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Research Article

Smart City Public Safety Intelligent Early Warning and Detection

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This study conducts in-depth research and analysis on the intelligent monitoring and early warning of public safety machines in the construction of smart cities, taking risk management theory as the theoretical basis and combining it with the actual situation, i.e., constructing a public safety risk management framework under the background of proposing urban refinement management, a typical case for in-depth analysis, and understanding how the community carries out public safety risk prevention and control through research and interviews and other research methods, mainly including the overall design and the design of application modules for the robot. Based on studying the existing research and combining the advantages of each research method, this study proposes a method suitable for the analysis of this study, which can improve efficiency and accuracy. The robot application module design part, around the system's main emergency command object, i.e., the robot, details its design in four aspects: data communication, situation display, auxiliary decision-making, and command and dispatch. The technical environment for system development is given, the development framework based on BS structure and the development and implementation of data interface modules are detailed, and the development and implementation of the robot application module are explained in detail. Finally, the system functions and performance, and further optimization directions are given based on the analysis of the test results.

1. Introduction

In response to the intricate and complex situation of urban public safety, urban public safety monitoring and management have become more and more complex, and the diagnosis, discovery, and early warning of urban public safety events are difficult to be realized by a single data source and traditional spatial data type; therefore, with the development of the internet, internet of things, social network, and integrated observation system, the process of urban public safety monitoring has been constructed by satellite, UAV, and ground video monitoring [1]. The urban three-dimensional public safety monitoring network is composed of mobile phones and GPS devices. The massive spatiotemporal data generated by urban public safety monitoring mainly include video, image, remote sensing image, vector map, and trajectory data. These data not only contain rich temporal, spatial, and semantic information but also have multidimensional, multiscale, and multitemporal characteristics and multimodal features. The multimodal characteristics of public safety monitoring data make the same spatiotemporal object that may have many different forms of data description, and the different modal data have the characteristics of low-level feature heterogeneity and high-level semantic correlation, in the process of urban public safety diagnosis, discovery, and early warning, and the traditional unimodal data retrieval is far from satisfying the retrieval of different modal data of the same event, how to deeply analyze the connection between the data of different modalities, and how to analyze the data of different modalities? It is necessary to deeply analyze the connection between data of different modes, establish a correlation between data of different modes, and realize efficient cross-modal retrieval of data of different modes of the same event to support accurate, rapid diagnosis, timely detection, and early warning of urban public safety [2]. The core problem of cross-modal retrieval technology is the need to analyze and establish a correlation between data of different modalities, and to achieve cross-modal retrieval between data of different modalities. In recent years, the research on cross-modal retrieval technology for ordinary text, image, and video has been rapidly developing in the computer field, but the research on cross-modal retrieval of multimodal spatiotemporal data with typical spatiotemporal characteristics and rich semantic information is less. With the development of three-dimensional public safety monitoring networks in cities, research on cross-modal retrieval techniques for multimodal public safety monitoring data has become the key to support diagnosis, discovery, and early warning of urban public safety events [3]. Therefore, cross-modal retrieval for urban public safety monitoring data, association construction of multimodal spatiotemporal data, spatiotemporal indexing methods considering spatiotemporal semantics, and cross-modal retrieval methods are the focus of this study.

The concept of urban public safety governance has also emerged. Cities are the most concentrated areas in terms of human and material resources and financial resources and are important representatives of the economic development of a region. As the scale of cities continues to expand and the level of urbanization continues to rise, a variety of urban public safety events pose a great threat to people's lives and safety. From the theoretical point of view, this study combines many research directions based on the discussion of urban public safety risk generation mechanisms with existing theoretical results and key perspectives, such as public safety, polycentric governance, and risk governance. Based on the detailed research in the field of management, the current situation of urban public safety combined, the establishment of public safety governance analysis framework, combined with the existing public safety governance problems, analysis, and research of public safety governance strategies, and the ways to improve urban public safety based on risk management (such as effective governance), the urban public safety governance proposed to propose improvement strategies, based on research results for exploration and improvement [4]. It is of positive theoretical significance because it can effectively combine theory and practice and further improve the theoretical system related to urban public safety governance.

Based on the background of emergency response to public safety events, this project researches and implements a robotic command-and-control system for public safety. On the one hand, it uses the advantages of robots' spatial accessibility, real-time controllability, and cooperation to improve the control of the emergency command-and-control system on the situation at the incident site, and uses the command-and-control system to solve the problems of slow response, weak command, control, and information occlusion in the response of individual robots. On the other hand, the use of advanced networks to achieve remote command and control, and the use of network technology, WebGIS, real-time data transmission, remote communications, artificial intelligence, and other real-time presentation of the scene situation, through the auxiliary decision support-related methods to assist commanders to quickly respond to events, improve the overall situation of each node robot to the scene of the grasp, decision-making, collaboration between each other, and the efficiency of implementation. Although actively exploring the integration and sharing of public safety video, innovative access methods, and following the relevant access specification requirements, the development of networking and integration of work programs, guidance around the integration of social video resource networking, the current public safety video surveillance is still in the public security organs to build, manage, and use as the dominant state, in the use of things that still have considerable space for mining. How to optimize the management mode of public security video surveillance resources based on the existing video network and video sharing service platform solves the problem of sharing and common use of public security video surveillance among departments. Our study is more efficient, more accurate, and more cost-effective than other studies. It has become a major issue nowadays to maximize the benefits of public security video surveillance resources, enhance the effectiveness of three-dimensional comprehensive prevention and control, improve public services and urban management, and enhance the ability of public security information to benefit the public.

2. Related Works

The city is a dense and complex special structural system. With the continuous progress of the economy, technology, and culture, the modern city is mainly driven by industrialization and informationization and gathers a huge number of elements to form an open and complex giant system. The close dependence, gradual differentiation, evolutionary change, and no-linear interaction among the elements in them are transformed into different distributions of time, space, and function through rise and fall. The city gathers many people and serves as the basic carrier of their productive life [5]. At the same time, human activity constitutes and governs the operation and development of cities. The individual units active in the city are constantly moving and changing, and present the normality and evolution of the city in a relatively stable group organization behavior. As an important component of smart city construction, it is crucial to cultivate a safe urban life form and create a smart and safe city [6]. The risk management model is constantly improved and optimized with the help of big data thinking and technology, and the systems and equipment related to comprehensive public safety emergency response, monitoring and surveillance, prevention and early warning, rescue, and command are constantly innovated, and the research of core hardware and software and the exploration of overall solutions are gradually launched [7].

In terms of subjects, some scholars believe that shaping the role of government guidance, community autonomy, and individual participation is a necessary path to optimize community public safety governance; in terms of platform construction, some scholars believe that the emergency management system is an important carrier for handling and transmitting various types of information in public emergencies and aiding emergency management decisions and that vigorously promoting the construction of emergency management information technology is an important means to effectively deal with urban emergencies [8]. It is an important means to effectively deal with urban emergencies, promote the effectiveness of government emergency plans, and enhance the emergency management capacity of urban communities [9]. In terms of mechanism, some scholars emphasize the need to insist on shifting the focus of public safety supervision downward and moving the gate forward, and to establish a sound organizational network for public safety supervision at the grassroots level; at the same time, it is necessary to absorb social forces utilizing social governance, mobilize multiple subjects, and integrate resources from all sides to realize the socialized operation of public safety supervision [10]. From the perspective of holistic governance theory, the establishment of a unified and integrated leadership institution for community public safety governance is the essence of cross-border cooperation, the partnership of institutions in different fields is the basic tool for cross-border cooperation, and the information network platform is the technical support for cross-border integration [11]. From the perspective of governance and collaborative government, some scholars also believe that a shift from loose cooperation based on government monopoly to an institutionalized collaborative model under government leadership should be realized among multiple subjects [12].

The rapid development and large-scale application of information technology have led to the gradual evolution of command-and-control systems with computers as the core, but the application of information technology in the system lags far behind the development of information technology itself. On the one hand, the system often shows a lag in intelligent assistance, failing to effectively combine various multimedia technologies, high situational awareness technologies, and intelligent auxiliary decision-making technologies. On the other hand, the relevant research focuses on face-to-face command and control, and not fully applies the development of reconnaissance and positioning technology, communication technology and network technology, and the implementation of remote command and control of the scene rescue personnel and their equipment, "man-machine" integration, and "full-area real-time dynamic" efficient command. With the development of intelligent robotics, a variety of special intelligent robots began to be developed and applied, such as rescue operation robots, reconnaissance robots, and fire robots, to provide strong support for the handling of public safety events. However, robots often perform tasks as independent individuals in incident response, mostly showing problems such as scattered emergency forces, slow response, weak command and control, and low efficiency in collecting and sharing information on-site.

3. Intelligent Monitoring and Early Warning Analysis of Public Safety Machines for Smart City Construction

3.1. Intelligent Monitoring System Design for Public Safety Machines in Smart City Construction. Public safety is a very complex system, and realistically, compared to national security, urban security, and social security, public safety is most closely related to people's daily lives. In other words, anyone who lives in a city has a great relationship with the public safety of the city [13]. From the previous research results on the connotation of public safety for other scholars, it can be found that the current research on the connotation of public safety is mainly focused on three aspects: one is the research on behaviors that endanger public safety at the legal level, the second is the research on professional public safety work, and the third is the research on public safety technology from the scientific perspective. By combining the research results of other scholars and the current direction of public safety research, public safety can be defined. Public security is the security of society and citizens, and from the perspective of public administration, it means that the external environment, basic values, interests, and institutions in the public sphere can maintain a fixed direction of progress and, as expected by everyone, ensure that the normal production life of society and citizens is not accordingly threatened.

From an economic point of view, a city is a network of economic factors and markets that intersect within a certain spatial area; from a geographical point of view, it is a dense agglomeration of people and houses in a suitable location; from a sociological point of view, a city is a form of social organization in which secondary and tertiary sector workers are the main population. The city is a complex of political, economic, and cultural elements that form a special area in which the inhabitants especially live, i.e., relatively free from agricultural production activities. It is clear from this that the key to urban security lies in the construction of a relatively stable system that brings together the various urban elements. However, the complexity of the various elements of the city itself makes it vulnerable to various factors in the process of managing the safe operation of the city, which in turn leads to the emergence of public safety problems [14]. As a basic element of the national structural system, the security of the city is related to the security of the whole country, so the upper layer of urban security is national security, and it is very important to manage urban public security well. This can be summarized that urban public security also means security from the perspective of the city; in particular, it also means that the city needs to follow certain laws and patterns in the process of development to ensure the stability of its operation, as shown in Figure 1.

Diagnostic analysis, discovery, and early warning of urban public safety events require spatiotemporal data of different modalities as data support, which is a gradual process of query conditions from rough to precise, so cross-modal retrieval of multimodal spatiotemporal data needs to be realized based on different needs at different stages. The multimodal spatiotemporal data retrieval for public security monitoring requires not only fast retrieval speed but also comprehensive consideration of cross-modal retrieval based on time, space, and semantics [15]. Based on the semantic-based multimodal spatiotemporal data association model and the spatiotemporal semantic integration indexing method proposed in the previous study, the spatiotemporal

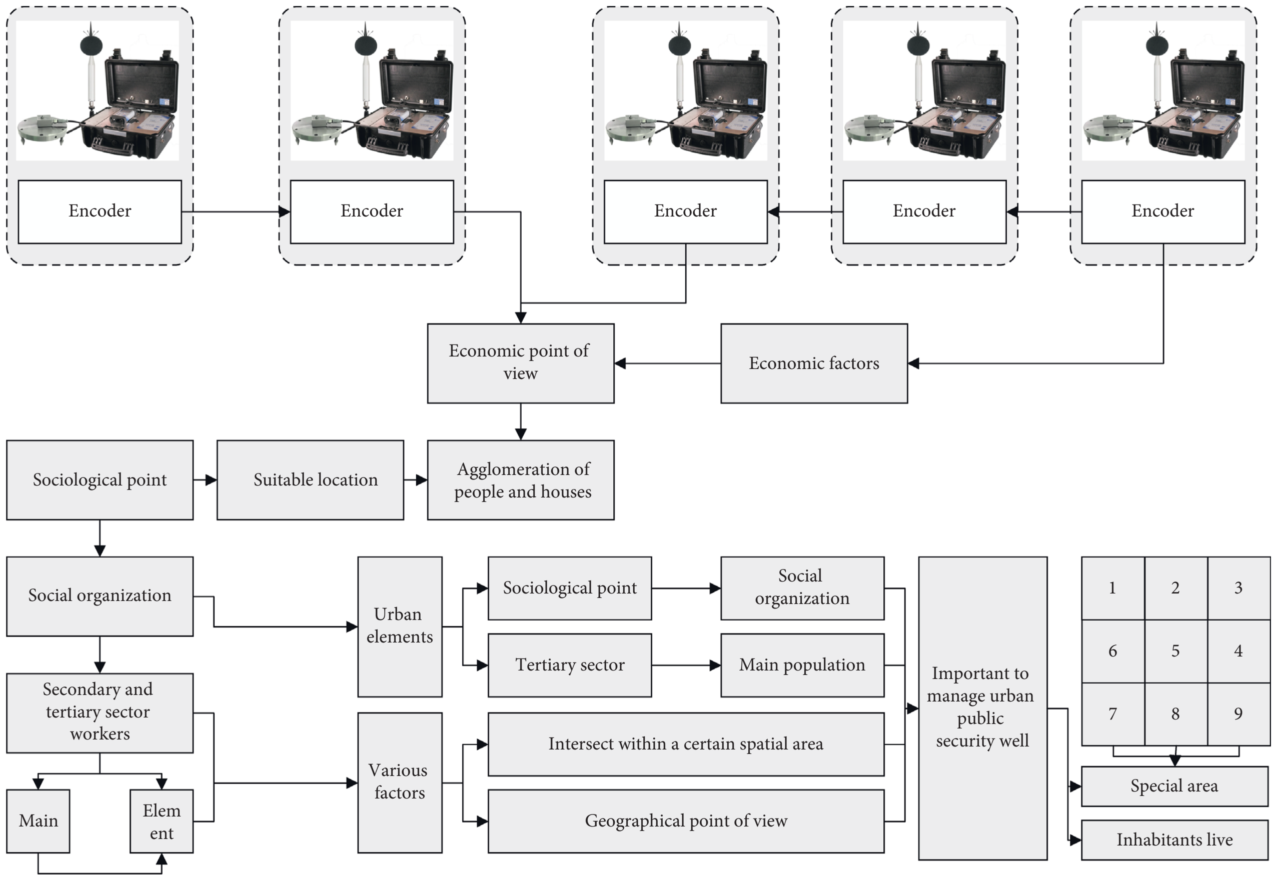

Figure 1: Intelligent monitoring framework of public safety machines for smart city construction.

association retrieval model will be studied from two aspects of spatiotemporal change objects and spatiotemporal change processes, and the cross-modal retrieval method for spatiotemporal change objects and the cross-modal retrieval method for spatiotemporal change processes will be proposed for the cross-modal retrieval needs of multimodal spatiotemporal data.

After the incident information is updated, the relevant plan is activated according to the basic characteristics such as the type and level of the incident. The relevant emergency members of the plan and the robot emergency team will arrive at the emergency site and immediately start a series of emergency rescue work following the contents specified in the plan. Referring to the laws and regulations related to emergency plans, the emergency plan of the robotic accusation system should form a system to formulate special emergency plans and on-site emergency disposal plans for all levels and types of accidents and all sources of danger that may occur, and clarify the responsibilities of relevant departments and relevant personnel in each process beforehand.

During the incident, and after the incident, in the preplanning management, in addition to the overall and special preplans for an incident emergency, the relevant preplans for robot emergency should be effectively supplemented so that the corresponding robot preplans can be activated according to the actual situation after the incident occurs to make a quick response. The robot command-and-control system's preplanning library mainly includes three major categories, as shown in Table 1.

To get rid of the problem that most of the cases can only see but not use the plan, the robot accusation system adopts intelligent process management of the plan, completes the process decomposition, analyzes each key node, and controls the progress of each key node [15]. The system provides a template for the preparation of the plan, and the user can enter the specific content and control the process of each key node in the plan, such as information reception, information transmission, and incident response. When an emergency occurs, the robot accuses the system of initiating and monitoring the process of the plan. First, according to the keywords of event type, level, and scope, the most similar plan in the plan database is automatically or manually matched, and the content of the plan is amended according to the actual situation. Then, each process task is issued according to the content of the plan, and the emergency resources involved are reasonably allocated. Finally, the task execution and resource dispatching are monitored in real time.

It is important to accurately locate the dynamic risk evolution in the city, advance the risk identification milestone and design, build a real-time chain-triggered strain mechanism for the local subsystems of the city, identify urban disaster risks as early as possible, and stimulate the

Table 1: Classification of preprogrammed.

Plan system	Illustration	Value
Comprehensive emergency plan	In general, it elaborates on the emergency guidelines, policies, emergency organization structure, and related emergency responsibilities for handling accidents	5
Special emergency plan	The basic requirements and procedures for emergency actions, measures, and guarantees are comprehensive documents for dealing with various accidents	8
On-site disposal plan	Target-specific accident categories	2

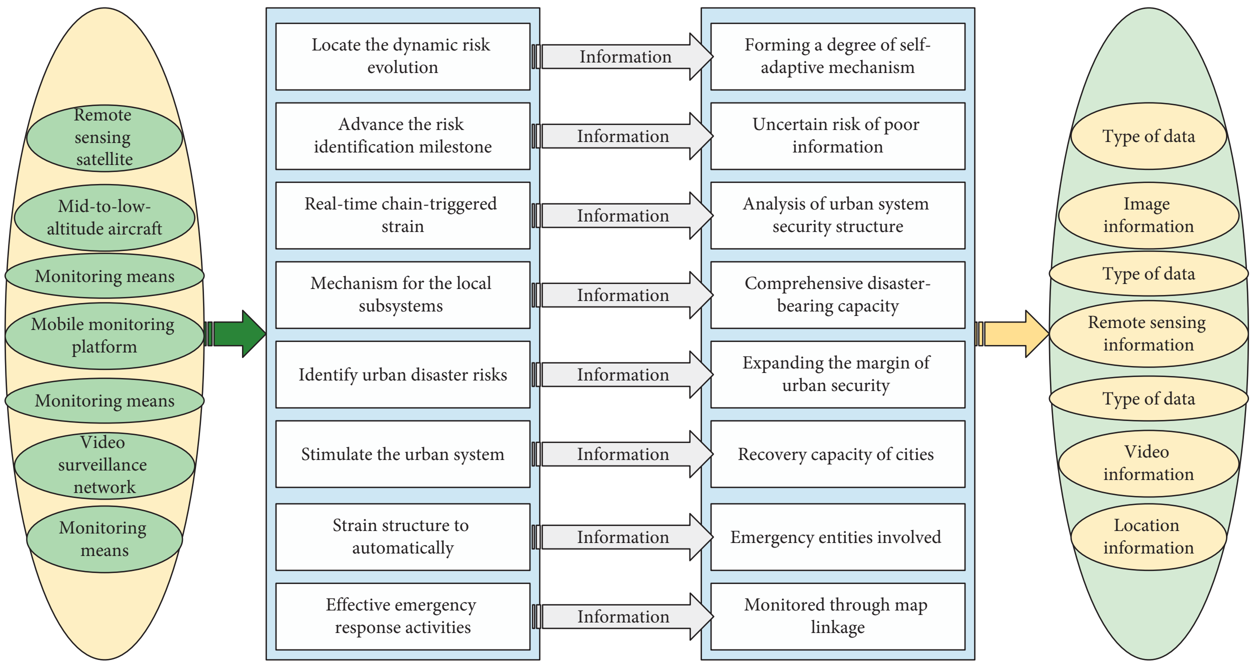

Figure 2: Public safety stereoscopic monitoring data acquisition and main data types.

urban system strain structure to automatically adjust to intervene in effective emergency response activities, thus forming a degree of self-adaptive mechanism for the uncertain risk of poor information. In addition, through the analysis of urban system security structure, it is easy to see that expanding the margin of urban security and improving the comprehensive disaster-bearing capacity and post-disaster recovery capacity of cities are important ways to ensure urban security, as shown in Figure 2. In the action phase, specific tasks are given to the robots and other emergency entities involved according to the specific content of the disposal plan, and the execution of the tasks is monitored through map linkage. In the above model, the arrows indicate the information flow, which runs through the whole process of the command-and-control system. The information involved in the robotic command-and-control system is generated and derived from the external environment and has the general characteristics of ordinary information, i.e., timeliness, transferability, dependency, sharing, falsifiability, and utility, so that the whole process of information acquisition, transmission, processing, and utilization is subject to higher requirements.

From the perspective of information flow in the command-and-control system, the data flow of the command-and-control system is analyzed [16]. The information sources of the command-and-control system mainly include two parts: the disaster site and the related emergency platform. As the main execution entity of the accusation system, the information of the robot includes the information of the body and the environmental information collected at the disaster site. The robot body information includes robot status, power, and other parameter information, while the disaster site information may include on-site video, pictures, and other sensor information. After the information is collected, the event emergency scene is presented to the commanders after the analysis and processing of the original data. After the commanders have sufficient knowledge of the event scene posture, they assist in developing the event disposal plan with the help of decision support-related methods. Finally, the commanders issue emergency rescue tasks to the executing entities on-site according to the disposal plan and monitor and adjust the emergency rescue process of the executing entities through real-time information feedback.

Different from traditional spatial data, public safety monitoring data not only have the massive and unstructured characteristics of traditional spatial data but also have multimodal characteristics. The multimodal characteristic refers to the data description of the same spatiotemporal object with multiple different forms and the characteristics of low-level feature heterogeneity and high-level semantic correlation between different modal data. For example, if the police want to use public security monitoring data to arrest a suspect, the police may identify the location of the suspect through the description of several different modal data such as video data and trajectory data of transportation. The multimodal nature of public safety monitoring data provides the possibility to support deep cross-modal analysis, mining, and application of multisource spatiotemporal data.

3.2. Design of Intelligent Monitoring and Warning Methods for Public Safety Machines. The key to making the huge amount of public data useful is data application, and the prerequisite for data application is data openness. Because of the limited technical power of the public sector itself, Hangzhou has introduced private organizations to provide technical services for the "City Brain" project [17]. According to the basic logic of "City Brain," it is easy to see that the private sector plays a leading role in the whole chain from data collection to data application. Taking traffic congestion as an example, the private sector has access to real-time video data from road video surveillance and can use the road traffic data it obtains to analyze and build models through algorithms to promptly adjust signals on-ramps and other roads to alleviate prolonged congestion; it can even use big data technology to make predictions based on real-time road conditions and plan routes for special vehicles such as ambulances. Private organizations can submit data requirements to the relevant departments according to their needs and perform operations such as cleaning, mining, and application of the data acquired after approval and consent. According to the complete chain of big data application, it is not difficult to find that while realizing the value of data, there is a possibility of data security problems occurring in each link of data collection, data cleaning, and data mining.

$$\begin{aligned} \Gamma_{ij} &= \sum_{k=1}^{m} w_k^2 \gamma_{\mathrm{ijk}}, \\ \sum_{i=1}^{p} \Gamma_{i\alpha} &\leq \sum_{i=1}^{p} \Gamma_{i\beta}. \end{aligned} \tag{1}$$

Cities are complex systems, and the construction of smart cities involves different fields, and to share resources and information data, the platform to be built needs to be cross-agency and cross-departmental, which is a complex and systematic project. In this process, the fields with great strategic significance, strong driving force, urgent realistic needs, and wide and large benefits are selected to build relevant projects and works, to achieve results in the short term and form a systematic model; in this way, we can achieve results in a short period and form a systematic model, summarize experience and practice, gradually expand the application area, and lay the foundation for subsequent construction. The development of various construction and management specifications, including basic network standards, information service standards, and security standards, can guarantee the stable, safe, continuous, and efficient operation of the smart city system. The information infrastructure should be optimized and improved, technical standard specifications, application standard specifications, and operation and maintenance standard specifications including perception equipment and cloud foundation should be established to guide and regulate the smart city, and the engineering projects should be incorporated into the assessment system for regular review and evaluation against them to ensure that the project construction effectively promoted, as shown in Figure 3.

The top-level design of a smart city takes a holistic view, integrates all levels and elements of the system, involves multiple participants, and defines unified goals. It follows the principles of integrated planning, collaborative integration, resource integration and sharing, and services for the benefit of the people, and is people oriented and city specific [18]. Its construction program needs to have a wide range of universality; integration of academic, administrative, investment, and other authorities' demands; a combination of guiding programs and unified data formats and interfaces; and attention to the design of the city management system and operational development environment in addition to the technical aspects. The construction of smart cities requires timely, accurate, and comprehensive access to all kinds of data and information from the operation of the city, and in this process, intelligent infrastructure is the main source of providing information, and the establishment of a perceptible infrastructure layer is the underlying foundation in the technical architecture of smart cities. The data of each business area are usually distributed in independent subsystems, and the amount of data is very huge. The data extracted from the database have inconsistent formats and are incomplete data, which may not meet the requirements of the destination library, and when there is a software upgrade, the database architecture and the form of storage behind it are different, which are bound to bring about the upgrade, conversion, and processing of data, and the conversion of data is now. The conversion of data nowadays is inefficient, and in the application of IoT, there is also the problem of integration of old and new system interfaces and cross-system interfaces that cannot be accessed, resulting in the problem of data conversion and transmission. Therefore, the establishment of a unified data interface can realize high-speed data conversion and effective transmission.

$$\begin{aligned} w_i &= \frac{\sum_{i=1}^{p} \Gamma_{ij}^2}{\sum_{i=1}^{p} \cdot \sum_{i=1}^{p} \Gamma_{ij}^2}, \\ R(j) &= \sum_{i=1}^{p} w_j^2 \Gamma_{ij}^2. \end{aligned} \tag{2}$$

The rule of law is to manage according to laws, regulations, and systems, using the rule of law thinking and the rule of law to solve the persistent problems of urban governance; intelligence is the future of urban refinement management; the key is to fully use modern technology and information technology, relying on the system platform to achieve information sharing, rapid linkage, and intelligent management; and standardization is to improve the

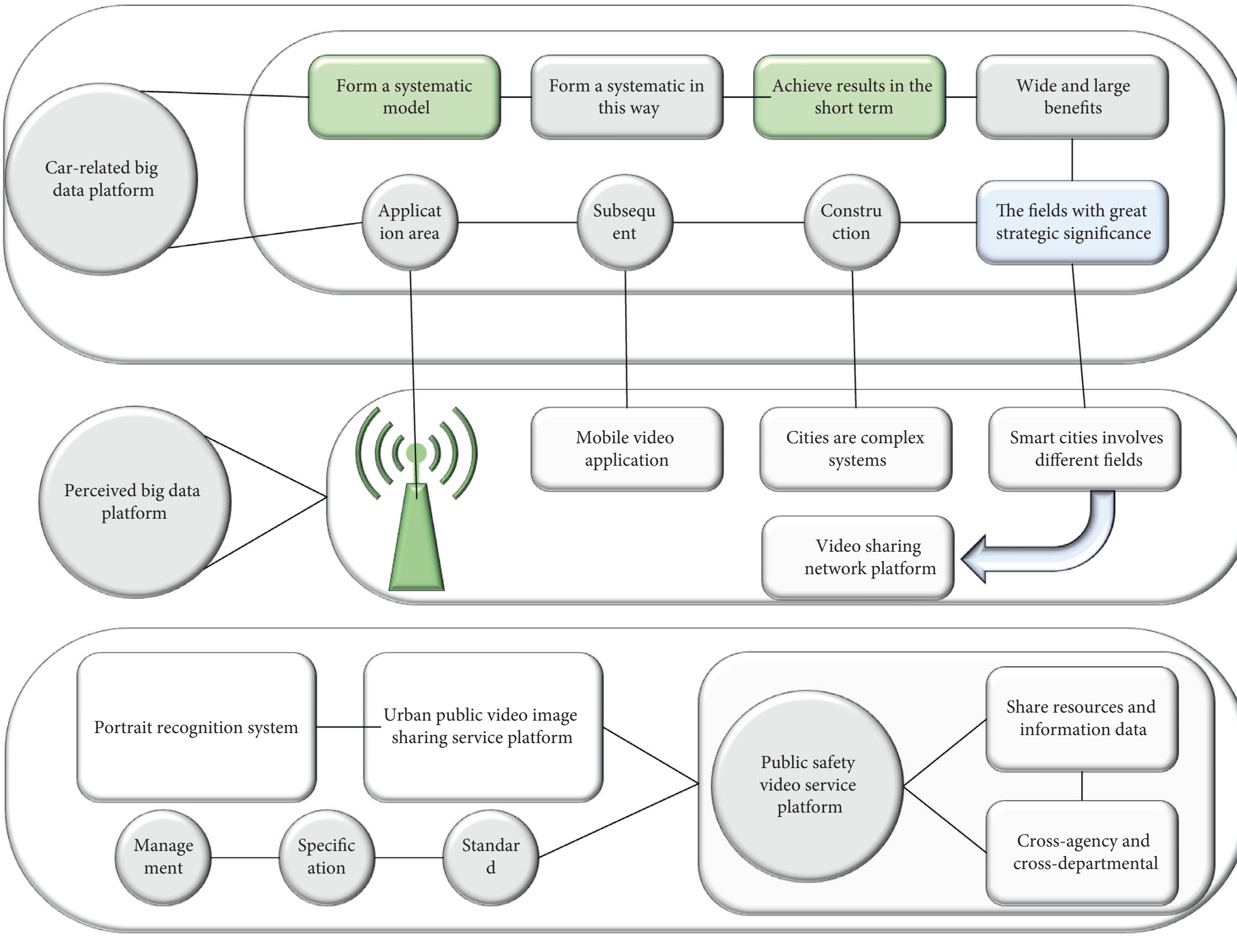

Figure 3: Public security video surveillance application system.

standard system for urban refinement. Standardization is to provide the basis for urban refinement management through a sound and complete standard system, integrating and unifying, bridging, and supplementing the scattered management standards of various departments, making them quantifiable, assessable, and traceable; socialization is to realize the diversification of management subjects, relying only on government departments for management that is not enough; and only by integrating the power of social, market, and other diversified subjects can we achieve the level of refinement management, requiring the social diversified subjects to do their duty while the government management responsibilities are in place [19]. Refinement in the field of urban management is to apply the concept of refinement in the process of urban management, to put people first, to seize the breakthroughs, to continuously promote the shortcomings, to promote the safety, order, and comfort of the city based on precise and scientific regulations and standards, to supplement with efficient and intelligent information technology tools, to adhere to the synergistic pattern of multigovernance, and to meet the interests of all social classes with better quality services and more humane management, as shown in Figure 4.

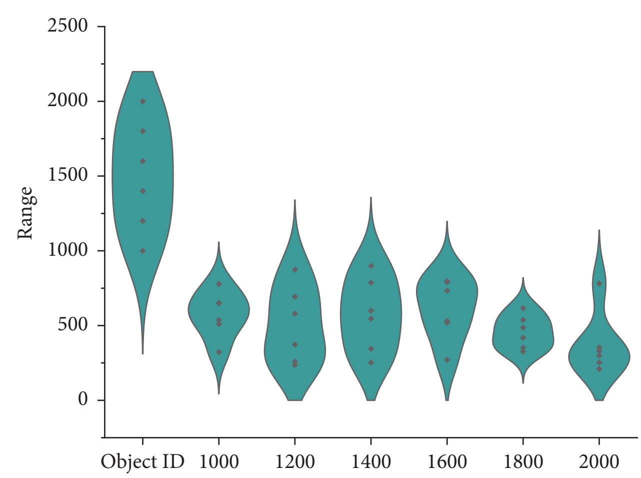

Figure 4: Monitoring early warning calculations.

In the case of data opened to the private sector by the public sector, not all public data can be opened to the private sector without conditions or boundaries. If public data involve the privacy of citizens, internal government secrets, secrets of commercial organizations, etc., and are opened to the private sector without conditions, there is a risk of improper use of the data by the private sector for profit.

$$z^{(1)}(t) = \left(z^2(2) + \frac{b}{a}\right)e^{-\alpha t} - \frac{b}{a}. \quad (3)$$

Public data should be classified into visible and useable data, visible and unavailable data, and unavailable and invisible data according to its level, importance, and confidentiality, and the data provided by the public sector to private organizations should be further subdivided on this basis. This will pose a great challenge to the security and authority of the government, and will also lead to security problems such as misuse of personal private data and theft of confidential business information by private organizations [20]. The government management center should be responsible for the senior leadership of government departments, and the team should be composed of full-time video information technology service personnel, supplemented by business departments and professional companies' research and development personnel, and clarify the responsibilities and tasks of the government management center and various industry departments, and following the division of responsibilities and the actual work needs of each department, video resource application authority should be reasonably allocated, and each division of the duty, working closely together to grasp the video surveillance construction, management, application, maintenance, and other aspects of the work, becomes the primary link to ensure that the video application is to deepen and enhance the use of benefits.

4. Analysis of Results

4.1. Intelligent Monitoring System Performance Results. It is also a highly practical and operational issue. From a practical point of view, different regions have different management requirements, and it is equally necessary to conduct in-depth research on this aspect in the process of public security governance and seek more effective management models. However, from the overall situation, there are still shortcomings in the overall public safety governance research, which leads to governance work greatly affected. In the process of urban public safety governance, it is necessary to pursue the alignment of interests, and the law is the basis for ensuring the alignment of interests and achieving efficient management. In the process of urban public safety governance, legalization is the key to ensuring the stable operation of the government administrative system and the autonomous system and is an important basis for coordinating the interests of the government and the interests of society. From the current situation of public safety governance, there is not yet a perfect system of laws and regulations for disaster mitigation and relief, which leads to the problem of unclear responsibilities in the process of urban public safety governance, especially when it comes to how to do the reconstruction and rehabilitation work within the shortest practice after the occurrence of a public safety incident, which is a lacking area at present.

The first is the most fundamental need for survival, which is reflected in access to food and drinking water. In the preparation of emergency shelters, in addition to the preparation of these substantive materials, it is necessary to calculate the amount of material distribution and the number of days of supply through the statistics of the number of evacuees and emergency materials in the place, so that the managers can improvise and deploy in time to guarantee the needs of evacuees; the second is the living needs, namely, rest and accommodation, washing, and excretion. In this process, it is necessary to monitor in real time the status of various pipeline networks, stability, and safety of the built accommodation facilities. In conventional emergency shelters, it is necessary to send stationed or testing personnel, but in the construction of smart cities, such workforce can be saved, as shown in Figure 5.

Access to information data and command platforms is required. These include the collection of the situation of people on-site and the monitoring of the status within the premises; a management platform that can display information and assist in decision-making; and the proficiency in changes in the surrounding environment to make predictions about the disaster situation and assist in decision-making about the next action instructions. The second is the demand for service output: through broadcasting and communication equipment, the command of the actions of the groups in the place; giving feedback and emotional reassurance to the affected groups; and the collection of the needs of the affected groups in the place. From the analysis of the top-level design of the smart city, promoting the construction of the smart city in various fields is not limited to the stacking of smart hardware in this field; similarly, the establishment of the emergency shelter cannot just be limited to the intelligent facility configuration of the place itself but should rely on the whole intelligent emergency system, from the four levels of the technical architecture layer by layer. Otherwise, it is an isolated set of intelligent hardware, without connecting it through a high-speed transmission network, without relying on the platform of cloud computing and big data processing and calculation, without forming the whole data sharing, without using the output of artificial intelligence and other technologies, etc. In this way, it also fails to grasp the essence of a smart city, and the manager cannot perceive the state of everything in the place in real time and cannot instantly obtain the needed data and information. It is not possible to capture the needs of citizens and make emergency responses in the first place, as shown in Figure 6.

When introducing larger-scale element information data, it will be possible to obtain more comprehensive element causality results, thus providing complete decision support for urban areas and overall fire emergency response capability improvement. When many similar cases of fire accidents introduced, the basis for risk diagnosis is enriched, and more references are available for judging the evolution of risk signs mapped by the state of each element in the grid cell, which will greatly specify the degree to which different elements affect the risk in different grid cells. Thus, the model can be used to create differentiated and dynamic capacity requirements and evaluation models for the grid cells at the end of the city and for the intermediate levels, thus providing a set of management technology solutions for urban fire safety adaptive mechanisms. The key to the

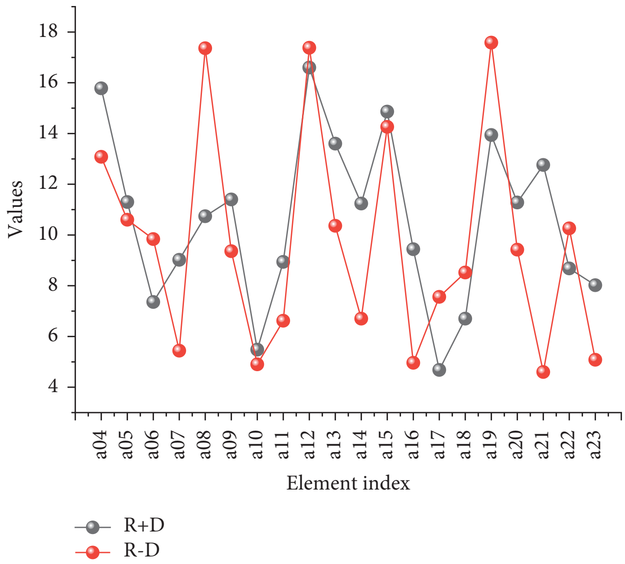

Figure 5: Centrality and causality of risk elements of grid cells.

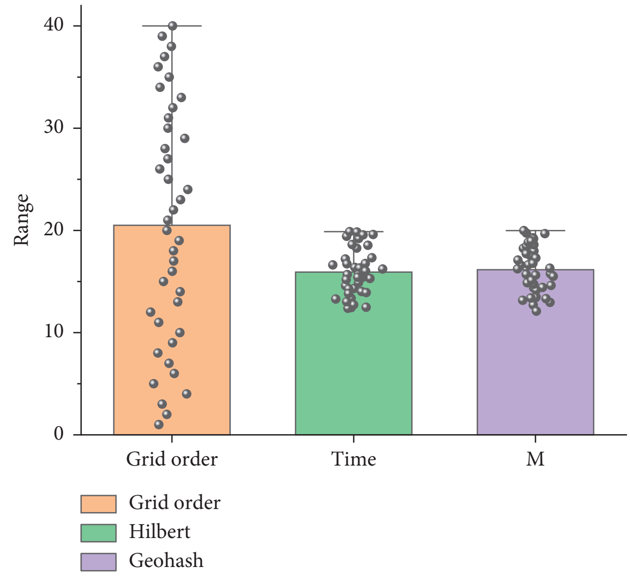

Figure 6: Operational efficiency.

sublimation of the comprehensive analysis from objective and correct to accurate and timely, in addition to the further optimization of the abovementioned model principles, lies in the maturity and improvement of the smart city platform, intelligence system, and the sharing mechanism of multifaceted information and data resources. Therefore, based on the actual operation of the experiments throughout this round of empirical calculations, fully combined with the current situation of urban risk governance, and oriented to the new era of urban regional fire safety risk diagnosis practice and adaptive mechanism construction tasks, the theoretical research of related initiatives is further carried out in the following from three aspects.

4.2. Intelligent Monitoring of Early Warning Results. As far as the regulatory platform itself is concerned, the lack of uniformity in the regulatory platform makes it possible for differences and disagreements to exist in the monitoring results of the same data, which adversely affects the timely implementation of government decision-making and emergency disposal, as the relevant personnel needs to verify the authenticity of different monitoring results before they can make decisions on whether and how to carry out emergency disposal, which misses the best timing. The lack of regulatory monitoring of the definition, algorithm, testing, and release of public data will make the use of public data by private organizations out of the control of the public sector, and private organizations may perform certain illegal and unlawful operations on the data in pursuit of commercial value, resulting in unpredictable, uncontrollable, or even irreversible consequences. With the advent of the cloud era, cloud technology has provided great convenience for data storage, etc. However, after the business goes to the cloud, the public sector's control over its data and business systems is weakened, and some of the management and operation, and maintenance rights are controlled by cloud service providers, and there is a lack of effective regulatory mechanisms and supervision means for cloud service providers, which may tamper, use, backup, or even sell public data on the cloud-based on their interests, resulting in serious public data security problems, leading to some public sectors' data on the cloud have doubts, as shown in Figure 7. Controls on network access are also not very strict. The inability to fully guarantee basic security means that data held within the public sector is at risk of external intrusion, and the leakage of certain confidential and sensitive data will have an extremely negative impact on the stability of society. In terms of monitoring technology, an immature and incomplete monitoring system may not be able to promptly detect hidden data risks, resulting in emergency response work not being carried out in the first instance and the damage caused by data security problems not being kept to a minimum.

As far as emergency disposal technology is concerned, without advanced disposal technology, even if the monitoring system issues a data security alert for the first time, it cannot make a rapid response, or even if the emergency disposal system makes rapid disposal at the first time, it cannot respond to and thoroughly solve the emergency data security problem due to its low technical content, which will likewise produce security problems such as leaking personal privacy, commercial secrets and state secrets, and so on. The use of big data technology to achieve analysis and prediction is related to the amount of data, algorithms, and objectives. To achieve data prediction, it is necessary to have sufficient data volume, mature algorithms, and clear objectives.

The retrieval time overhead increases with the increase in data volume, but the overall retrieval time overhead of this study's index is lower than that of the combinatorial index, which is mainly because this study's index merges the retrieval results of multiple behavioral processes, while the combinatorial index also requires the retrieval results of

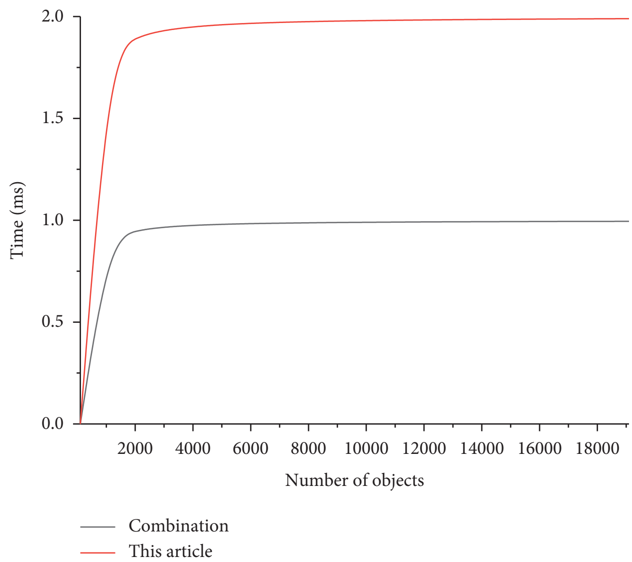

Figure 7: Comparison of early warning performance.

temporal, spatial, and semantic associations in each behavioral process retrieval separately before this merging. In addition, as the data volume increases, the retrieval time of this index grows slower and the gap between the retrieval time of this index and that of the combinatorial index gradually increases, mainly because as the data volume increases, the retrieval time is not only affected by the number of retrieval results merged but also by the semantic saturation, with the increase in data volume, the semantic information contained in the data content tends to be saturated, i.e., the amount of keywords tends to be stable, and the time of the word dictionary matching stage tends to be stable. The above experimental results indicate that the retrieval performance of this study's index for the event change process is better than that of the combinatorial index, and the larger the data volume, the higher the retrieval performance of this study's index.

5. Conclusions

In this study, we propose a semantic-based multimodal spatiotemporal data association model for the characteristics of low-level feature heterogeneity and high-level semantic correlation of multimodal spatiotemporal data. Based on the feature-semantic mapping mechanism of spatiotemporal data, the model uses ontology theory to construct a semantic expression model of multimodal spatiotemporal data and realize the normalized semantic expression of multimodal spatiotemporal data; on this basis, the temporal correlation, spatial correlation, and semantic correlation calculation methods of multimodal spatiotemporal data are proposed to realize the correlation construction and correlation metric of multimodal spatiotemporal data, which provides model support for public safety monitoring-oriented data. It is found that smart cities have not paid enough attention to the field of urban public safety, and there are no in-depth development and application in smart emergency response. The robot application module is combined with related technologies to develop and implement four aspects of robot data communication, situational display, auxiliary decision-making, and command and dispatch. Public data security management is a continuous project, and due to the differences in the interests of the subjects, the supervision mechanism should be carried out throughout the process, while technical means, policies, and regulations need to be constantly improved to cope with new problems that constantly arise. In the future, we will conduct more in-depth research on this basis and apply it in practice.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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