Research on Ship Energy Consumption Monitoring System Based on Computer Intelligent Technology

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Abstract. With the continuous development of automation technology, and has been widely used in all walks of life, the degree of automation integration in shipbuilding industry has also been greatly improved. In order to ensure the safe and reliable operation of marine power equipment, provide reliable and accurate real-time information for the operation of management personnel, and reduce human error judgment and great waste of manpower, a marine engine room monitoring system based on CAN bus is designed. The system uses computer intelligence technology to improve the real-time detection ability of ship power equipment parameters, and can display the important operation parameters and status of the equipment in real time. When a fault is detected in the running state of the equipment, the system will automatically alarm and record the fault and adjust the operating parameters of the equipment to realize the control of the remote equipment.

Keywords: Computer Intelligence Technology, Ship Energy Consumption, Monitoring System

1. Background and significance

Most ships in the process of operation, it is not easy for shipowners to track and supervise the whole process. In addition, in the actual operation of the ship, most of the engine management personnel adopt the crude oil metering, that is, during the on duty period, the crew will manually copy and calculate the fuel reading, fill in the engine log and noon report, and send them to the company in the form of mail and telegram. Finally, the company will summarize and analyze the data. This basic manual measurement method is not only low efficiency, information lag, can not avoid the error caused by data false alarm, omission and manual reading, but also can not ensure that all readings are at the same time point each time. It can not meet the needs of modern management, which will bring certain economic losses to shipping companies. Therefore, ship managers urgently need a more automatic, scientific and humanized ship energy consumption management mode, which can accurately measure the oil consumption in the process of ship operation, so as to make more targeted energy-saving and engine
maintenance programs, comprehensively improve the comprehensive benefits and enhance the competitiveness of the enterprise. [2]

Building a harmonious smart ship and smart ocean is bound to be a leading direction. Changing the traditional management mode of ship energy consumption and combining Internet technology to scientifically manage ship energy consumption is also one of the important aspects to achieve this goal. The computer intelligent technology ship energy consumption monitoring system is mainly to solve the real-time detection of ship fuel consumption and provide technical means for the management of ship fuel consumption. The system will record the fuel consumption and other relevant data in the process of ship operation in a comprehensive real-time manner, and form a fuel consumption database, and analyze the fuel consumption and ship related performance, so as to provide a reference for shipping enterprises. The energy-saving work provides quantitative basis and scientific guidance, so as to truly achieve "energy consumption and energy conservation". Through the statistical analysis of the fuel consumption data of a single ship, as well as the horizontal and vertical comparative analysis of the fuel consumption of the same route and the same ship type, it can provide reliable operation diagnosis and optimization suggestions, reasonable route design, reduce energy consumption cost, and control unnecessary waste and loss from the technical method. This is of great significance to ease the world's energy shortage, achieve the purpose of creating more corporate and social benefits, promote the sustainable development of shipping industry, and accelerate the construction of smart ships and smart oceans.

2. Computer technology marine fuel consumption detection method

Flowmeter measurement method is to install the fuel flowmeter directly in the fuel pipeline system. The electromagnetic signal generated by the fuel flow meter will be converted into digital signal. By detecting the digital signal, the instantaneous consumption and cumulative consumption of fuel can be calculated. Using flowmeter to measure fuel consumption not only has small workload and high data accuracy, but also most flowmeters provide remote communication interface, which improves the expansibility of the system. When the diesel engine is working, a part of the fuel will flow back to the fuel system. Flow meters can be installed on the inlet and return pipelines respectively, and then the fuel consumption of the diesel engine can be obtained by calculating the difference value, but this is relatively troublesome. [3] All ships are equipped with flow meters on the oil inlet pipeline and in front of the mixing tank, so the reading of the flowmeter is the fuel consumption of the system. (As shown in Figure 1)
3. On line monitoring system of ship energy consumption

The on-line monitoring system of ship energy consumption is mainly composed of three parts: the data acquisition and processing system at the ship end, the communication system between the ship and the shore, and the on-line monitoring and management system for the data on the shore.

3.1. Ship side data acquisition and processing system

By installing intelligent sensor device on the ship or using the existing data acquisition and internal communication system of the ship, taking the bridge and engine room as the main data acquisition points, the ship's fuel consumption data, ship's navigation parameters (speed, course, ship's position) and the important parameters related to the ship's energy consumption (main engine power, speed, total load of the ship's power grid) in the centralized control system are collected in a centralized and regular manner. At the same time, the data can be transmitted to the shore data center by using the ship communication system. (As shown in Figure 2)
3.2. Ship shore communication system

It is a bridge to realize the sharing of ship shore information and the interaction between ship and shore. Its main function is to transmit all kinds of data acquired by the ship side data acquisition and processing system. Inmarsat-cif maritime satellite communication system and mobile communication network are the main technical means for ship shore communication. Satellite communication covers a wide range and is mostly used for ocean going ships, while mobile communication network is mostly used for inland or riverside ships. \cite{4}

3.3. On line monitoring and management system of shore data

The main function is to receive all kinds of data sent from the ship, classify and itemize the energy consumption related data, and display them to the management personnel in the form of chart, and overlay the ship information on the electronic chart to dynamically and graphically display the dynamic information such as ship position and track, so as to facilitate the shore personnel to understand the ship dynamics, scientific management and ship scheduling more intuitively.

4. Overall scheme design of the system

The realization of ship energy consumption online monitoring system depends on the cooperation of hardware and software. In the process of system development, hardware design and software design are interrelated, and sometimes they are also cross meanings. \cite{5} The ship side is responsible for collecting all kinds of instrument data, and the key is to understand the communication and transmission protocol between the data acquisition terminal and various hardware equipment, and write the relevant data acquisition, storage and transmission procedures; the work of the shore side data center is mainly to build a database to store all kinds of ship data information, and to develop the shore side data online monitoring system based on B/S architecture. (As shown in Figure 3)

![Figure 3. program framework](image-url)
4.1. Composition of data acquisition and processing system at ship end

The fuel flowmeter is installed in the fuel system to convert the fuel consumption data into digital signal. Ships usually use low-quality heavy oil with high viscosity, so elliptic gear flowmeter with high safety and suitable for high viscosity liquid is adopted in the system, which can measure the instantaneous oil consumption rate and cumulative oil consumption of the system and support remote communication. GPS module can obtain the latest navigation dynamic information (longitude, latitude, speed, course, etc.) of the ship, which is processed by the acquisition terminal and sent to the data center. The manager can not only master the ship dynamic information in real time, but also effectively analyze the relationship between ship energy consumption and navigation data.

The centralized control panel is the existing data acquisition and communication system of ships, which can effectively monitor the operating parameters of marine engine equipment, including the main engine operating parameters, cooling water system, fuel system, ship power station and other system parameters. Therefore, we can make full use of the engine room centralized control panel to obtain the parameter information required by many systems, so as to reduce the transformation of the original system of the ship and reduce the unnecessary equipment investment. The acquisition terminal is installed on the running ship, and its function in the whole system is similar to "central sensor". According to different communication protocols, it needs to collect and process the data of intelligent instruments, sensing devices and engine room central control panel in time, and then transmit them to shore data service center through wired, wireless or satellite networks.\(^7\)

5. Architecture of on-line monitoring and management system for shore data

5.1. In terms of development and maintenance costs

To develop the application of C / S architecture, the operating system used by users must be considered, and all the mainstream operating systems in the market should be developed one by one, so the initial development investment is large. When installing, debugging and upgrading, it is also necessary for all clients. Once some software modules are modified, all client software needs to be re installed, which also has certain requirements for the user's operation level. In the application of B / S architecture, the development, debugging and installation of the program are concentrated on the server, and the client hardly needs to make any adjustment, which greatly reduces the installation, maintenance and upgrade costs of remote users. (As shown in Figure 4)

![Figure 4. Technical scheme of remote monitoring system](image_url)
5.2. In terms of performance

The advantage of B / S architecture is the flexibility of browsing and accessing. Whenever and wherever there is a network, the program and data of the server can be accessed through the browser of various network terminals. The CIS architecture needs to interact with the server through special client software. Although it can reduce part of the pressure on the server, if the program function is complex, it will occupy more memory resources of the client, and sometimes the program can not run, which reduces the user experience.\[7\]

6. Conclusion

By studying the ship energy consumption monitoring system based on computer intelligence technology, we can not only grasp the energy consumption of ships in real time, and respond to the problems caused by energy consumption in time, but also can use this as a basis to formulate energy saving and emission reduction strategies, so as to contribute to the ecological health of our country and sustainable development.

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