

# *Research on Building Police Intelligent Patrol Command and Dispatch System under Big Data Technology*

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**Abstract:** In recent years, public security safety has been one of the core issues of high concern to the whole society. Building a smart patrol command and dispatch system has become one of the development directions for public security organs in response to the increasingly complex and ever-changing public security situation. This article was based on big data technology, analyzing the characteristics and value of patrol data, and using methods such as machine learning and deep learning to construct a smart patrol command and scheduling system for public security, in order to improve the efficiency and level of public security work. By applying experimental testing methods and comparing with traditional methods, performance data of the public security intelligent patrol command and dispatch system can be obtained. Experimental data showed that the stability of the intelligent patrol command and scheduling system based on big data technology reached 86%, accuracy reached 88%, security reached 84%, and work efficiency reached 85%. After comprehensive testing, the performance, safety, and stability of the public security intelligent patrol command and dispatch system have been effectively verified.

## 1. Introduction

With the continuous development of the economy and social progress, people's demand for public security work is also increasing. The intelligent patrol command and dispatch system has become an important means to solve public security security issues. Patrol is one of the routine public safety management tasks of public security organs, and quickly and accurately grasping the patrol situation and responding to relevant events in a timely manner is the key to the efficiency and quality of patrol work. Traditional patrol monitoring methods are no longer able to meet the management and control requirements for public safety, and there is an urgent need to use big data technology to build an intelligent patrol command and scheduling system.

The public security work is the basic management work of the public security organs. Its main task is to strike suspect quickly and effectively, and maintain social stability. There are many theories related to the research of big data technology and the intelligent patrol command and scheduling of public security. For example, some scientists have found that big data provides a huge

database for the application of artificial intelligence in public security assault and scheduling, intelligently disseminating dynamic information and providing comprehensive information about events in specific situations [1-2]. Some experts believed that big data has become an important strategic resource for countries, a new opportunity to reshape their competitive advantages, and a new way to improve social governance [3-4]. Some experts also pointed out that video patrol command and scheduling systems based on cloud architecture can not only improve the efficiency of police situation assessment, but also accelerate the decision-making of emergency commands [5-6]. In public security work, the issue of police strength is an important factor that cannot be ignored, and solving this problem naturally relies on information technology.

The main research content of this article includes the characteristics and value of patrol data, the construction principles of a public security intelligent patrol command and scheduling system, intelligent decision-making algorithms, data warehouses, and patrol path optimization algorithms. On this basis, the innovation points of this study are mainly reflected in the following aspects: building a public security intelligent patrol command and dispatch system based on big data technology to improve the efficiency and level of public security work. The path optimization algorithm method is adopted to model and analyze patrol data to improve the accuracy and timeliness of patrol command scheduling. The patrol path optimization algorithm based on road network data is designed to reasonably plan patrol routes, thereby improving patrol efficiency and coverage.

## **2. Public Security Intelligent Patrol Command and Dispatch System**

### **2.1 Patrol Data**

The construction of smart policing is an important component of the informationization of public security organs, achieving various tasks such as public security information collection, case resolution, on-site command and dispatch, and dynamic management [7]. The comprehensive application and improvement of intelligent patrol resources can further promote the more active and effective role of big data in public security management work. The police force of public security organs is limited, and public security is responsible for commanding, managing, and maintaining social order. Therefore, real-time collection of police information within the jurisdiction is necessary [8]. During the operation of the intelligent patrol command and scheduling platform, it is necessary to ensure its high performance, ensure the normal operation of equipment and network, and also prevent data loss. In the intelligent patrol command and scheduling system, advanced technology is mainly used to encrypt and protect information [9-10]. Remote access control is achieved through data transmission equipment and network communication facilities. The patrol duty business activities are shown in Figure 1:

In public security patrol work, collecting and analyzing patrol data can help public security departments develop more effective and accurate patrol strategies, improve the efficiency of crime prevention and crackdown work [11]. The following are the characteristics and values of patrol data. **Timeliness:** Patrol data has the characteristics of real-time and fast processing, which helps commanders adjust the patrol area and frequency in a timely manner, and improves patrol efficiency. **Spatial relevance:** The patrol data is bound to the map through GIS technology, which can compare the types of crimes in different regions and time periods to help the police capture suspect. **Diversification:** The data information of various patrol methods and tools can be summarized on the same platform, such as patrol vehicles, police motors, police drones, surveillance videos, etc., to achieve data sharing and information exchange [12]. **Resource optimization:** Through the analysis of patrol data, it can provide strong support for the allocation of police resources, enabling commanders to reasonably arrange patrol tasks for personnel and vehicles, and improve the

utilization rate of police resources. Quantifiable effect: Based on patrol data, digital methods can be used to evaluate and rank patrol work, facilitating self-management and public disclosure by public security organs. Corresponding adjustment measures can be taken according to changes in the effect [13].

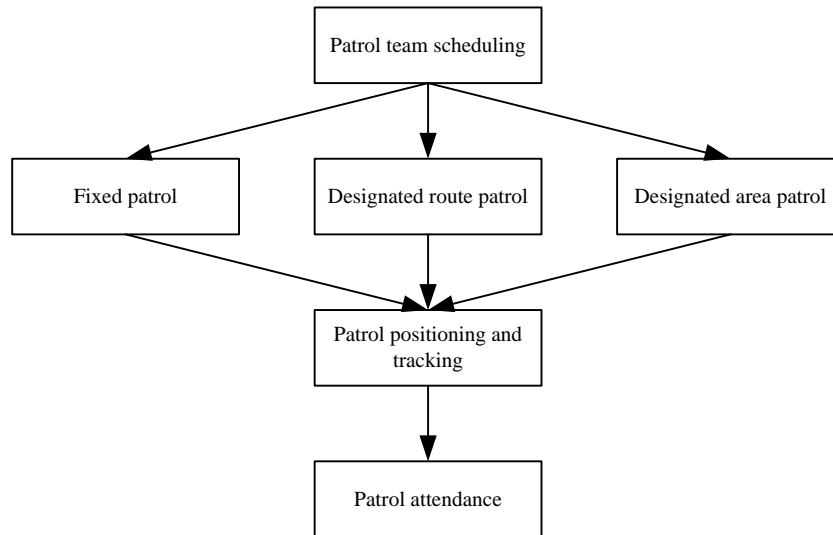


Figure 1: Patrol and duty business activities.

## 2.2 Construction Principles of Intelligent Patrol Command and Dispatch System for Public Security

The construction of a smart patrol command and dispatch system for public security can improve the scientificity and precision of police management. The following are the construction principles of the intelligent patrol command and dispatch system for public security. **Scientification:** Based on data analysis, establish a scientific and reasonable patrol mode, including patrol areas, personnel configuration, vehicle configuration, etc., to improve work efficiency and practical results. **Precision:** Patrol work should be finely managed according to specific circumstances, improve the efficiency of police resource utilization, and reduce patrol costs and unnecessary manpower waste. **Security:** It ensures the safety of police personnel during the patrol process, achieves real-time positioning, status monitoring, and patrol route recording functions, and improves the work security level of police personnel [14]. **Portability:** The command and dispatch system should be designed based on the principles of portability, convenience, and ease of use, and support the operation and viewing of mobile devices, smartphones, etc. **Openness:** The command and dispatch system should be compatible with the data information of various patrol tools, such as police vehicles, police vehicle monitoring, police field equipment, etc., to achieve data sharing and information exchange.

The main function of the public security intelligent patrol command and dispatch system is to collect, analyze, and organize police situation video image information, providing strong clues for the scientific investigation of cases by public security organs. Establish a comprehensive, secure and reliable police operation mechanism and assessment system using information technology such as mobile internet technology and cloud computing, and real-time grasp the police situation within the jurisdiction during public security patrols. During the process of investigating the case, promptly provide feedback to the police command center on suspicious evidence and related situations discovered during patrols near the crime site. Upload the on-site situation to the police management platform using mobile terminal devices and wireless network technology [15]. At the

same time, the recording function of data such as patrol locations and road conditions for patrol personnel has been implemented. Receive patrol vehicle signals and feedback them to the patrol management system, and process analysis reports. Accept the instructions such as photos and images sent by the monitoring probe video recording, send them back to the police intelligent dispatch room, and update and control the information in real-time through system software. In the context of big data, the Public Security Intelligent Patrol Command Center utilizes wireless radio frequency identification technology to achieve intelligent vehicle detection and positioning [16-17]. Transforming traditional manual management into automated management, effectively integrating various police resources to improve the overall work efficiency of public security organs, reduce human and material cost investment, and enhance the level of public security logistics support.

### 2.3 Algorithms for Big Data Technology

The big data platform is based on cloud computing and effectively processes, stores, and manages massive amounts of information through collection and analysis. Building an intelligent patrol and dispatch system in public security intelligent policing requires the use of cloud technology to upload the actual situation and work needs of various departments of the public security organs to the cloud and establish a data sharing mechanism [18]. Cloud storage technology can be used to store all kinds of intelligence information when building the intelligent patrol and defense command system. In an intelligent public security system, the main links are data collection, transmission, and analysis. The purpose of encrypting data is to ensure that information is not leaked during storage. The public security organs are paying increasing attention to information security. Therefore, when constructing a smart patrol command and scheduling system, it is necessary to consider the possibility of illegal theft during data transmission.

Intelligent decision-making algorithm is one of the core technologies of the public security intelligent patrol command and scheduling system, aiming to optimize patrol routes and personnel allocation through algorithms, improve the utilization rate of police resources and work effectiveness. Common intelligent decision-making algorithms include genetic algorithms, which continuously screen, combine, and optimize various patrol plans to achieve optimal solution selection and route planning. Fuzzy algorithm, based on fuzzy logic, fuzzifies and compares different patrol plans and routes, and outputs the optimal patrol plan and route. Neural network algorithms continuously identify and optimize typical patrol routes through learning and memory, making police officers' patrol operations more automated and efficient.

The optimization algorithm for patrol paths is one of the core technologies in the intelligent patrol command and scheduling system of public security, with the aim of providing the best patrol path scheme for effectively utilizing police resources and improving patrol efficiency [19-20]. Common patrol path optimization algorithms include genetic algorithm, which simulates the evolution process and utilizes gene expression based patrol path optimization technology to achieve collective intelligent decision-making and select the optimal patrol path planning. Ant colony algorithm simulates ant foraging behavior to achieve the goal of finding the optimal path and solve complex patrol planning problems. The shortest path algorithm, based on the Dijkstra algorithm, achieves the calculation of the shortest path and optimizes patrol paths to construct feasible solutions. The A \* search algorithm is a shortest path graph search algorithm. The heuristic function used is:

$$g(m) = h(m) + p(m) \quad (1)$$

In the formula, h (m) represents the estimated cost from the starting node to node m, and p (m) represents the estimated cost from node m to the target node. Using the distance evaluation function,

the mathematical description of Manhattan distance in x-dimensional geometric space is:

$$J_{man}(a, b) = \sum_{i=1}^x (am_i - bm_i) \quad (2)$$

Euclidean distance can be described as:

$$J_{eu}(a, b) = \sqrt{\sum_{i=1}^x (am_i - bm_i)^2} \quad (3)$$

Among them,  $am_i$  and  $bm_i$  are the i-th components of the x-dimensional space vectors a and b.

Data warehouse is an important function of the public security intelligent patrol command and dispatch system, with functions such as data integration, storage, management, processing, analysis, and decision support. The following is the role of a data warehouse. Data integration: Patrol data from different data sources are cleaned, integrated, and deduplicated to form a consistent and complete patrol dataset, which is convenient for future analysis and use. Data management: The data dictionary, standardized data element and classification code of patrol data are established to effectively manage and maintain patrol data and metadata. Data analysis: Many data mining and statistical analysis techniques need to be carried out in data warehouses, such as multidimensional analysis, data mining, clustering analysis, etc., which can provide fast, accurate, and automated data analysis services for police officers. Decision support: Based on various analysis models and indicators of data warehouses, the patrol command and scheduling system can output accurate and reliable decision support tools to assist commanders in selecting and making patrol plans.

The above is an introduction to the main technologies and principles related to the intelligent patrol command and dispatch system of public security. These technologies and principles can provide faster, more reliable, and safer patrol management technical support for public security organs, and accelerate the pace of scientific and technological construction of public security.

### 3. Design and Implementation of the Intelligent Patrol Command and Dispatch System for Public Security

#### 3.1 Command and Dispatch System Framework

In the construction of smart policing, building an intelligent patrol and command system for public security is currently the top priority of the work of public security organs. The command and dispatch system effectively utilizes technologies such as police information analysis and management, video surveillance probes, etc. The intelligent patrol command and dispatch system for public security consists of video surveillance and collection of police situations, information management of physical evidence appraisers, dynamic data analysis, and fault diagnosis as its core components. This enables the use of a microgrid alarm platform as the main body to conduct on-site real-time inspection and handling of inventory. The information collection section includes the collection of sensor signals, the selection of analog-to-digital converters, and the labeling and alarm time in the database. The data processing part refers to real-time monitoring of on-site environmental parameters and making corresponding response actions. The network structure of the patrol dispatch command system is shown in Figure 2:

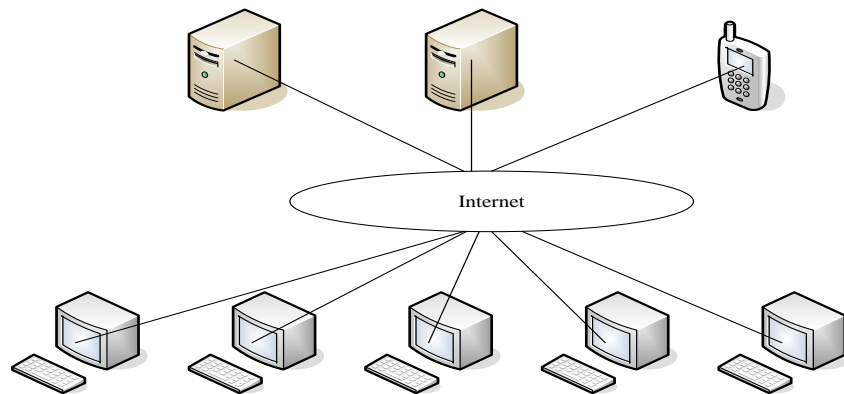


Figure 2: Network structure of the patrol and dispatch command system.

The Public Security Intelligent Patrol Command and Dispatch System is an intelligent patrol management system based on artificial intelligence technology, which can help public security organs achieve comprehensive monitoring and command scheduling of police patrols.

**System architecture design:** The public security intelligent patrol command and dispatch system adopts a distributed architecture, consisting of front-end, back-end, and database. The front-end is mainly responsible for data display and user interaction, the back-end is responsible for data processing and algorithm calculation, and the database is responsible for data storage and management. **Technical scheme design:** The system adopts artificial intelligence technology, including computer vision, machine learning, natural language processing, etc., which can achieve comprehensive monitoring, command and dispatch of police patrols. **Data security solution design:** The system adopts distributed storage and backup mechanisms to ensure the security and availability of data, while adopting data encryption technology to ensure the confidentiality of data.

The Public Security Intelligent Patrol Command and Dispatch System is a software and hardware system that integrates multiple functions, including equipment management, event monitoring, patrol route planning, personnel scheduling, etc. The setting of equipment management parameters mainly includes the input of information such as equipment number, name, model, installation location, etc., and the setting of equipment status, such as online, offline, fault, etc., to facilitate administrators to timely understand the operation of the equipment.

**Event monitoring parameter settings:** This module needs to monitor the video information transmitted by the device in real time. It needs to set the video image quality, resolution, frame number, etc. to ensure the quality of video monitoring, and set corresponding alarm levels and methods based on the event type, such as SMS, phone, email, etc. **Patrol route planning parameters** are set based on patrol needs, including designated patrol personnel, time intervals, patrol locations, etc. Reasonable patrol routes need to be developed according to actual regulatory situations to avoid duplication or omissions. The personnel scheduling parameters are set based on real-time monitoring of personnel establishment, rest time, and other conditions to set the scheduling plan for patrol personnel. Data analysis and other technologies can be used to automatically allocate tasks and routes, improving scheduling efficiency.

### 3.2 Functional Design Operation Mode

Its functions include the following aspects:

**Police patrol monitoring function:** The system can monitor the police patrol situation in real-time, including the position of police officers, patrol routes, patrol time, etc. **Alarm warning function:** The system can monitor and warn the alarm situation in real time, and detect and handle the alarm situation in a timely manner. **Task scheduling function:** The system can automatically assign tasks



and police officers based on the police situation and patrol situation. Data analysis function: The system can analyze and mine police patrol data, providing data support and reference.

Its operating mode includes the following aspects:

Real time monitoring mode: The system can monitor the situation of police patrols in real time, and detect and handle police situations in a timely manner. Automatic scheduling mode: The system can automatically assign tasks and police officers based on the police situation and patrol situation, improving scheduling efficiency and accuracy. Data analysis mode: The system can analyze and mine police patrol data, provide data support and reference, and optimize patrol plans and scheduling strategies.

In short, the Public Security Intelligent Patrol Command and Dispatch System is an intelligent patrol management system based on artificial intelligence technology, which can achieve comprehensive monitoring and command scheduling of police patrols, improve the efficiency and accuracy of police patrols, and provide strong support for the daily work of public security organs.

### 3.3 System Testing

The application of big data technology in the intelligent patrol command system of public security can achieve the collection, storage, and analysis of police information, and feedback these results to the dispatch center. By monitoring the on-site situation in real-time and conducting investigations, relevant evidence of the case is obtained. In the process of building a testing platform for the public security intelligent patrol command system, it is necessary to fully consider the conditions that need to be met in different environments. In order to ensure that the system can achieve the expected results and achieve normal use, meet user requirements and functions, comprehensive testing and verification of relevant hardware equipment should also be carried out. After establishing the intelligent patrol command system testing platform, a comprehensive inspection should be conducted on the entire construction of public security intelligence, the analysis and application of security information data, and emergency response capabilities. When building a testing platform for the intelligent patrol command system, it is necessary to conduct performance indicators testing on the system to ensure that the equipment operates normally. Corresponding functional module software is configured according to requirements. In the process of building an intelligent patrol command system, the selection of testing indicators should be reasonable to ensure that the selected standards can coordinate and cooperate with each other.

The public security intelligent patrol command and dispatch system effectively identifies the affairs within the patrol area through real-time collection of police situation information, video monitoring, and other methods. Based on image analysis technology, multiple recognition methods are used to comprehensively judge the target area and surrounding environment from multiple perspectives.

The police intelligent patrol command and dispatching system needs comprehensive and rigorous testing, including unit testing, integration testing, system testing, acceptance testing, etc. The specific testing plan is shown in Figure 3.

For different stages of testing content, corresponding testing plans need to be developed to ensure the smooth launch of the system. Unit testing mainly tests the correctness of the scheduling functions of each unit in the system, requiring testing with different data and scenarios to verify the robustness of the system in various abnormal situations, such as network disconnection, equipment failures, etc. The specific parameter results of unit testing are shown in Table 1.

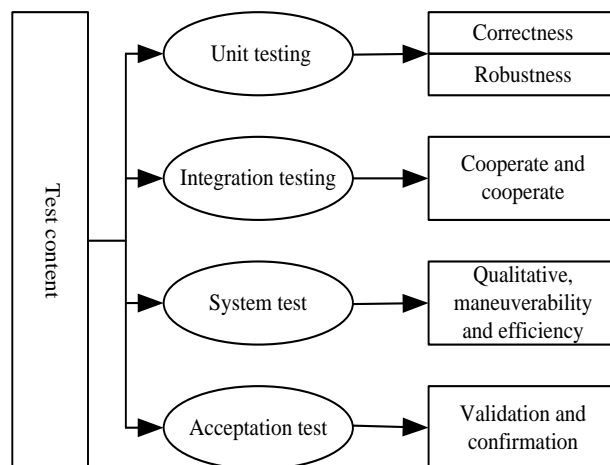


Figure 3: Public security intelligent patrol command and dispatch test scheme.

Table 1: Specific parameters of the unit test.

	Number
Number of test cases	600
Execute the number of use cases	600
Test coverage	100%
Number of critical defects	0
Number of serious defects	20
General defect number	40
Number of minor defects	60

The number of test cases developed for this unit test is 600, and the number of implementations is 600. The unit test coverage rate is 100%. During the execution of this unit test, 20 serious errors, 40 general errors, and 60 minor errors were found in the code.

Integration testing mainly tests the mutual cooperation and collaboration between different modules in the system, checks whether the interfaces between modules are normal, and whether information transmission is smooth. The video monitoring module and patrol route planning module are tested to check the correctness of the data between the two modules. After the integration test runs normally, comprehensive testing is conducted on the security and reliability of the entire system, including evaluating the stability, operability, efficiency, and other aspects of the system. Full process test cases are tested to address system defects and errors, ensuring a sound system environment. The test results are submitted to users and relevant departments for verification and confirmation, ensuring the correctness and compliance with actual needs of system delivery and use.

As shown in Figure 4, this article can find that in the traditional public security patrol command and scheduling system, its stability, accuracy, security, and work efficiency are relatively low. In the intelligent patrol command and scheduling system of big data, its stability, accuracy, security, and work efficiency have all been improved to a certain extent. Stability is guaranteed, and after long-term running tests, the system has shown good stability. It can not only run stably on different operating system platforms, but also operate effectively in high-intensity information processing environments. The security has been greatly improved, and key information such as important databases involved in the system has been effectively protected by security policies, ensuring that data is not tampered with or damaged by people, and ensuring the smooth progress of public security work. The efficiency has been significantly improved. After the system has planned



appropriate patrol routes and scheduling strategies, the work efficiency of patrol officers has significantly improved, improving the efficiency of public security police in handling cases and maintaining legal order.

#### 4. Test Results of Command and Dispatch System

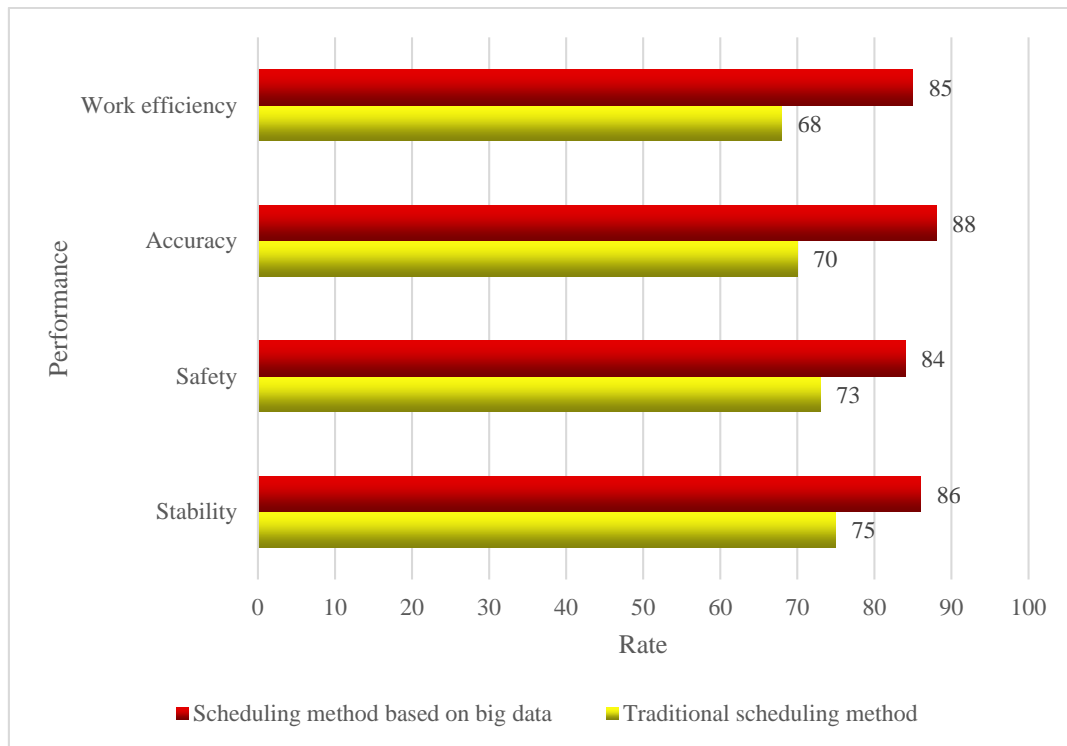


Figure 4: Performance results analysis.

#### 5. Conclusions

This article took the construction of a smart police patrol command and dispatch system as the research goal, and used big data technology and artificial intelligence algorithms to study the patrol issues of public security work. Through the collection and preprocessing of patrol data, a patrol model that balances predictability and decision-making has been established, achieving timely tracking and control of patrol work. In addition, by designing optimization algorithms based on path planning, patrol routes are optimized to improve patrol efficiency and coverage, providing support and guarantee for public security work. In summary, the methods and schemes proposed in this article can improve the efficiency and level of public security work, and have certain practical application value and promotion significance.

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