Application of Beidou Satellite navigation technology in monitoring discharge sewage and exhaust gas of ship

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Abstract. The Beidou Satellite Positioning and Navigation System (BDS) developed by China independently, has unique positioning and short message communication functions. The application of this technology provides a highly reliable and stable operation control method for detecting pollutants discharged from ships. The precise positioning and directional measurement of the ship can also realize the real-time uploading of emission data and the issuance of instructions, which realizes reliable monitoring of ship sewage discharge. This application has a positive effect on the development of China's Beidou Satellite positioning and navigation system and on seawater environmental protection, and it is also of great significance for the standardization of ship sewage.

1. Background

Since the beginning of the 21st century, the rapid development of the world economy and shipping industry has led to a sharp increase in the number of ships operating, and the pollution problems caused by ships in the course of operations have become increasingly serious. Compared with motor vehicles and industrial sewage discharge, ship pollutant emissions are generally carried out at sea and at night. The site is relatively concealed and difficult to be directly perceived by the public, which is difficult to manage. At the same time, the marine environment is special. Once pollution occurs, the scope of impact is large, the damage is far-reaching, the control is complicated, and the management is difficult. Ship pollution control will become one of the important contents of China's environmental pollution control.

In this paper the Beidou Satellite functions will be combined to provide a set of automated, intelligent, high-efficiency, low-cost, integrated, real-time intelligent detection and processing system for ship sewage and waste gas, enabling centralized monitoring of the discharge of any ship's sewage and exhaust gas at the monitoring center. The sewage monitoring parameters can be viewed in real time, and the situation can be informed and taken in the first time when problems occur.

2. Ship sewage and waste gas monitoring system frame design

The system consists of three subsystems, namely, ship pollutant emission online monitoring and information collection subsystem, ship pollutant emission information transmission and alarm subsystem and ship pollutant emission monitoring platform subsystem.[1]

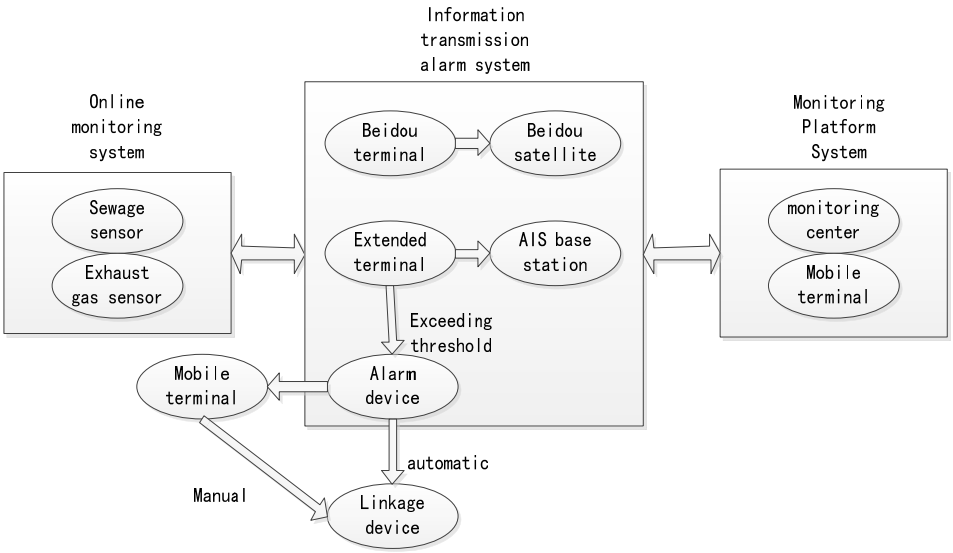

Figure 1.Frame design

The online monitoring subsystem of ship pollutant discharge collects the sewage and exhaust emission information of the ship respectively, transmits the signal collected by the sensor to the mobile terminal and stores it in real time, and the on-duty personnel can view the latest data and historical data at any time on the mobile device. If the monitored value exceeds the threshold, the system will automatically make sound and light alarm, and the excess emission information will be transmitted to the maritime supervision platform PC and mobile through information transmission together with the location information collected by Beidou and AIS terminals. The supervision platform receives and reports the over-standard information of the ship's sewage and the location-related information in real time, so as to promptly make corresponding measures. The linkage automatically starts up automatically after the alarm occurs.

3. Online monitoring and information collection subsystem

The oil concentration sensor, flow meter, PH meter, liquid level meter, biochemical oxygen demand sensor (COD monitor) and other equipment are installed on the ship sewage discharge pipeline for real-time collection of ship sewage parameter information.[2]Exhaust temperature, intercooler temperature, exhaust pressure, sensors such as SOx, NOx, CH_4, O_2, diesel engine speed and fuel consumption are installed in the intake and exhaust lines, the main shaft or the oil return line for collecting information related to exhaust emissions.

4. Information transmission and alarm subsystem

The ship pollutant information transmission and alarm subsystem mainly uses the existing shipborne AIS equipment for function expansion and development, and receives the pollutant discharge information transmitted from the ship's pollutant discharge online monitoring subsystem, and carries out related processing. If the emission index exceeds the standard, for one thing, the AIS function expansion device can be used to sound and light and display the alarm on the ship's personnel, and the alarm will be transmitted to the mobile station on the mobile terminal for the first time. For another thing, the information can be transmitted by using the AIS channel and the Beidou message service to the ship pollutant discharge maritime monitoring platform subsystem.

5. Key technologies

5.1. Shipborne extended AIS equipment

The various signals collect by the sensor are processed into conversion and amplification, and then sent to the onboard extended AIS device[3]; the calculated value is compared with the set threshold by

calculation and judgment. Assume that the oil concentration setting threshold is 15 mg/I. If the monitored value exceeds the threshold, the system will automatically sound and light alarm.

*5.2.*Beidou Service

The ship pollutant emission information transmission is to utilize the communication and positioning functions of the Beidou Satellite. The AIS and Beidou terminals are responsible for transmitting the ship information and ship positioning information to Atmega128 respectively.[4]Atmega128 decodes and encodes the information and sends it to the Beidou terminal. in. Beidou service cooperates with shipborne AIS equipment for remote transmission to achieve real-time monitoring. Beidou message transmission of monitoring data and location information is divided into the following steps: (1) Monitoring data is uploaded to Beidou Satellite through the sending terminal, Beidou terminal; (2) Beidou Satellite forwards monitoring data to the ground center station; (3) The receiving end acquires monitoring data from the ground center station through the Beidou terminal. The communication frequency of the Beidou message service is once per minute, and it can transmit up to 80 Bytes at a time.

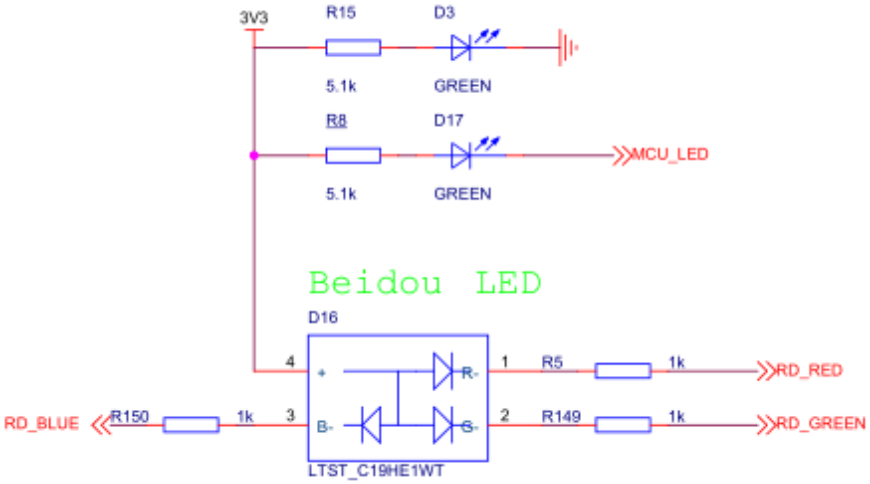

Figure 2. Beidou service part design circuit diagram

6. Monitoring platform subsystem design

Ship pollutant monitoring platform system from Beidou and the AIS information receiving module, the single chip control module, the alarm module and the liquid crystal display module are composed of four parts. The MSPFS5438A MCU HJ12864ZW liquid crystal display module and the CC-50 Beidou receiving module were used as the core devices to build the system hardware platform. The software process design mainly includes the Beidou positioning information receiving software flow, the positioning information processing software flow, the positioning and alarm information display software flow; the software programming is carried out in C language according to the design flow. The system is designed to realize the receiving, processing and real-time display of the liquid crystal screen of the alarm ship's sewage exceeding the standard information and position related information.

To test the efficiency of the introduction of the Big Dipper monitoring platform system into the ship sewage intelligent monitoring system, a comparative experiment was designed.

7. Comparison of efficiency analysis of traditional sewage discharge monitoring system

To test the efficiency of the introduction of the Big Dipper monitoring platform system into the ship sewage intelligent monitoring system, a comparative experiment was designed.

7.1. Experimental parameterst

The experimental parameters are shown in Table 1.

Table 1.Experimental parameters.

project	data
Connection network	Internet of things
working voltage	50 ± 0.2V
working frequency	40Hz
Detection distance	0.02-4m
Working current	55A
Monitoring duration	24H
output signal	Electrical frequency signal
working temperature	0-25℃

7.2. Experimental process

According to the parameters set above, two vacuum monitoring systems with the same performance and state are selected. One of them is controlled by Beidou Satellite monitoring platform, and the other one is controlled by traditional network. Two groups of contrast experiments are carried out.

7.3. Experimental results and analysis

7.3.1. Experiment results

Analysis of Figure 3 shows that the vacuum sewage intelligent monitoring system introduced by the Beidou Satellite monitoring platform and the vacuum sewage intelligent monitoring system under the traditional network control can monitor the sewage discharge, but the vacuum sewage intelligent monitoring system introduced by the Beidou Satellite monitoring platform has far-reaching monitoring effect. Far better than traditional systems. Looking at Figure 3, when the actual value has 13 change points, the system controlled by the Beidou Satellite monitoring platform can monitor 9 change points with high accuracy; however, the traditional network-controlled system can only monitor 7 change points. The difference from the actual value is large.

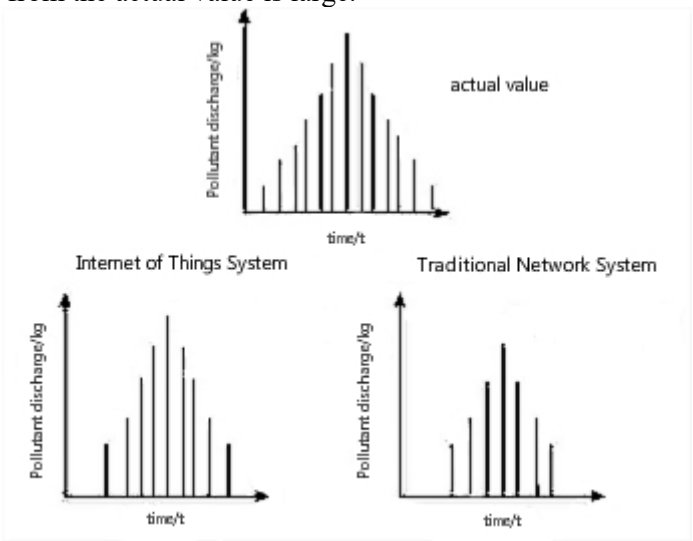

Figure 3 Experiment Analysis

7.3.2. Experimental conclusion

Based on the above experimental results, the following conclusions are obtained:

(1) Group A experimental conclusion: The vacuum sewage intelligent monitoring system controlled by Beidou Satellite monitoring platform and the traditional network-controlled vacuum

sewage intelligent monitoring system can monitor the discharge value change point and record it, but the Beidou Satellite monitoring platform controls The system is able to detect more numerical changes and is closer to the actual value.

(2) Group B experiment conclusion: In the same time, the range of sewage discharge that the Beidou Satellite monitoring platform control system can monitor is always higher than the range of sewage discharge that can be detected by the traditional network monitoring system, and the monitoring capability can even reach the traditional level. More than twice the network monitoring system.

Monitoring the same range of sewage discharge, the Beidou Satellite monitoring platform monitoring system consumes less time, enabling efficient and rapid monitoring.

In summary, the Beidou Satellite monitoring platform control system is superior to the traditional network monitoring system in terms of monitoring range, monitoring accuracy and monitoring time, and has good development potential.

8. Conclusion

Based on the AIS extended application and the Beidou message, the online monitoring and monitoring system for ship sewage and exhaust emissions combines the technology of the Internet of Things,using the extended AIS equipment terminal in combination with the Beidou terminal, using sewage and exhaust emission monitoring sensors and Beidou short message service. The relevant data of ship pollutant discharge can be transmitted to the maritime supervision center in real time, so that the sewage and exhaust gas emissions of any ship can be monitored centrally on the monitoring platform and the mobile terminal, and the sewage monitoring parameters can be viewed in real time. Ability to take timely action. Increase the monitoring of ship discharges and improve maritime supervision capabilities.

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