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Research Article

Maritime Intelligent Monitoring System Based on Wireless Sensor Network and Construction of Shipping Legal System

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With the continuous advancement of the rule of law in society, the pace of global integration is accelerating, and all countries are actively expanding the development of sea areas. The previous maritime navigation management model cannot meet the conditions for active ocean development in the new era. The state must manage ships. My country has established a series of legal systems for ship management, including ship inspection systems, ship registration systems, and ship safety inspection systems. New management models, new service concepts, and prospects have gradually become the focus of attention of domestic and foreign waterway managers. With the continuous advancement of the rule of law in our country, the law enforcement requirements of maritime navigation management are also getting higher and higher. It is very important to create a good legal environment. This article is aimed at studying how to play the role of wireless local area network in maritime navigation management and how to establish a relatively complete legal system. This paper proposes a gray fuzzy comprehensive algorithm. If the fuzzy subset method is used to determine the membership matrix in the fuzzy comprehensive evaluation, then there will be a sudden drop in the degree of membership due to a slight change in the critical value of the index level. Based on this algorithm, a set of preliminary models of maritime channel management is established. The experimental data in this article mentions that in 2017-2020, the percentage of a certain maritime management's attention to the legal system has clearly shown an upward trend. In 2020, the attention to the legal system is even as high as 69%. It can be seen that supervision improving the legal system is an effective measure. From the data, we can see that the rule of law score in 2018 was about 1.5 points lower than that in 2019, and the rule of law score in 2019 was 7.5 points. The results show that administration according to law puts forward higher requirements on the ability and service level of administrative agencies and their administrative law enforcement personnel, especially in the process of law enforcement, dealing with affairs related to administrative counterparts. Therefore, it is very necessary to establish a complete legal system.

1. Introduction

After the 1990s, wireless communication has achieved rapid development all over the world. Whether it is military communications or civil communications, many new systems and modes are appearing on different frequency bands, providing people with a variety of services. The development of general maritime affairs is still in the "initial stage." The development and development of general aviation require the guarantee and support of national and local laws, regulations, policies, and operating environment. Sound laws and regulations are an important guarantee for the orderly development of my country's ordinary maritime affairs. Improving the maritime management law to ensure the order, rapid, and sustainable development of maritime affairs can be described as urgent issues and need to be urgently resolved. Therefore, legislative research is of broad importance to the development of the entire maritime channel management. Mainly devoted to personnel training, research, and construction of maritime management disciplines, researched and put forward the concept of maritime management and theoretical models of causes of water traffic accidents, and initially constructed the research object and content system of maritime management.

In recent years, rapid progress has been made in the construction of informatization in the fields of navigation and

maritime affairs. The information networks of all levels of government systems are interconnected, and the transmission of official documents on the Internet has been successful. Various large-scale organizations, water transportation enterprises, and organizations have established computer networks, each established an office automation system, continuously established e-government websites, and each established several business management systems.

With the progress of the times, more and more researches on wireless local area network are carried out. Wang et al. found that in recent years, with the rapid development of the blue economy, broadband maritime communications have attracted much attention. In addition to the traditional MF/HF/VHF frequency bands, people are paying more and more attention to the use of higher frequency bands to provide broadband data services to the sea. To design an efficient maritime communication system, the first and most basic requirement is to develop a framework to understand wireless channels. In an integrated air-ground-sea communication network, there are two main types of channels to study, namely, air-to-sea channels (such as for communication links from aircraft-based base stations or relays) and maritime channels (such as for land-based communication links, ship/ship-to-land, or ship-to-ship communication) links. Due to the unique characteristics of the maritime propagation environment, such as sparse scattering, ocean wave motion, and the pipe effect on the sea surface, the modeling of these maritime channel links is different from traditional terrestrial wireless channels in many aspects [1]. Lionis et al. found that free space optical communication (FSO) uses visible light and infrared spectra for data transmission, which has significant advantages, such as very high data rates, security and immunity, low installation costs, and ease of use, without any licensing restrictions. However, a major challenge faced by FSO systems is its inherent limitations due to environmental conditions, especially atmospheric turbulence. This paper focuses on the experimental performance analysis of the real FSO system in the marine environment. We propose a new model that allows FSO link performance estimation at sea and depends on point measurement of environmental parameters. F has measured the received signal strength index (RSSI) and used regression modeling to construct a second-order polynomial to quantify its relationship with the macroenvironmental parameters collected by the weather station [2]. Jansen et al. presented new experimental evidence to prove the effectiveness of using scene motion information to analyze scene structure in maritime imaging applications. The data captured by the new airborne multichannel SAR (MSAR) system is analyzed, which is particularly suitable for sampling the velocity profile of scatterers in the marine environment. Although previous work has demonstrated a practical MSAR system for correcting blur artifacts caused by scene motion, it has shown for the first time how the information provided by the MSAR system systematically classifies maritime scenes into different perception categories. The provided method is superior to traditional classification techniques based purely on the spatial structure of the image. In addition, the simplicity of the feature space involved and the proven classification performance of the images captured by the airborne MSAR system emphasize the advantages of this method [3]. Araki et al. clarified the structure, applicability, and goals of current Japanese privacy information protection and research ethics legislation and checked the provisions of relevant laws/regulations for academic research purposes. Methodological research design is based on the descriptive research of the system. Using the "e-Gov" database, the laws/regulations concerning private information protection and research ethics applicable to medical research and human genome/gene analysis research involving human subjects are included in the research. The Pharmaceutical Law (Law No. 145 of 1960) and related GCP/GPSP regulations and laws/regulations related to administrative organization, management, and procedures are excluded. In addition, the guidelines and Q&A related to these laws/regulations and all 47 county regulations on the protection of private information are selected from relevant ministries, government organizations, and county websites [4, 5]. The newspaper registration system has always been the basic framework of the Korean publishing industry. In 2016, Park proposed that the Korean Constitutional Court ruled that part of the registration requirements of online newspapers was unconstitutional. Therefore, the registration system needs to be reviewed. Since the "Newspaper Law" imposes penalties on publishers who fail to apply for formal registration with government agencies, the registration system is a constraint for newspaper publishers. In addition, it is questionable whether this registration system can continue to operate effectively in the Internet age. With the increase of single-person media, the registration requirements for Internet newspapers may be unreasonable. In addition, this registration system treats Internet Service Providers (ISPs) unfairly and discriminatorily. This research examines the current newspaper registration system and reviews how the system has evolved historically and legally [6, 7]. Anderson and Gupta combine the company's maritime channel management legal system literature flow to study whether the maritime channel management performance can be improved when its governance structure reflects the requirements of maritime channel management and legal systems. Using a sample of 1736 maritime waterway management companies representing 22 countries, Anderson and Gupta found that the joint effect of a country's maritime waterway management legal system is indeed important when explaining the relationship between the performance of a specific country and the overall level of corporate governance. The results also show that companies operating in market/combined countries tend to obtain higher market valuations than companies with comparable levels of corporate governance [8]. Haller et al. proposed that the interface between mental health and law has expanded rapidly in the past few years because the courts heard more and more cases and passed new laws. Although court decisions and laws may be regarded as infringements by psychiatrists who deal with children with mood disorders, Haller et al. suggests that the effect is to provide professionals with new options to help patients. Haller et al. introduced many situations where the legal system can be used [9]. For

battery-powered wireless stations, energy saving is one of the important issues of IEEE802.11 wireless local area network (WLAN). Recently, Lei and Nilsson studied the power saving mode in IEEE802.11 infrastructure mode through M/G/1 queue with batch service. They obtained the upper and lower bounds for the average packet delay and the average percentage of time the station stays in the doze state (PTD). In this article, the power saving mode is further studied; the simple derivation of the average and variance of the packet delay and the precise value of PTD are obtained. The numerical results show that our analysis results of PTD are in good agreement with the simulation results. Using our performance analysis, we can find the maximum listening interval, while meeting the average quality of service (QoS) and packet delay variance, while minimizing the power consumption of the site [10]. Through the research of scholars, we know that with the rapid development of WLAN technology, more and more people pay attention to the security of wireless local area network. Among the marine infrastructure, the maritime administration department provides the most basic services. Therefore, how to play the role of wireless local area network in maritime management and improve the legal system has become a major problem.

The innovations of this paper are (1) the experiment based on wireless local area network completed the software design of wireless mobile terminal of wireless local area network, realized the basic wireless access function, and made maritime channel management more effective. (2) Use gray fuzzy comprehensive method and risk assessment method to resolve the ambiguity between risk factors. This makes the legal system of maritime management more complete. With the development of wireless communication technology and digital signal processing technology, a new generation of mobile multimedia communication terminals can process multimedia information such as images, sounds, and video streams. And because it can be used in video surveillance systems, personal multimedia data terminals, video phones, network transmission and wireless multimedia communications, and other fields, it has a wide range of applications.

2. Gray Fuzzy Comprehensive Evaluation Method

2.1. Fuzzy Algorithm Based on Local Area Network. This paper mainly proposes the gray fuzzy comprehensive method based on wireless sensor network. At the beginning, the importance of maritime law enforcement is described, and then in the method part, the gray fuzzy comprehensive method is introduced in detail, and it is extended to the fuzzy algorithm based on local area network. WLAN is the abbreviation of wireless local area network, which refers to the application of wireless communication technology to interconnect computer equipment to form a network system that can communicate with each other and realize resource sharing. The essential feature of a wireless local area network is that it no longer uses a communication cable to connect the computer to the network, but connects it wirelessly, which makes the construction of the network and the movement of the terminal more flexible. Cellular network, also known as mobile network, is a mobile communication hardware architecture, divided into analog cellular network and digital cellular network. Because the signal coverage of the communication base stations that constitute the network coverage is hexagonal, the entire network is named like a honeycomb. Wireless network technology based on cellular technology and office area network (WLAN) was widely adopted. The wireless local area network in the Chinese market is mainly used for public services, corporate intranets, campus networks, and governments with special geographic areas [11]. Figure 1 shows the basic structure of a general wireless local area network.

Fuzzy algorithms are intelligent algorithms. When we do not have a deep understanding of the model of the system, or objective reasons make it impossible to conduct in-depth research on the control model of the system, the intelligent algorithm can often play a small role; fuzzy algorithm is used. Gray-fuzzy comprehensive evaluation is an evaluation method established based on fuzzy mathematics and related theories of gray systems on the basis of the definite imperfect information of the evaluation object [12]. The gray fuzzy comprehensive evaluation method is a comprehensive judgment method for the evaluation object, which comprehensively considers a variety of risk factors, and has a good effect on processing gray fuzzy information [13]. The specific modeling steps of the gray fuzzy comprehensive evaluation method are as follows.

The establishment of the evaluation factor set is shown in the following formula:

$$f_i^h(y) = \frac{y - y_i^h(1)}{y_i^h(2) - y_i^h(1)}. \tag{1}$$

Suppose $Y = (y_1, y_2, \cdots y_m)$ is the m types of influencing factors of the assessed object, and the number of influencing factors is determined by the characteristics of the studied object, as shown in the following formula:

$$f_i^h(y) = \frac{y_i^h(4) - y}{y_i^k(4) - y_i^k(3)}. \tag{2}$$

After the establishment of the evaluation index system, a reasonable determination of the index weight is the basis of the evaluation work. The accuracy of the weight of each evaluation index and the objectivity of the evaluation index system directly affect the authenticity and accuracy of the selection results. Suppose $Y = (y_1, y_2, \cdots y_m)$ is the level of the evaluated object, which is generally divided into $3 \sim 5$ levels, mainly to determine the degree of evaluation level to which the evaluated object belongs. The evaluation risk level can be taken as $X = \{\text{high, high, medium, low, very low}\}$.

Determine the gray level and the white component function used to evaluate the gray level. The gray level is determined based on the analysis of the actual evaluation object. Generally speaking, the gray level of the gray level is determined according to the number of inspections, the gray level the number of gray levels corresponding to each index is

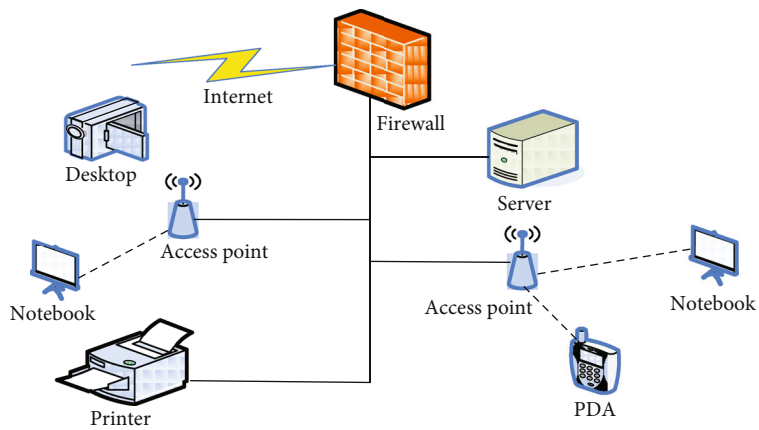

Figure 1: Basic structure diagram of wireless local area network.

determined, and the whitening weighting function to be used is determined according to this [14]. Suppose there are S gray classes, namely, $h \in \{1, 2, \cdots, n\}$, and use f_i^h to indicate that the index I belongs to the whitening weight function of gray class h. The key to system evaluation is to determine the whitening weight function. There are two commonly used whitening weight functions: typical whitening weight function and lower limit measure whitening weight Functions, as shown in Figures 2 and 3.

As shown in Figure 2, the evaluation model is to combine the evaluation index value and the weight of the evaluation index into an overall comprehensive evaluation value through certain mathematical methods and means. The use of mathematical evaluation models to quantitatively analyze maritime law enforcement risks in general navigation management can provide an intuitive basis for maritime risk prevention. In the process of assessing maritime law enforcement risks in general navigation management, the gray whitening weight function is first used to determine the gray statistical value of each index, then the gray weight matrix is obtained, the hierarchical analysis method is used to determine the weight of each index, and finally, the fuzzy evaluation is used to make comprehensive judgment to determine the degree of maritime law enforcement risk in general navigation management [15, 16].

Figure 3 shows that, in general maritime management, the risk factors of implementing maritime law are ambiguous and gray. Therefore, this article combines the fuzzy comprehensive evaluation method and the gray system called the Grifati comprehensive evaluation method [17]. The gray fuzzy comprehensive evaluation method is based on gray fuzzy mathematics and adopts the principle of fuzzy relationship synthesis. Quantification is not an easy task, but based on specific evaluation criteria to quantify several unclearly defined factors. The object belongs to judgment method. The gray fuzzy comprehensive evaluation method uses fuzzy transformation form to make comprehensive evaluation, by establishing a set of risk factors, a set of comments, and determining a set of weights for comprehensive evaluation, making the evaluation process more reasonable [18].

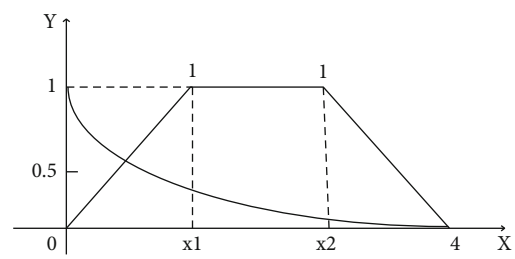

Figure 2: Typical whitening weight function graph.

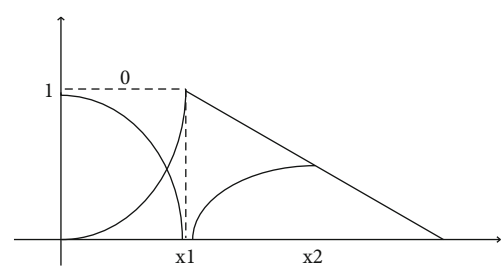

Figure 3: Whitening weight function graph of lower limit measure.

2.1.1. Unary Linear Prediction Model. Univariate linear predictive analysis is a model that deals with the relationship between independent variable a and dependent variable b. The survey object is the linear relationship between these two variables [19]. The mathematical model takes the factors that affect the prediction as independent variables or explanatory variables, and the prediction objects are dependent variables or explanatory variables. The following relationship is shown in the following formula:

$$y_i = a + bx_i + u_i. \tag{3}$$

U is a random variable called a random term, two constants are called a random term, and a and b are two constants.

The number is called the regression coefficient (parameter).

2.1.2. Build a Model. For the regression equation, there are n sets of sample observations, and the difference between the estimated value y_i and y corresponding to $y_i = a + bx_i$ is called the estimation error. Obviously, the error size is an important indicator to measure the quality of the estimator, so the least square sum of the error is used as the minimum measurement on the basis of the total error [20]. Estimation of the parameters: using the least square method to determine the model parameters as shown in the following formula:

$$\hat{a} = \begin{pmatrix} a \\ u \end{pmatrix} = \left(Q^T Q\right)^{-1} Q^T Y_N. \tag{4}$$

Establish a prediction model, find the cumulative sequence, and derive the cumulative sequence, as shown in formula (5):

$$x^{(1)}(t+1) = \left[x^{(0)}(1) - \frac{u}{a}\right] e^{-at}, \tag{5}$$

$$\tilde{x}(t+1) = (-a) \times \left[x^{0}(1) - \frac{u}{a}\right] e^{-at}. \tag{6}$$

Equation (6) uses the residual analysis method in model testing. After passing the model test, the predicted value of the sequence will be cumulatively generated and restored using accumulation and subtraction to obtain the predicted value of the original sequence Yin.

2.2. Fourier Transform Method. For N-point finite length $X(N)$, the discrete Fourier transform formula is [21] the following formula:

$$Y(k) = IDFT[Y(k)] = \frac{1}{N} \sum_{N=0}^{N-1} Y(k) W^{-nk}. \tag{7}$$

According to the important properties of the discrete Fourier transform, for a statistically decreasing finite-length sequence $Y(n)$, the imaginary part obtained by the Fourier transform will always be negative [22], that is, the following formula:

$$Y(k) = -\sum_{N=0}^{N-1} Y \sin\left(\frac{2\pi nk}{N}\right). \tag{8}$$

If it is a statistically increasing signal strength sequence, $Y(1)$ is greater than 0, and the same formula is used to calculate the attenuation speed of the sequence $Y(n)$ in the following formulas:

$$Y(1) = -\sum_{N=0}^{N-1} Y(n) \sin\left(\frac{2\pi n}{N}\right) \prec 0, \tag{9}$$

$$E[(Y(1))] = E\left\{\sum_{N=0}^{N-1} Y(n) \sin\left(-\frac{2\pi n}{N}\right)\right\} \prec 0. \tag{10}$$

Equations (9) and (10) show that the signal strength change estimation algorithm based on fast Fourier transform can not only detect the current signal strength attenuation in real time but also estimate the moving speed of the mobile terminal. From the previous analysis, it can be seen that in the process of moving wireless LAN devices, in addition to the distance between the wireless access points, the moving speed is also an important factor affecting the trend of the signal strength. The faster the moving speed, the signal strength changes. The magnitude of the change is also more drastic, and the following formula is obtained:

$$E[(Y(1))] = E\left[\sum_{N=0}^{2^{N-T}} \left(y(n) - y\left(\frac{n}{2} + n\right)\right)\right] \prec 0. \tag{11}$$

A new LMS prediction algorithm based on a new variable step size is proposed. On the other hand, according to the fast Fourier transform signal intensity change estimation algorithm used to predict the current moving speed of the mobile terminal MS, in order to avoid the limitation of the moving speed factor when the scanning threshold is fixed, the algorithm is used to dynamically adjust the scanning threshold threshold. On the one hand, based on the new variable step size prediction algorithm, using the real-time detected signal strength sequence as the basic data, predict the signal strength value of the mobile terminal in the next time period to obtain the following formula:

$$V = \frac{|X(1)/N|}{\lambda}. \tag{12}$$

Through actual measurement, it is known that in an indoor environment without interference, the coverage of D-LIN is a circular area with a radius of about 70 meters [23], when the moving speed of the MS is calculated by the signal intensity change estimation algorithm of the fast Fourier transform knowing the situation, according to the corresponding relationship between the change of signal strength in the WLAN and the moving speed of the mobile terminal, the prediction algorithm of the scanning threshold closing value LMS per unit time is shown in the following formula:

$$e(n) = \frac{Y(1)}{N} - \frac{y(1)}{(n-1)}. \tag{13}$$

In the formula, $e(n)$ is the current error, and $e(n-1)$ is the last error. When $e(n)$ increases, the adjustment value of the corresponding step size increases, otherwise, $e(n)$ decreases, and the adjustment value of the corresponding step size decreases. The change is controlled by adjusting parameter Y fast or slow, and finally, control the speed of change of the step size, and get the following formula:

$$\beta(n) = \exp\left(-\left|\frac{e(n-1)}{e(n)}\right|^k\right). \tag{14}$$

Based on the signal strength of the new variable step size

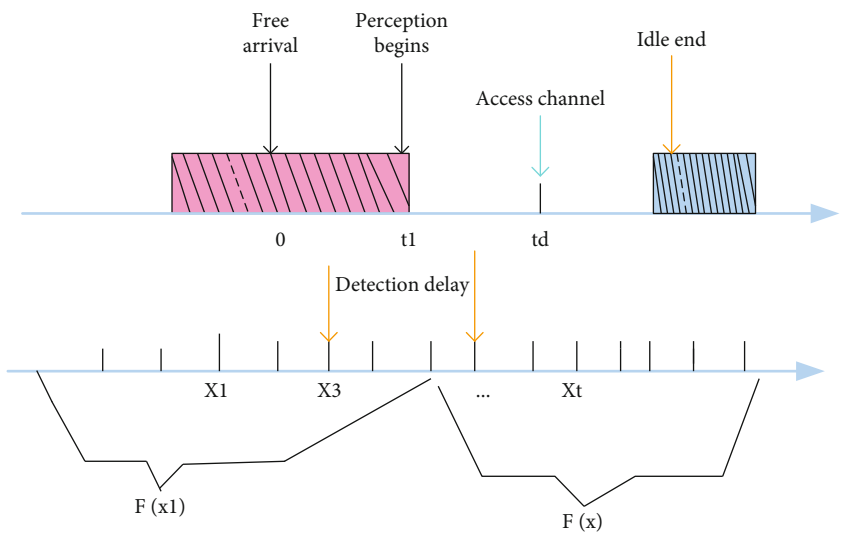

Figure 4: Channel model.

LMS prediction algorithm and formula (15), the mobile terminal can adaptively adjust the scanning threshold according to the moving speed in real time, so that the MS can reduce the signal strength to the switching threshold before the signal strength drops to the switching threshold. There is sufficient time to scan and provide the necessary AP information for the next handover, so that when the MS moves too fast, it can still successfully complete the next target network without increasing the handover delay. The handover work has achieved the purpose of improving the robustness of the handover algorithm and optimizing the handover performance [24], as shown in the following formula:

$$q(n+1) = q(n) - \mu(n)q(n)\{(y(1)-1)\}. \tag{15}$$

The purpose of the second user decision is to achieve a specific optimal operating effect during the entire system operation, that is, to select the most suitable strategy for the development of the control system.

2.3. Channel Model Algorithm. The Y user detects the observed value of the channel. Obviously, in the detection process $t = 0$, the observations obtained by the secondary user before and after the detection channel are distributed according to different distributions [25]: $\{Y_1, Y_2, \cdots, Y_{T_0}\}$ is an independent and identically distributed process with a probability density of $f_0(y)$, and $\{Y_1, Y_2, \cdots, Y_{T_0}\}$ is a process with a probability density of $f_0(y)$ $\{Y_1, Y_2, \cdots, Y_{T_0}\}$ is an independent identically distributed process with a probability density of $f_0(y)$. The time unit in Figure 4 is the detection time interval.

Continue to check the channel to obtain other observations Y_{T+1}. This requires rules that assist users in continuing to detect or access the channel. Assuming $t = T_0$, the user "confirms" that the channel is empty and then visits the channel to start sending. Next, the problem of high-speed access is how to determine the end rule of the user's torque acquisition. Of course, the user's goal is to minimize the time delay from the start of $\{Y_1, Y_2, \cdots, Y_{T_0}\}$ detection to the final access, and at the same time, it is also necessary to reduce the probability of conflict during access. Therefore, there are the following objective functions and restriction in the following formula:

$$\min E[(T_d - T_0)^+]. \tag{16}$$

Among them, $(T_d - T_0)^+$ represents the average value of the aforementioned detection delays. Because the secondary user may access the unfinished channel of the main user due to channel error determination, in expression (16), the restriction condition refers to T_d. The user occupies the channel. In fact, in order to ensure performance, the probability of erroneously accessing the channel is a certain threshold ζ that must be guaranteed to be lower than this, such as the following formula:

$$P_R[T_0 = k] = p(1-p)^{k-1}(1-\lambda_0). \tag{17}$$

Equation (17) is as follows. The geometric distribution refers to the probability of obtaining the first success in the Nth Berunui test. In other words, the N Bernoulli test failed $N-1$ times for the first time, and the Nth Bernoulli test failed. Just success, $1-P$ represents the probability of failure (occupation), and P is the probability of final success (idle). You can also know from the following formula. Observation of the idle probability at the beginning of the following formula:

$$\lambda_0 = \Pr\,[T_0 \le t | Y_1, Y_{2\ldots}, Y_N|]. \tag{18}$$

$T \le t$, then the user accesses the channel, and the posterior probability λ is the following equation:

$$T_d = \inf\,\{t : \lambda_t \ge \eta_d\}. \tag{19}$$

2.3.1. State Space. When analyzing the channel model of the primary user, the secondary user has three basic states 0, 1, and Δ. Among them, 0 and 1, respectively, represent the current channel state (occupied and idle) of the secondary user. Δ represents the decision of the user who accesses the channel. This indicates the end of the access process, so the absorption status is as follows, as shown in Figure 5.

Decision theory refers to the channel switching and channel access strategies adopted by the secondary users under the above optimization problems. When a user accesses a channel, the decision theory is the only basis for selecting a new channel to determine the access, and it is also the basis for determining the state transition of the model. Figure 5 is a state transition diagram. From Figure 5, the state transition and transition probability of the decision theory can be obtained.

2.3.2. Sufficient Statistics. In decision theory, users obtain switching and access strategies under the minimum cost condition, as shown in the following equation:

$$\lambda_t = T(\lambda_0|y), a(t-1) = S. \tag{20}$$

By analyzing equation (20), we can know that the physical meaning of λ_t is, at the moment, the posterior idle probability of the channel when the user observes the $Y_t = y$ condition.

2.4. Conducive to Wireless Local Area Network to Form an Integrated Access Control Model in Collaborative Office. The security of "username and password" is very low, and the password is easy to be stolen and cause the loss of the enterprise. Therefore, new solutions have been formulated, such as the use of symmetric encryption technology, and the integrated access control strategy of the collaborative office platform to use user management components and role management components. And resource management components, by setting the organization management module, user management module, role management module, and authority management module to manage the access strategy, strengthen security guarantee. The rights management module is mainly the management of system resources [26]. Authorities mainly include two parts of operations and objects. The object is the resource operation in the access control system. The flow chart of the integrated access control to the object resource is shown in Figure 6.

Figure 6 shows that integrated access control mainly involves users, roles, and resources, and the figure shows the relationship between their database table structures. By deleting user information that is no longer a system user and the corresponding permissions that they have in time, it can prevent these users from still using the original permissions to access system resources and cause information leakage, thereby avoiding unnecessary losses and improving system security performance.

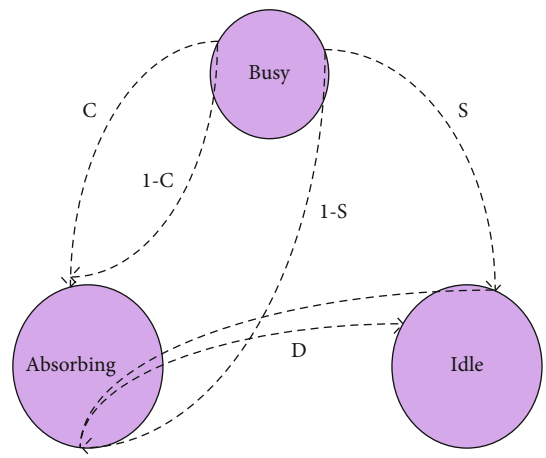

Figure 5: POMDP state transition diagram.

3. Experimental Analysis of Risk Assessment Index System for Maritime Law Enforcement

3.1. Comprehensive Analysis of Examples. Comprehensive evaluation is a complex problem composed of evaluation object set, evaluation index set, evaluation method set, and evaluator set [27]. The selection of various element sets will ultimately affect the result of comprehensive evaluation. This article invites 8 law enforcement officers engaged in navigation management, that is, maritime law enforcement officers responsible for navigation police (announcement), ship traffic management, water and underwater operations or activities, maritime cruises, etc., these maritime law enforcement officers are familiar with the business they are engaged in, with rich experience and representativeness, ask them to rate the maritime law enforcement risks of a certain maritime administration in the general navigation management according to the risk level standard. The expert scores are shown in Table 1.

It can be seen from Table 1 that among the eight law enforcement officers in general navigation management, their legal professional quality is relatively high, with an average of about 6.5, but the score of the legal system is low, about 3, so it can be learned that the law of maritime management. The system needs to be strengthened and improved in order to make maritime management better, so we can take the following measures:

(1) In the navigation management to improve the level of law enforcement equipment, law enforcement equipment is the basis for maintaining shipping safety and ensuring water traffic safety. While improving the quality of maritime law enforcement personnel, in order to increase investment in law enforcement machinery and improve the integrity of law enforcement machinery, maritime agencies need to invest in more law enforcement vehicles and patrol boats as well as transportation and inspection tools in other major sea areas

(2) Improve legal awareness. The legal knowledge of the maritime law enforcement officials determines the

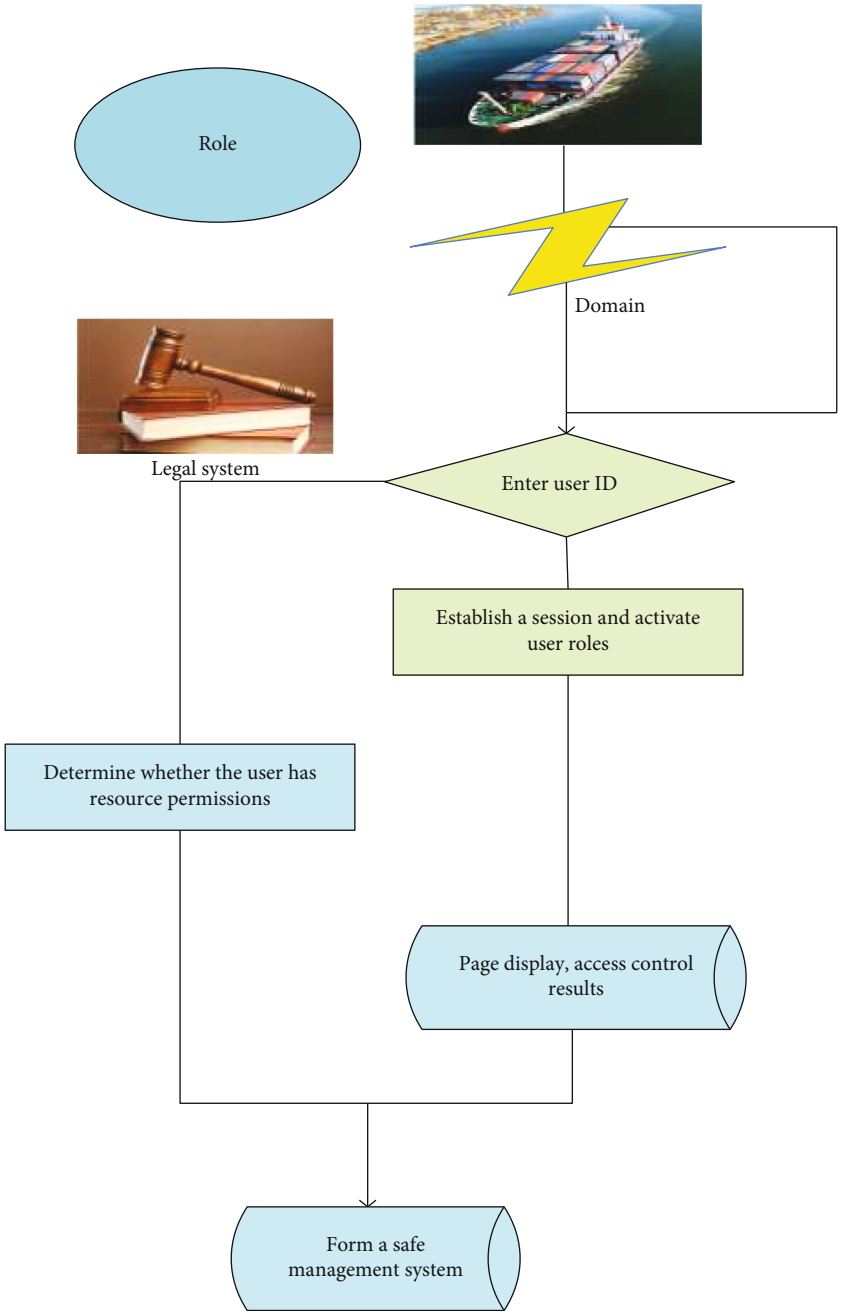

Figure 6: Flow chart of resource integrated access control.

correctness of the maritime law enforcement personnel's understanding of maritime law and regulations and determines the legality of law enforcement measures in the law enforcement process. The law enforcement work of maritime law executives is a complex task that requires purposeful, appropriate, and conscious training

(3) Improving the law enforcement supervision mechanism and strengthening supervision can improve the law enforcement capacity and efficiency of maritime agencies. The Maritime Safety Administration should positively evaluate political trends, thoroughly interview port companies, shipping companies, industry groups, etc., and accept comments. At the same time, the Maritime Safety Administration also needs to expand monitoring channels, increase social participation, and implement monitoring through WeChat, e-government's electronic evaluation system, and other forms of network monitoring

According to the results of the risk assessment of maritime law enforcement in general navigation management, the level of maritime law enforcement risk in the general navigation management of the Maritime Safety

Table 1: Scorers' scores on maritime law enforcement risk factors in general navigation management.

	The scorer's scoring value for maritime law enforcement risk factors in general navigation management					
	Professional quality of law enforcement personnel	Law enforcement personnel's interest view read	Law enforcement equipment	Legal system	Supervision system	Legal awareness
Expert rating	6	7	5	2.8	5.4	2.8
	7	8	4.4	2.5	3.5	5.2
	5	6	6.5	4.3	4.3	3.5
	8	7	6.8	4.8	4.5	3.9
	6	9	6.4	3.9	4.1	4.5
	6	7	7.8	5.4	3.9	4.3
	8	8	6	2.4	5.1	4.8
	7	8	5.3	3.1	5	4.5

4.6.

Administration is moderate, so the Maritime Safety Administration should take reduction measures. From multiple aspects of law enforcement risks, first select 4 out of 8 managers to compare the scores of professional knowledge, law enforcement equipment, and legal system in 2017 and 2018, as shown in Figure 7.

It can be seen from the comparison chart in Figure 7 that the legal expertise of law enforcement officers in 2017 was higher than that of legal awareness and law enforcement equipment, with an average score of about 7.3, while the average score of law enforcement equipment was only about 3. Therefore, the perfection of the legal system is not high. After some measures in 2018, the legal management of the four law enforcement officers has been improved, and the score has increased to about 6. Therefore, a complete maritime management legal system must be improved by improving law enforcement equipment and legal awareness and improving legal system. Improve the law enforcement system for maritime management. After improvement, look at the situation of the four law enforcement officers in 2019 and get Figure 8.

As shown in Figure 8, after improvement, the situation of the four law enforcement officers in 2019 has been significantly improved. The score of law enforcement equipment is as high as about 8.1, and the score of the legal system is as high as about 7.5, which is an increase of about 1.5 from 2018. Therefore, the maritime agency, we must focus on improving the overall quality of maritime law enforcement personnel and establish a maritime law enforcement team that is familiar with maritime laws and regulations, has high ethics and high-level law enforcement capabilities, and has high professional quality.

3.2. RSA/ECC Performance Analysis. The data of the navigation system and the maritime system are not heterogeneous at one level, but are different at multiple levels. The goal of heterogeneous data merging is to realize the combination and sharing of data resources, information resources, hardware equipment resources, and data of different structures including human resources. One of the core points is to establish integrated data for navigation systems and maritime systems through various tools and processing logic based on scattered data and partial data. Build a data warehouse oriented to the maritime field.

At present, the bottleneck problem in the construction of shipping and maritime informatization is the disadvantages of large and scattered information in various business departments. Solve the integrated management of provincial-level navigation and maritime business integration, in order to achieve collaborative management between various business departments, administrative departments, decision-making departments, and other departments. The security analysis of ECC, RSA, and DSA is shown in Table 2.

It can be concluded from Table 2 that the ECC password has many advantages. (1) safe and reliable: as shown in Table 1, the unit security strength of ECC ciphers is higher than that of RSA and DSA, which has its aggressiveness. There are absolute advantages. For example, 160-bit ECC has the same security as 1024-bit RSA and DSA, and a 210-bit ECC cipher has the same security as 2048-bit RSA and DSA. The key length required for ECC ciphers is much shorter than that of RSA ciphers. This will effectively solve the problem that the engineering is difficult to achieve, because the key length needs to be extended to improve the security strength. Efficient implementation: RSA can increase the speed of public key processing by choosing a smaller public key (3). In other words, increase the speed of encryption and signature verification to verify the speed of encryption and signature. Same as ECC, but in terms of processing speed of secret keys (decryption and signature), ECC is much faster than RSA and DSA. Therefore, the overall speed of ECC is much faster than RSA and DSA. Under the same security strength, if a 160-bit ECC cipher is used for encryption, decryption, or digital signature, it is about 5-8 times faster than 1024-bit RSA and DSA (see Table 2). Table 3 is the implementation of ECC cipher and RSA encryption software speed comparison.

It can be seen from Table 3 that the installation cost is low. With the same security strength, the key size and system parameters of the ECC password are much smaller than the RSA password, so the storage space required by the ECC is required. The password is much smaller, and the transmission bandwidth requirement is low. The hardware needs to implement the logic circuit of the ECC password. The

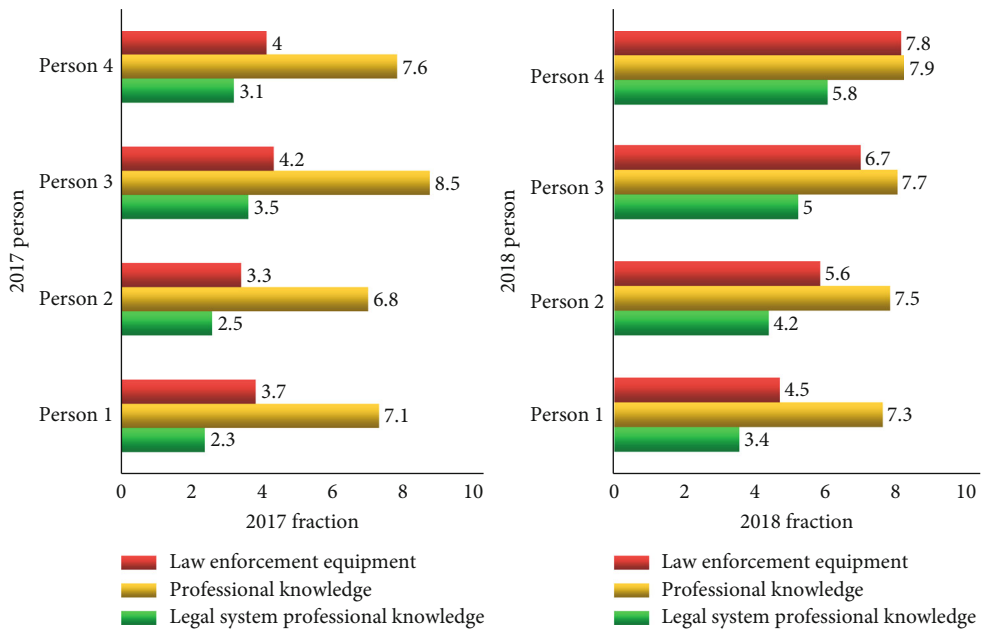

Figure 7: Comparison of law enforcement equipment and legal systems.

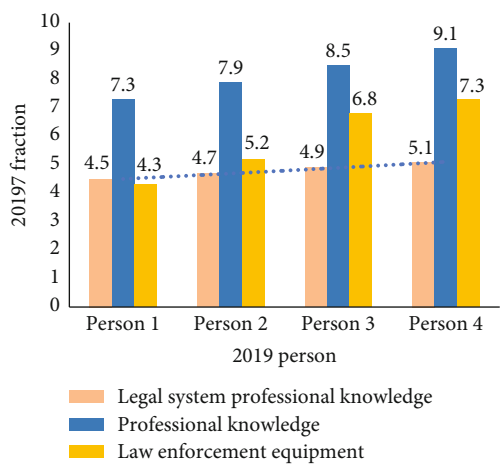

Figure 8: 2019 law enforcement equipment and legal system trends.

Table 2: Security analysis of ECC, RSA, and DSA.

Time required to decipher	RSA/DSA (key length)	RSA/ECC (key length)	ECC (key length)
9^3	535	153	5 : 1
9^7	647	163	7 : 1
9^{11}	748	198	8 : 1
9^{19}	984	216	9 : 1
9^{28}	1073	279	10 : 1

number of logic gates is much less than that of the RSA password, and it consumes less power. Due to all these advantages, ECC ciphers can be implemented in many environments where RSA ciphers cannot be implemented.

Table 3: RSA and ECC speed comparison.

Function	Security builder 1.2 ECC (ms)	BSAFE 5 RSA (ms)
Key pair generation	2.9	3743.5
Sign	1.9 (ECNRA)	198.6
Sign	4.0 (ECDSA)	198.6
Verify	7.8 (ECNRA)	13.8
Verify	9.6 (ECDSA)	13.8
Diffie-Hellman key exchange	7.6	1563.0
Time required to decipher	8	130
RSA/DSA (key length)	65	98

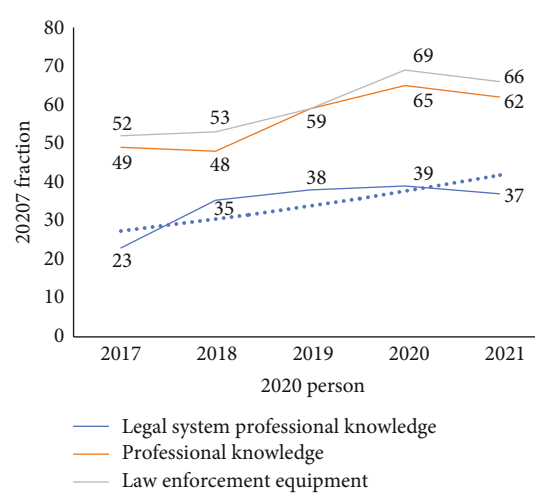

Figure 9: 2017-2021 trend map of the legal system of a maritime department.

The supervision system is not perfect. The maritime agency will have weak supervision, weak supervision, and insufficient supervision, which affects the image of the maritime law enforcement agency to a certain extent. Therefore, the maritime agency should correct its attitude and actively accept supervision [28]. This article continues to collect data from a certain maritime administration department from 2017 to 2021 after the supervision system has been improved, as shown in Figure 9.

Figure 9 shows that from 2017 to 2021, the percentage of a certain maritime management's emphasis on the legal system has clearly shown an upward trend [29], and the emphasis on the legal system in 2020 is even as high as 69%. This shows that the supervision and improvement of the law system is an effective measure and should be maintained [30].

4. Discuss

Based on the introduction of general navigation management related knowledge and based on wireless local area networks, this article studies what role wireless network domains can play in maritime channel management and how to identify maritime law enforcement risks, establish maritime channel management, and establish a sound legal system for law enforcement and risk assessment index system.

This paper also uses the gray fuzzy comprehensive assessment method to establish a risk assessment model for maritime law enforcement in general navigation management. Combining that the maritime law enforcement risk factors are vague and gray, by establishing a gray fuzzy comprehensive evaluation model, not only the overall maritime law enforcement risk situation can be obtained but also which risk factor has the greatest impact on the maritime law enforcement risk.

This paper also verifies the practicability and reliability of the experimental methods selected in this paper through case demonstration and RSA/ECC performance analysis, proposes corresponding preventive measures based on the evaluation results of maritime law enforcement in general navigation management, and establishes a complete legal system.

5. Conclusions

Based on the analysis of the risk factors of maritime law enforcement personnel in the law enforcement process and based on the role of wireless local area network, this paper establishes an index system for maritime law enforcement risk assessment in general maritime management. Through the selection of various evaluation methods, a comprehensive evaluation method combining gray fuzzy comprehensive evaluation and gray system theory is selected, and various algorithms are used to determine the weight of each risk factor of maritime law enforcement, and a mathematical model for maritime navigation management in navigation management is constructed. The public's legal awareness and awareness of rights protection have also increased. Finally, it can be learned that the level of service provided by law enforcement personnel in maritime waterway management is becoming higher and higher. Through the improvement of law enforcement equipment and supervision system, effective and better management can be achieved. Therefore, it is very important to establish a complete legal system. Due to the author's limited research level and ability, this article still has certain deficiencies in the content, and further research is needed.

Data Availability

No data were used to support this study.

Conflicts of Interest

There are no potential competing interests in our paper.

Authors' Contributions

And all authors have seen the manuscript and approved to submit to your journal.

References

[1] J. Wang, H. Zhou, Y. Li et al., "Wireless channel models for maritime communications," *IEEE Access*, vol. 6, pp. 68070–68088, 2018.

[2] A. Lionis, K. Peppas, H. E. Nistazakis, A. D. Tsigopoulos, and K. Cohn, "Experimental performance analysis of an optical communication channel over maritime environment," *Electronics*, vol. 9, no. 7, p. 1109, 2020.

[3] R. W. Jansen, M. A. Sletten, T. L. Ainsworth, and R. G. Raj, "Multi-channel synthetic aperture radar based classification of maritime scenes," *IEEE Access*, vol. 8, pp. 127440–127449, 2020.

[4] K. Araki, Y. Masuzawa, Y. Takahashi, and T. Nakayama, "The Japanese legal system and the applicability of laws and regulations on private information protection and research ethics relating to medical research," *Nihon koshu eisei zasshi Japanese journal of public health*, vol. 65, no. 12, pp. 730–743, 2018.

[5] R. Lou, W. Wang, X. Li, Y. Zheng, and Z. Lv, "Prediction of ocean wave height suitable for ship autopilot," *IEEE Transactions on Intelligent Transportation Systems*, pp. 1–10, 2021.

[6] A. Park, "Legal research on registration system of newspapers and journals," *Journal of Media Law, Ethics and Policy Research*, vol. 15, no. 3, pp. 131–162, 2016.

[7] R. Lou, Z. Lv, S. Dang, T. Su, and X. Li, "Application of machine learning in ocean data," *Multimedia Systems*, pp. 1–10, 2021.

[8] A. Anderson and P. P. Gupta, "A cross-country comparison of corporate governance and firm performance: do financial structure and the legal system matter?," *Journal of Contemporary Accounting & Economics*, vol. 5, no. 2, pp. 61–79, 2009.

[9] L. H. Haller, L. A. Dubin, and M. Buxton, "The use of the legal system as a mental health service for children," *The Journal of Psychiatry & Law*, vol. 7, no. 1, pp. 7–48, 1979.

[10] S. Baek and B. D. Choi, "Performance analysis of power save mode in IEEE 802.11 infrastructure wireless local area network," *Journal of Industrial and Management Optimization*, vol. 5, no. 3, pp. 481–492, 2009.

[11] M. Ji, G. Caire, and A. F. Molisch, "Fundamental limits of caching in wireless D2D networks," *IEEE Transactions on Information Theory*, vol. 62, no. 2, pp. 849–869, 2016.

[12] M. Agiwal, A. Roy, and N. Saxena, "Next generation 5G wireless networks: a comprehensive survey," *IEEE Communications Surveys & Tutorials*, vol. 18, no. 3, pp. 1617–1655, 2016.

[13] Z. Yong, Z. Rui, and J. L. Teng, "Wireless communications with unmanned aerial vehicles: opportunities and challenges," *IEEE Communications Magazine*, vol. 54, no. 5, pp. 36–42, 2016.

[14] W. Hong, S. He, H. Wang et al., "An overview of China millimeter-wave multiple gigabit wireless local area network system," *IEICE Transactions on Communications*, vol. E101. B, no. 2, pp. 262–276, 2018.

[15] K. Murugan and M. Usha, "Time orient flow estimation based data mining approach for intrusion detection in wireless local area networks using delay averaging scheme," *Middle East Journal of Scientific Research*, vol. 24, no. 1, pp. 97–102, 2016.

[16] S. Wan, *Topology Hiding Routing Based on Learning with Errors*, Concurrency and Computation: Practice and Experience, 2020.

[17] B. Bellalta, L. Bononi, R. Bruno, and A. Kassler, "Next generation IEEE 802.11 wireless local area networks: current status, future directions and open challenges," *Computer Communications*, vol. 75, p. 1, 2016.

[18] F. Heidari, F. Dabiri, and M. Heidari, "Legal system governing on water pollution in Iran," *Journal of Geoscience and Environment Protection*, vol. 5, no. 9, pp. 36–59, 2017.

[19] K. Aranovskiy and S. Knyazev, "Constitutional foundations of the execution of the Ecthr judgments in the legal system of the Russian Federation," *Law Enforcement Review*, vol. 1, no. 1, pp. 139–150, 2017.

[20] F. F. Russo, "Informality: the doorstep of the legal system," *SSRN Electronic Journal*, vol. 1, no. 1, pp. 49–70, 2018.

[21] D. T. Johnson, "Juries in the Japanese legal system: the continuing struggle for citizen participation and democracy," *Social Science Japan Journal*, vol. 19, no. 1, pp. 116–119, 2016.

[22] A. Kuersten, "China's changing legal system: lawyers and judges on civil and criminal Law. CHUAN FENG , LEYTON P. NELSON and THOMAS W. SIMON . Basingstoke, UK Palgrave Macmillan, 2016. xv + 264 pp. $110.00; £68.00. ISBN 978-1-137-45205-4," *China Quarterly*, vol. 227, no. 227, pp. 820–822, 2016.

[23] B. Francis, I. Hasan, and L. Li, "A cross-country study of legal-system strength and real earnings management," *Journal of Accounting & Public Policy*, vol. 35, no. 5, pp. 477–512, 2016.

[24] G. L. Wells and A. Quigley-Mcbride, "Applying eyewitness identification research to the legal system: a glance at where we have been and where we could go," *Journal of Applied Research in Memory and Cognition*, vol. 5, no. 3, pp. 290–294, 2016.

[25] F. Perez-Fontan, V. Pastoriza-Santos, F. Machado, F. Poza, N. Witternigg, and R. Lesjak, "A wideband satellite maritime channel model simulator," *IEEE Transactions on Antennas and Propagation*, vol. PP(99):1-1, p. 1, 2021.

[26] X. Zhang, "Fault intelligent processing method for data transmission channel of maritime communication," *Journal of Coastal Research*, vol. 93, no. sp1, pp. 699–699, 2019.

[27] M. Abdullah Al, M. D. Alam, A. Akhtar et al., "Annual pattern of zooplankton communities and their environmental response in a subtropical maritime channel system in the northern Bay of Bengal, Bangladesh," *Acta Oceanologica Sinica*, vol. 37, no. 8, pp. 65–73, 2017.

[28] F. Wang, W. Wu, Q. Peng, E. H. Zhao, and X. X. He, "Maritime wireless channel environment at VHF/UHF bands and its space-time frequency selectivity," *Acta Electronica Sinica*, vol. 45, no. 6, pp. 1523–1529, 2017.

[29] J. Xiao, C. Li, and J. Zhou, "Minimization of energy consumption for routing in high-density wireless sensor networks based on adaptive elite ant colony optimization," *Journal of Sensors*, vol. 2021, no. 3, 12 pages, 2021.

[30] J. Mabrouki, M. Azrour, D. Dhiba, Y. Farhaoui, and S. E. Hajjaji, "IoT-based data logger for weather monitoring using Arduino-based wireless sensor networks with remote graphical application and alerts," *Big Data Mining and Analytics*, vol. 4, no. 1, pp. 25–32, 2021.