc. on a wide range of relevant topics listed below:

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Indian Maritime University – Mumbai Port Campus comprises of two premier institutes, Lal Bahadur Shastri College of Advanced Maritime Studies and Research (LBS CAMSAR) & Marine Engineering and Research Institute (Former D.M.E.T.). LBS CAMSAR is the post sea training institute whereas MERI Mumbai is the pre – sea training institute.

LBS CAMSAR was founded in October, 1948 under the recommendations of the Merchant Navy Training Committee as Central Government premier post sea training institute for Merchant Navy Officers of Navigation & Engineering. And since then, it is offering the comprehensive range of courses for Merchant Navy Officers.

Marine Engineering and Research Institute (M.E.R.I.), formerly known as Directorate of Marine Engineering Training (D.M.E.T.), was established in the year 1949 by the Govt. of India, when the need was felt to train Marine Engineers separately. And since then, it is imparting the education and training to the cadets with a goal of producing the best marine engineers and nautical officers for the world with adopting the latest technology to meet the latest and demanding requirements of the shipping fraternity.
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MESSAGE FROM THE CONVENER

It is very heartening to note that Indian Maritime University – Mumbai Port Campus (Marine Engineering & Research Institute) is organizing a two days Technical Fest Brinicle in association with Maritime Training Trust, D.G Shipping on 28th & 29th March, 2019. This fest is an initiative taken by Maritime Training Trust with an objective of enhancing the maritime knowledge of the participants and to provide all the stakeholders of Maritime Industry an opportunity to gain a great deal of insight into the “emerging technologies”.

I am thankful to IIRE Journal of Maritime Research and Development for collaborating with us. It is pleasing to note that the twelve accepted papers dwell on maritime subjects ranging from Artificial Intelligence, IoT, Inland waterways in India, Sustainable Development, which will dominate the industry in the coming years.

As the success of the event depends ultimately on the people who have worked in planning and organizing it, so I would like to thank the members in all the committees for their great efforts on this success.

Hare Ram Hare
Convener, Brinicle
Editorial

IIRE efforts to ingrain culture of research continues unabated.

A specific seminar is planned in March 2019 at Mumbai bringing researchers, industry and academia together to discuss and highlight the importance of research in the maritime sector.

Yet another opportunity arose when the Indian Maritime University – Mumbai Port Campus invited IIRE to collaborate in the presentation and publication of research based papers of their young cadets pursuing graduate maritime courses. Twelve papers were selected after a process of review which are now being published in a Special edition of the IIRE Journal of Maritime Research and Development. It was heartening to see papers dwelling on some contemporary themes like, Technology inroads into shipping, Sustainable Shipping, Coastal & Inland Waterways that is finding lot of thrust in India. Block-chain technology, Artificial intelligence, Energy efficiency are the areas covered in some of these selected papers. Papers chosen for publication in the Journal was the reward propagated and this brought in much encouragement and healthy competition. The moot idea was once again to engrain the discipline of research in the impressionable minds of the young cadets finding their sea-legs in a dynamic and highly operationalized and challenging shipping environment.

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DISTRIBUTED DATA NETWORK OF INTELLIGENT SHIP BASED ON ARTIFICIAL INTELLIGENCE

Cadet Avishek Ankit

Abstract
Based on the requirements analysis of data storage and application, the paper proposes a new design of the distributed data network platform of intelligent ship. Furthermore, the paper also discusses the application of distributed database and the pre-processing of ship data in ship network platform. And the design will provide powerful data support for intelligent ship management and application.

Keywords- Intelligent Ship, Network Platform, Distributed database, Data pre-processing

1. INTRODUCTION:

With the increasingly diversified and complicated functions of the intelligent ship system, the ship data presents the characteristics of massive and high-dimensional, which make the traditional ship data network management platform cannot meet the need of modern ship applications. In addition, networked, refined and intelligent management has become an essential condition for the survival and development of Marine transportation industry, and the key to this trend development is the reasonable management and application of ship data, thus promoting the continuous development and innovation of ship data management mode. The proposed intelligent ship distributed data network management platform combined with the inherent characteristics of intelligent ship system and the diversity of ship application demands in this paper can improve the ship data management efficiency to a certain extent.

2. STRUCTURE OF INTELLIGENT SHIP'S DISTRIBUTED DATA NETWORK:

The data of the ship is heterogeneous and multi-source, including ship position, speed, course, wind direction and wind speed, water depth, steering Angle command, operating condition of the main engine, alarm of the main engine, cargo temperature, humidity, etc. The above data correspond to the ship's GPS, gyrocompass, log, detector, host monitoring system and refrigerated container sensor, etc. These equipment models and interfaces are various, which bring great difficulty to data collection. In addition, for the host status parameters, alarm
information and cargo information that must be obtained, the signal quantity and signal type of different ships vary greatly, and there are problems such as large space distance, long communication distance, more signal points and more cables between them.

Therefore, the distributed data network platform of ship discussed in this paper will be based on the above problems. In addition, the intelligent ship's distributed data network platform integrates data collection, fusion, analysis and remote transmission. Through data collection and analysis, the intelligent network platform management, intelligent energy efficiency management, intelligent navigation management, intelligent engine room management and other comprehensive management can be achieved.

The distributed data network platform of intelligent ship adopts three-layer and four-level structure. From the perspective of data, it can be divided into four parts: data collection, data transmission, data storage and data application. (As shown in figure 1)

![Distributed Data Network Platform](Source-ddbnic.in)

Using sensor technology, wireless access technology, embedded data acquisition module and video monitoring equipment, the ship data can be comprehensively
collected. The specific collection objects and contents include: Navigation parameter (the ship location information, speed, track, wind speed, wind direction, steering commands and to respond to and echo sounding, etc.), engine room monitoring information, the host system, fuel system, oil system, cooling water system, exhaust system, air system, steering system, anchor system, boiler system and auxiliary system, etc.), Marine environment information (typhoon path and sea condition, etc.) and reefer container temperature information, video monitoring, etc. Taking ship engine room for example, as the most concentrated part of ship system equipment, the data collection and processing of ship engine room is a relatively large work. This process often involves processing hundreds of thousands of digital, analog, and frequency signals at the same time, as well as providing alerts and control commands for specific situations. The platform directly acquires the engine room monitoring data from the intelligent engine room management application through the data interface, and outputs them in a standard format and stores them in the database. For intelligent navigation, the sensor converts the meteorological data into the digital signal required by the data collector for the measurement. The data acquisition module connects various functional plates through the bus to collect and process each sensor signal of distributed configuration, and the processed data is transmitted to the database in a wired way.

The data transmission of the equipment on the ship and the data transmission between the servers are mainly connected via wired and wireless LAN. And when the ship is near the shore, wireless LAN, radio and 3G/4G are used to access Internet communication. The communication between ocean-going ships and shore-based mainly relies on the maritime satellite communication system: after the analysis and processing of relevant data through the shipboard application server, data packets will be transmitted via the satellite ground station to the onshore network data network platform via the Internet through the Web server and maritime satellite communication equipment.

In order to improve the storage capacity and security of ship data, the platform establishes distributed database. After collected, the ship data is stored to each storage node through the data transmission network, and then the storage node makes reasonable data backup and data pre-processing order to improve the utilization efficiency of data, the original data will be preserved reasonably in each storage node,
and the pre-processed data will be stored in layers. According to different data models corresponding to basic applications (such as fault detection of engine room equipment, etc.) and advanced applications (such as ship dispatch, etc.), the required data are stored to corresponding layers.

Data applications are mainly divided into two parts: ship application and company application. At the ship end, the data collected by the sensing layer can be transmitted through the network layer to expand the application related to ship navigation and cargo monitoring and management. The application of the company terminal can be divided into two parts: the secondary company and the parent company. Each secondary company receives the information transmitted by the ship terminal through the network layer to carry out the operation level of ship dynamic monitoring and scheduling, cargo monitoring, emergency disposal, remote medical treatment, ship fuel consumption management and so on. In addition to the functions of secondary companies, the group head office system can also carry out macro management applications such as comprehensive analysis and auxiliary decision-making.

For the intelligent ship's distributed data network management platform, data storage is a crucial part. The optimization degree of data storage will largely determine the efficiency of data management and application.

3. DISTRIBUTED STORAGE OF SHIP DATA:

Distributed database is an important part of the ship distributed data network platform and its optimization degree is the key to the ship data management efficiency. The common ship distributed database is a relational database, which is easy to use, easy to maintain and can be used for complex queries. However, with the increasing of ship data volume, the relational database gradually reveals many problems that are difficult to overcome. For example, due to the diversification and refinement of ship function application services, concurrent load increases during database op damage. In order to satisfy the secure storage and management of intelligent ship system data, the database should have high availability, high performance, autonomy and centralized.
Control operation. If the database cannot withstand such high concurrency, it may cause database crash, user data loss or damage. In order to satisfy the secure storage and management of intelligent ship system data, the database should have high availability, high performance, autonomy and centralized control structure.

The intelligent ship's distributed data network platform adopts distributed database, and its structure is shown in figure 2, including distributed data storage node and database engine.

The distributed database engine is the core of the system, which is responsible for SQL parsing, rewriting, execution and other operations, while managing the underlying storage nodes. Distributed storage nodes use relational databases and are mainly responsible for data storage, processing and synchronization. In the process of ship data management, database clusters of different sizes can be flexibly constructed. By dividing business data into different database storage nodes, the pressure of ordinary database on massive data can be greatly reduced. Requests that have been passed
through SQL will be distributed to each node's idea workstation for execution, which will take advantage of the compute resources of each node to improve the efficiency of the ship system server cluster.

Based on the distributed database infrastructure, each data storage node under the distributed database cluster is divided into several layers. Both layers of the database should have the same standard configuration. The data collected by the data collection network of the vessel equipment is stored in the real-time library, sequence library and relation library respectively after the data pre-processing. The sequential database belongs to the extension of the real time library in memory, and mainly holds the data sequence that changes rapidly in order. Some individual measures can be changed over a period of time all the data stored in the real-time library. For the stratification of the storage node, one of the layers serves the ship foundation applications, such as the host speed control, cabin temperature regulation, etc. The other layer serves the advanced applications of the master station or shore-based users, such as cargo status inquiry, shore-based ship dispatch and emergency command. This classification method can realize more refined, efficient classification management of ship data, and differential treatment of system security, professional business, advanced application and rapid response of business analysis.

The advantage of this design is built on the premise that the sub-station server, the master server and the application server and other related servers are well configured with the corresponding data model. When shore-based users or ship workstations send application requests, they can quickly and efficiently extract data from distributed database accurately, so as to avoid the disadvantages such as congestion and time consuming of ship data network caused by traversing data.

4. PREPROCESSING OF SHIP DATA:

The data collected by ship monitoring and acquisition equipment will be stored to each storage node under the distributed database by the pre-data collection network and the SQL engine. Due to the inherent problems of ship monitoring equipment and impurity factors of data transmission channel, the "dirty data" inevitably exists in each storage node. Ship "dirty data" mainly includes missing data and redundant data. The existence
of these two kinds of data will lead to the incompleteness and reproducibility of data sets. While wasting valuable data storage space, it will also cause great deviation to ship fault diagnosis and other applications.

At present, a relatively simple and effective missing data method is the nearest neighbour filling algorithm based on clustering analysis, which combines Mahala Nobis distance and Grey analysis to calculate K nearest neighbours. This method can improve the accuracy of numerical filling, reduce the limitation of recording attribute, and expand the application scope.

For the problem of ship data redundancy, the existing methods of detecting similar repeated records are mostly based on the idea of ranking records in the database. The main methods include key generation to sort records, n-gram method, priority alignment algorithm and so on.

In order to meet the demand of potential application for raw data, the original data is not fully covered in the process of data pre-processing. The original data were selectively covered with the data with high integrity and validity after data pre-processing.

The application server will be extracted from the distributed database according to the requirements. The process of ship "dirty data" pre-processing is shown in figure 3.

![Fig.3. Pre-processing of ship data (Source: intelligent ship archives)](image-url)
For the intelligent ship distributed data network platform, reasonable data pre-processing can not only improve the ship data storage capacity, but also greatly boost the data utilization efficiency. Taking intelligent energy efficiency management as an example, due to the complexity of influencing factors of energy efficiency management data model, the direct extraction and management of relevant raw data not only consumes database management resources but also greatly reduces the reliability of energy efficiency management scheme. Therefore, reasonable data pre-processing is also an essential part of the intelligent ship data network platform, which combines with distributed database to facilitate the efficient development of intelligent ship data network management platform.

5. CONCLUSION:

The distributed data network management platform of intelligent ships discussed in this paper takes ship application demand as the fundamental starting point and conducts targeted research according to the inherent characteristics of intelligent ship system. This platform not only makes up for the defects of the traditional data management platform, but also has the advantages of "comprehensive perception, reliable transmission and intelligent application", which can be applied in the management of ocean shipping. It can establish a security monitoring platform integrating various departments of shipping enterprises and ocean shipping.

In addition, the distributed data of ship data network platform will greatly enhance the ocean shipping goods transportation safety, navigation safety, the monitoring and control system and the fuel consumption and other aspects of security, reliability, efficiency, become the vessel intelligent management and application provides powerful data support.

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