

Application Research of Ship Maritime Safety Decision System Based on Big Data and Artificial Intelligence



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Abstract With the continuous development of global economic integration, international shipping, as a cheap and large-capacity transportation method, has also developed rapidly. However, marine safety accidents occur from time to time. In the current economic situation, ship safety issues are particularly important. The purpose of this article is to study the application of marine safety decision-making system based on big data and artificial intelligence. This article first analyzes the concepts of big data Hadoop platform and artificial intelligence, and then this article analyzes the current safety problems in marine shipping. In the experimental part, this paper designs a maritime safety decision system. The goal of the system is to analyze the ship's navigation status, and use artificial intelligence, machine learning and other advanced technical methods to replace the original artificial experience prediction method to predict the ship's operating data. In terms of the specific model selection of the system, this paper selects the multi-layer perceptron which is more suitable for ship navigation data with greater volatility as the core model for predictive model training. Experimental results show that the performance of the system can meet the application requirements. In this paper, by analyzing the forecast error of the system, the error is controlled within 15%.

Keywords Big data · Artificial intelligence · Shipping safety · Safety decision system · Machine learning

1 Introduction

The ocean area accounts for 71% of the total area of the earth. In the vast ocean, it not only has abundant biological resources and indispensable water resources on which human beings depend, but also contains a lot of oil and mineral resources closely related to human development [1]. Its importance is obvious. Although the concept

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of blue land has only begun to gain attention in this century, the development and utilization of marine resources have long become a strategic focus for the development of many countries. The war will intensify. Therefore, maritime transportation, marine survey, marine rescue and other related industries and technical research have also developed rapidly.

The research and development of maritime safety decision support system are to establish a maritime safety decision support system based on a large amount of information consultation and maritime search and rescue and decision support system, combining decision support system theory and specific implementation of maritime search and rescue [2]. When studying the maritime safety decision support system, in addition to taking into account the specific conditions of the shipwreck accident and the current marine conditions and weather and other objective factors, the rescue coordination center as a decision-maker must consider the selection and optimization of the existing rescue forces, in case of the occurrence maritime search and rescue bases, using various ship accidents and seeking experience and strategies to solve and deal with new problems, will greatly improve the level of maritime safety decision making and play an important role in reducing casualties and ensuring property safety [3, 4].

This article analyzes the big data Hadoop platform and artificial intelligence, and then this article analyzes the current safety problems in maritime shipping. Taking this as the theoretical basis, this paper designs a marine safety decision system. The goal of the system is to analyze the ship's navigation status and use artificial intelligence, machine learning and other advanced technical methods to replace the original artificial experience prediction method to predict the ship's operating data. By analyzing the prediction error of the system, the performance of the system can meet the application requirements.

2 Method

2.1 *Big Data Technology*

As an open-source distributed computing platform, Hadoop currently has a large number of applications in the Internet field. Hadoop takes Hadoop Distributed File System (HDFS) and MapReduce as its core, and provides a distributed infrastructure with transparent system details [5, 6]. HDFS has the advantages of high fault tolerance and high scalability and can be deployed on inexpensive servers to form a distributed file system for storing and querying data [7]; the MapReduce distributed programming model allows users to develop parallel applications freely need to know the specific distribution style of the underlying framework.

HDFS has the following advantages:

It is suitable for batch processing. The biggest feature of distributed computing is local computing. Mobile computing does not move data. Secondly, it will display the specific data storage location to the computing framework to facilitate the allocation of computing resources.

Suitable for massive data processing. It can process data above the terabyte level and can also process millions of files. In addition to the above-mentioned advantages, it can also access the streaming file. It can be used for multiple calls at a later time through a write, and HDFS is built on a low-cost server to make the cost better. But HDFS also has disadvantages, such as the storage of millimeter level and the storage of a large number of small files. The main reason is that the NameNode's memory is limited.

2.2 Artificial Intelligence

Artificial intelligence is a discipline that studies structural intelligence or implements machine intelligence. It is a science that studies simulation, expansion, and expansion of human intelligence [8, 9]. From the perspective of the status quo and development level of the discipline, artificial intelligence is the prelude to contemporary science and technology and is also an emerging discipline where new ideas, new theories, new technologies and new achievements are constantly emerging. Artificial intelligence refers to machines (including hardware and software) capable of performing tasks. In short, artificial intelligence is a new technology science that researches and develops the theory, method, technology and application system for simulating, expanding and expanding human intelligence. At this stage, artificial intelligence has gradually penetrated into all aspects of social life [10]. In the maritime and aviation industry, establishing a safety decision-making system is a countermeasure in the new era.

2.3 Problems in Shipping Safety

- (1) Ship safety management responsibility is not in place. Affected by the idea of heavy production and light safety, some companies have failed to implement the ISM rules, and some local companies have not implemented this rule at all. In addition, under the influence of the interests of all parties, some inspections and supervision are weak, thus leaving hidden dangers for security.
- (2) Human factors seriously affect shipping safety. Among human factors, the crew's physiological factors, psychological factors, and skill factors all directly determine the degree of safety. The psychological status is affected by the working environment, labor compensation, and daily life. At present, the

domestic crew members are generally underpaid, and they are under pressure from families and society. The situation is not optimistic; the status quo of skill factors affecting shipping safety cannot be ignored.

- (3) The quality of management and law enforcement teams is not high. Management and supervision play a decisive role in shipping safety. However, some members of the management team and law enforcement supervision team are not familiar with this industry or even do not understand it at all, and there is no shortage of people with low professional ethics. And accept supervision.
- (4) The maritime investigation is difficult to obtain evidence, and the purpose of the investigation is not clear. For various reasons, such as some evidence is fleeting, some evidence is easy to change with the change of time and environment, and some evidence is not likely to be obtained because of the interest relationship. When the maritime investigation takes evidence, verifies, and confirms the facts. There are inherent difficulties. In addition, due to the influence of subjective and objective factors such as the recipient system, habits and interests, the purpose of China's maritime investigation is often unclear, and some cases are declared closed after the cause and responsibility have been determined. What's more, the purpose of the investigation is to resolve civil disputes, consciously or unconsciously focusing on finding the cause from the technical and operational aspects of the nautical personnel, which is not conducive to finding the true cause of the accident, let alone proposing valuable safety Suggested.
- (5) The maritime investigation is not standardized. There are four specific aspects. One is that the maritime investigation and reporting procedures are not standardized, only the content of the report is required, and there are no clear regulations on the investigation and reporting procedures; second, the maritime investigation and processing team is weak; third, the maritime investigation and processing are not completely separated. Therefore, it is difficult to ensure the accuracy, fairness, rationality, and seriousness of law enforcement; fourth, the maritime investigation and processing work are not disclosed from investigation, processing to conclusion, forming a "dark box" operation, which has a bad social impact. The lessons learned from the accident are not well absorbed by the nautical community, nor are they convenient for related research, thus losing the significance of maritime investigations.
- (6) The internal conditions of shipping and external environment are poor. Ships are seriously aging, and there are not many people who fail to meet the technical specifications. Some companies purchase foreign retired ships to pursue their immediate interests to directly engage in operations. The relevant ship inspection and safety supervision and management are not strong enough, thus leaving hidden dangers for safety.

3 Experiment

3.1 Data Collection

A shipping company is one of the regional transportation companies with the most complete shipping routes, the densest shipping schedules, and the most extensive business network coverage in the lock area of the company. It is also one of the largest regional transportation service operators in the region. The data in this article comes from the company's ship transportation data from January to June 2019.

3.2 System Objectives

The system establishes a data collection process through big data technology, combs and converts real-time IoT information and business operation information, and stores it in a data warehouse. By establishing a ship management strategy model, the data is introduced into the model to extract key sensitivity factors for ship navigation analyze the situation and use artificial intelligence, machine learning, and other advanced technical methods to replace the original artificial experience prediction method to predict the ship's operating data.

- (1) Use big data technology to realize real-time data collection and establish a storage platform that integrates internal and external data. Construct a data warehouse for ETL and analysis, integrate multi-system, internal and external data such as business operating system production data, ship navigation system IoT data and external ship trajectory data, and structure the unstructured data to form a structured process The data warehouse provides a data basis for the system to conduct security analysis and prediction.
- (2) Establish a SaaS-based cloud service platform. Data exchange is performed on the cloud service platform with standard interfaces, thereby improving the adaptability and scalability of the system.
- (3) Using artificial intelligence and machine learning methods to assist ships in sea navigation for data prediction and analysis. On the basis of data, artificial intelligence and machine learning methods suitable for ship business characteristics are selected to replace traditional artificial prediction, and the stability and consistency of safety analysis are improved.

3.3 System Content

The predictive analysis function of the system needs to predict the development trend of the future business data based on the collected and accumulated past data, which is realized by the machine learning method in the artificial intelligence system. In

terms of the specific model selection of the system, this paper selects the multi-layer perceptron which is more suitable for ship navigation data with greater volatility as the core model for predictive model training. From the perspective of technology framework selection and technology implementation, the system selects the popular and mature WEKA framework in the industry. The default language of the framework is seamlessly integrated with the language used on the back end of the system platform to achieve seamless integration at a lower cost.

In the stage of concept and data model construction, the system builds multi-dimensional and multi-indicators on the daily operation and production indicators of shipping companies on the basis of business analysis and investigation, preprocesses the data through the characteristics of the data collected by the platform, and lacks business data. The data interpolation technology is used to complete, and the data noise is reduced. The system integrates the processing process into the platform, which can be completed automatically on the basis of the platform data.

3.4 Experimental Environment

The experiment in this paper was conducted on a notebook with SSD with Windows10, 16G and 256G memory. The security decision system is built using Hadoop.

4 Discussion

4.1 Experimental Results and Analysis

In this paper, the actual data is used to detect the prediction results output by the machine learning method. The error rate between the prediction results and the actual navigation data of the month can be controlled within 15%, which is relatively close to the actual value. Therefore, the prediction results can play an important role in assisting safety decision making in actual navigation. The specific experimental result data is shown in Table 1 and Fig. 1, the data is the result of the author's experimental collation.

Table 1 Experimental index data results

Time	January	February	March	April	May	June
Error (%)	10	14	15	-13	5	-2

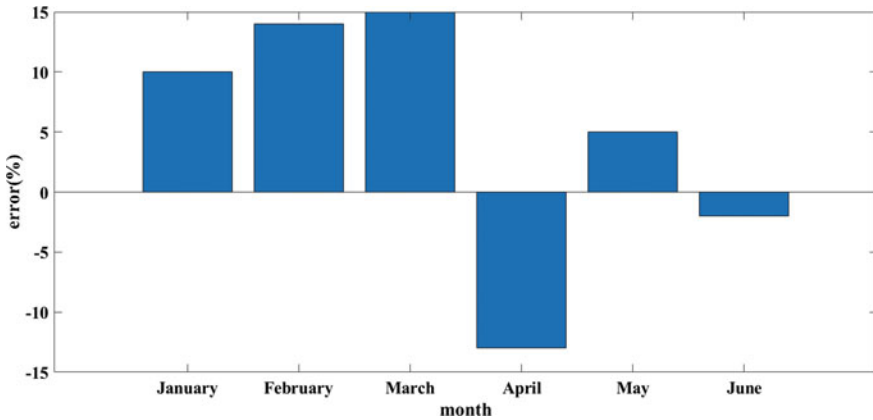


Fig. 1 Experimental data results

4.2 Suggestions for Strengthening the Safety of Shipping

- (1) Maintain lookouts and increase vigilance. Before the ship sails to the sea area where there is a risk of pirate attack, the necessary measures should be taken to improve the alert capability of the ship. To increase the number of watchmen and watchmen on the ship, increase the number of watchers, and do related training for the watchmen. The purpose of reducing the time for each gaze is to enable the gaze personnel to maintain a sober state. Multiple anti-glare telescopes should be equipped in the cab to observe the approaching ships. It can also be equipped with night vision to keep the radar in working condition. A 1:1 dummy can be placed in a strategic position around the ship, giving the pirate the illusion that many people on the ship are watching. Maintaining uninterrupted hope on the ship is the basic means to ensure the safety of the ship's shipping. It can provide early warning of pirate attacks in advance, so that the ship can prepare early and can start the ship safety protection plan in advance.
- (2) Control measures against personnel risks. Accelerate the reform of the crew training model; increase the entry threshold for passenger ship crew; increase the training and evaluation of crew training; urge the company to improve the safety organization and staffing; strengthen the company's management staff business training; increase the maritime law enforcement staffing.
- (3) Control measures against ship risks. Strengthen the safety supervision of passenger ships: Strengthen the safety inspection of passenger ships: increase the maritime law enforcement vehicle and ship configuration.
- (4) Control measures for navigational environmental risks. Accelerate the standardization and transformation of passenger-related terminals; strengthen the regulation of key waterways and safety supervision; implement the channel improvement project for the airway sections in the jurisdiction area with

poor channel conditions, many obstacles, and a large impact on navigation safety, improve channel navigation conditions: strengthen channel management In particular, for low-level sectors with high ship density, safety supervision should be strengthened to prevent accidents. Establish account books for obstructing objects in jurisdictions, conduct statistics and graphic indications of obstacles such as shoals, reefs and shipwrecks that are likely to cause accidents in jurisdictions in different seasons, formulate quarterly accident prevention and control measures, strengthen publicity to remind ships to pay attention, and further strengthen supervision Sex: Strengthen safety supervision during water level alternation: Strengthen safety supervision under poor visibility conditions; strengthen on-site supervision during peak passenger flow; strengthen supervision of ship navigation order.

- (5) Management and control measures for managing risks. Strengthen the operation and management of shipping companies: strengthen the company's hidden danger investigation and rectification; strengthen the company's emergency drill training: improve the maritime agency settings and staffing; improve and improve the maritime safety management system; optimize and improve the maritime safety management measures; strengthen the construction of modern regulatory facilities and equipment: strengthen emergency protection capacity building; strengthen on-site safety supervision; strengthen the electronic construction of basic ledger.

5 Conclusion

Shipping is one of the five major modes of transportation and an important basic industry for economic development and social stability. Preventing and resolving major risks of water traffic safety, ensuring domestic shipping safety, curbing the occurrence of heavy and extraordinarily serious water traffic accidents, and minimizing the loss of people's lives and property are the important responsibilities and primary responsibilities of governments at all levels, industry authorities, and shipping companies. Therefore, carrying out domestic shipping safety risk research has very important practical significance and practical value for safe and safe development. The analysis and decision-making system of shipping production based on big data and artificial intelligence, based on big data technology and machine learning methods of artificial intelligence as a means, has significantly improved the accuracy of maritime safety decision making.

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