

Research on Policing Situation Awareness Driven by Artificial Intelligence

Tuo Shi*, Yutong Wu, Zhanhao Cui, Di Yuan and Qichen Wang

Beijing Police College, Beijing 102202, China

* Corresponding author

Abstract: Policing situation awareness is an all-round perception and understanding based on the surrounding living space and the development of things to better and earlier warn potential risk issues. Taking the past policing data as a logical starting point and starting from the overall perspective, it is a strategy to improve the perception, identification, analysis and understanding hidden in the public safety risks, and the ability to deal with the respond, in order to ultimately prepare in advance for upcoming social safety issues and make decisions and actions to fully ensure the smooth development of tasks. The third wave of artificial intelligence has brought the unprecedented opportunities for policing forecasting and early warning. Relying on the rise of artificial intelligence technology, especially deep learning technology, as well as taking the historical policing data as a logical starting point, a scientific and systematic policing situation awareness model can be an inevitable choice for the public security organs to realize "policing following crime" and "integration of intelligence, command, duty and action". Based on the concept of artificial intelligence-driven policing situation awareness, this paper constructs an artificial intelligence-based policing system model, explores the operation process of the system model, as well as proposes the future development path of the operation model, which provides a certain reference for the construction of the policing situation awareness system.

Keywords: artificial intelligence; policing situation awareness; big data; smart policing

1. Introduction

Currently, the diversified social situation has increased various crimes significantly, while the amount of policing information is an important criterion for measuring the overall social security in the field of public security, leading to the great working pressure of public security organs. In general, the policing situation usually can be divided into criminal, public security and order types according to different relevant legal standards, therefore, those public security organs need to pay more attention to the public security and criminal policing. In this aspect, how to effectively control the rising momentum of various illegal and criminal policing is a difficult problem faced by the public security organs. As we know,

the traditional passive and responsive policing handling strategies have become very difficult to adapt to changes in the external situation and the people's increased living standards. The early warning and prediction of policing situation is the only way for public security organs to realize smart policing in the era of artificial intelligence [1]. The policing situation indicates the complex characteristics due to various external environment and other factors, but its development and changes have inherent laws. More importantly, these laws can not be easily captured only by traditional empirical perception and simple statistical analysis, especially being much difficult to realize the scientific perception prediction of policing situation.

The third wave of artificial intelligence has brought unprecedented opportunities for policing predication and early warning. Relying on the rise of artificial intelligence technology, as well as taking the historical policing data as a logical starting point, a scientific and systematic policing situation awareness model can be an inevitable choice for the public security organs to realize "policing following crime" and "integration of intelligence, command, duty and action" [2].

2. Discussion on the Concept of Policing Situation Awareness

2.1. Origin of Situation Awareness

The concept of situation awareness can be understood as an ability to perceive social insecurity in all aspects based on the surrounding living space and the development of things. Taking big security data as the logical starting point and from the overall perspective, it is a strategy to improve the perception, identification, analysis and understanding hidden in the public safety risks, in order to ultimately take social safety issues as the starting point in the process of making decisions and actions.

Strictly speaking, "situation awareness" is not a new term, and this concept originated from military needs. "If you know the enemy and know yourself, you need not fear the result of a hundred battles" [3], which can be regarded as the essence of situation awareness. In the past few decades, those western countries have invested a lot of resources in the related research and development in space and military fields. The situation awareness systems developed mainly include tactical information

system, missile early warning system (anti-missile situation awareness system) and space flying object monitoring system based on photoelectric monitoring.

The technology of situation awareness was not developed into the field of information technology security until the early 1990s, and the first research was used in the next-generation intrusion detection system. Among them, the most effective application is the Einstein Project founded by the United States, which was formally implemented in 2003 [4]. The reason for creating the plan was that “the system can automatically collect, correlate, analyze, and share computer security information among the US federal government, so that federal agencies can receive its information and threats to network infrastructure in real time.”

2.2. Extension of Situation Awareness in the Field of Network Security

In April 2016, our country clearly stated that we should accelerate the security assurance of key information facilities for research and development, perceive network security trends 24 hours a day, and timely increase network security protection and deterrence capabilities, in order to create network security situation anytime and anywhere.” From that moment, the new concept of "situation awareness" has been quickly accepted and widely used in the field of network security. The purpose is to fully perceive the network security threat situation, understand the health and its application of the network, and achieve complete network attack tracing and evidence collection through whole-process analysis technology, thus helping security personnel to take targeted countermeasures [5].

Although the concept of "situation awareness" is now widely used in the field of network security and threat

intelligence, its deeper connotation and extension are often cited in the field of predictive policing affairs. Especially along with the rise of artificial intelligence technology, the integration of situation awareness and policing has no longer only focused on the conceptual stage. Driven by the technology [6], policing situation awareness has already achieved many theoretical innovations and practical applications. What’s more, the policing situation awareness based on artificial intelligence technology will also bring unprecedented opportunities and results to it.

2.3. Definition of Policing Situation Awareness

Based on the concept of "situation awareness", the author believes that it can be defined as an all-round perception and understanding based on the surrounding living space and the development of things to better and earlier warn potential risk issues [7]. Taking the past policing data as a logical starting point and starting from the overall perspective, it is a strategy to improve the perception, identification, analysis and understanding hidden in the public safety risks, and the ability to deal with the respond, in order to ultimately prepare in advance for upcoming social safety issues and make decisions and actions to fully ensure the smooth development of tasks.

3. A Model of Policing Situation Awareness Driven by Artificial Intelligence

3.1. Framework of the Policing Situation Awareness System Driven by Artificial Intelligence

In this paper, a new policing situation awareness driven by artificial intelligence mode is described as the following framework in Figure 1.

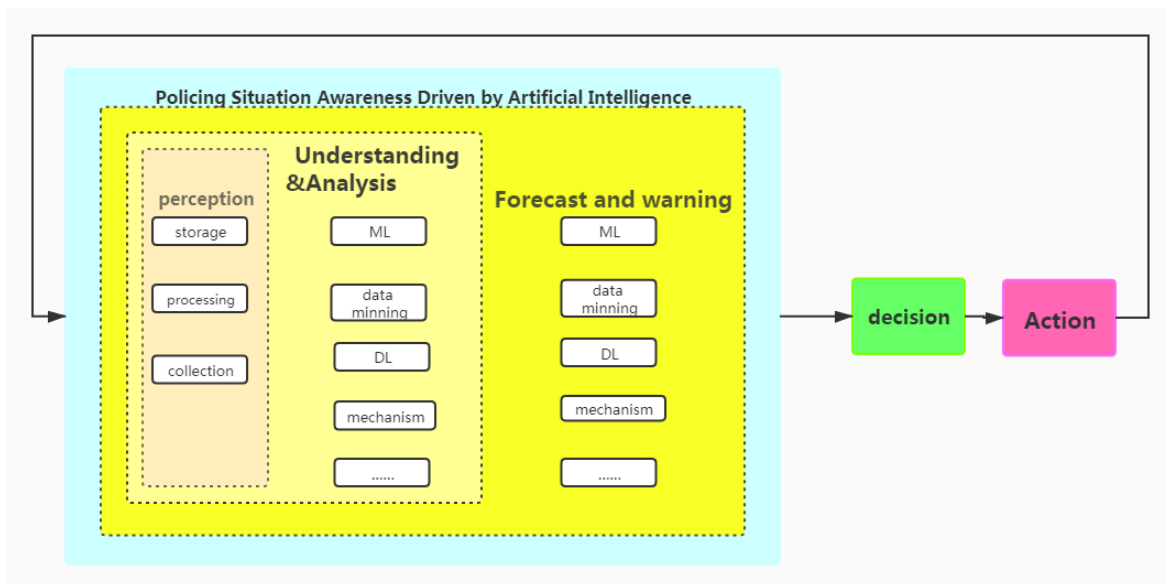


Figure 1. Framework of the policing situation awareness system.

The policing situation awareness driven by artificial intelligence actually includes three aspects of meanings, mainly from the perception and discovery of policing situation information, to the understanding and analysis

of policing information, and then to the forecast and early warning, and ultimately to carry out the policing situation efficiently and accurately. During the three stages of perception discovery, understanding and analysis, as well

as prediction and early warning based on artificial intelligence technology, it can be found that the first stage is the basis for the next stage, and the three stages are closely correlated and progressive.

In terms of the overall operation process of the system, the first stage is the perception of various components in the environment, that is the input of information, such as the perception and discovery of the policing situation. In detail, the use of artificial intelligence and big data technology can help timely discover and collect various policing situation data, and further carry out simple data sorting in the early stage, so as to facilitate the storage and fix of a large amount of policing information in a timely manner. What's more, the second stage is a comprehensive understanding of the current policing situation, that is the specific processing of information. Through the analysis and understanding of the collected data, and with the help of artificial intelligence and big data technologies, the application of machine learning, deep learning, data exploration, knowledge graphs and other related technologies can further integrate multiple heterogeneous policing data to reveal the hidden essential incentives, allowing to better discover the relevant knowledge of the policing situation, form the insight into their characteristics, as well as a deep understanding of the internal and external factors. In this aspect, the public security organs can more thoroughly interpret crimes, understand crimes and analyze crimes, but it is very necessary to take into account the mechanism model at this stage. In other words, the business experience model, data model and the mechanism model of the public security organs for many years can together form a strong support for the interpretation of the policing situation. The third stage is the prediction and planning of the subsequent situation, that is the output of information. Through the perception, discovery, understanding and analysis of the first two stages based on the intelligence knowledge orientation, the allocation of policing resources and service planning emphasizes more proactive measures to intervene, prevent and control, thus gradually forming a "prediction, early warning policing" strategy. Therefore, the ultimate goal is to make decisions and actions more efficient.

3.2. Discovery of Policing Awareness

Policing awareness discovery means to timely discover multiple static and real-time dynamic data related to the policing situation, not only including historical crimes, event data, static attribute data, dynamic trajectory information and social online data related to the perpetrators, but the data related to the external environment, such as geographic information, traffic, weather, communications, personnel mobility and social environment [8]. The quick data collection, storage, and processing by relying on artificial intelligence and other related equipment and public security personnel can help timely discover the possible security risks and hidden crimes, which are also the core of the policing awareness. As an important engine for policing situation discovery, artificial intelligence technology can help

police officers obtain data and even perceive potential related data, which can provide strong support for obtaining holographic data to the greatest extent.

3.3. Analysis of Policing Situation

Regarding the understanding of data related to policing situation, it becomes very necessary to conduct effective and deeper exploration of these structured and unstructured data [9]. The in-depth exploration of policing information is a complicated process of analyzing or extracting a large amount of unknown and useful laws or patterns from the massive policing information database. In the understanding and exploration of policing data, relying solely on traditional manual experience becomes very difficult to deal with complex and tedious multiple source data. Therefore, artificial intelligence and big data technology must be conducted to carry out systematic, process-oriented, precise and automated data interpretation [10]. Based on the understanding and analysis of artificial intelligence policing situation, it takes the data obtained from previous perceptions as the analysis object, and timely applies the analysis techniques of machine learning, deep learning, and knowledge graphs to process, classify and analyze the existing police data. More importantly, the application of these analysis techniques can help discover the higher value of data and obtain value-added intelligence, which aims to integrate technology and manual experience to understand the mechanism of policing situation at a deeper level, and play a key role in the early prediction and warning.

3.4. Forecast and Early Warning of Policing

Under the premise of discovery, perception and in-depth understanding of the policing situation data, it can realize its prediction and early warning to achieve the deployment and response in advance. Therefore, the prediction and early warning based on the policing situation is an extremely important part of the situation awareness [11]. Concerning the current policing demand, the prediction and early warning of the policing situation can be divided into the following four scenarios: the first is the location and time of the policing situation risk occurring; the second is the prediction and early warning of potential public safety risk behaviors and those who commit illegal and criminal acts; the third is the prediction of the most likely known illegal criminal cases of those criminal suspect. The fourth is to predict the possible crime victims, or the individuals most likely to become victims of crime in some cases [12].

The ultimate goal of policing prediction and early warning is to forecast and prevent crimes through collecting and processing the information in a timely manner, so as to provide sufficient response basis and practice for public security organs deploying open and secret police patrols, setting parking checkpoints and deploying hidden line detection points. Especially the efficient matching between the policing force and resources at the right time node and at the right place can

properly complete the crimes fighting and gradually meet people's increasingly high standards of living.

4. Future Development Path of the Policing Situation Awareness Model Driven by Artificial Intelligence

4.1. Research on the Practical Model of Policing Situation Awareness Supported by Big Data and Intelligent Technology

Among a large amount of data, the association mapping and analysis of different data can have great significance in forming groups, finding useful relationships and patterns, determining key figures and event connection patterns. What's more, the utilization of a series of sub-model analysis methods [13], such as cluster analysis, association rule, vector space model and social network analysis can accurately calculate the public relationship between data, and better present the overall situation involved in the entire case. Only by analyzing the crime scenes and updating the service contents and methods in real time according to the changes, we can better understand and accurately grasp the changes of the parties, and fully improve their acceptance and satisfaction with the model. Policing situation awareness and tasks are often dynamic and personalized, being very difficult to form a universal practical model. In the big data environment, people's data can be collected through various channels, while the plight and needs of the parties also can be quickly modeled based on the related data. According to the difference between the environment and time nodes, this paper quickly constructs the dynamic elements and indicators of intelligence based on the basic attributes of the parties, calculates the correlation and restrictions between the elements, further determines the weights and time sequence relations, and finally forms a practical model integrating intelligence, problems, tasks and scenarios [14].

In addition, the policing situation awareness driven by artificial intelligence will also promote the development of the decision-making and intelligence analysis models. In view of the irreversible features of time and space of crimes, investigators can not predict and prevent the crimes in advance, but can only take investigative measures after the occurrence. However, the data-driven predictive policing has greatly added the intervention time of the investigation behaviors [15], instead of focusing on the retrospective and traditional investigation mode. It means the investigation behavior is already in progress before or when the crime occurs. In this way, investigative behavior not only focuses on crimes that have occurred, but those not yet occurred or are occurring. At present, an increasing number of countries have realized the necessity of exploring smart technology and big data-driven operation mode of policing situation awareness, while more and more departments begin to integrate situation awareness technology and concepts into investigation practices [16]. Therefore, the policing situation awareness driven by artificial intelligence will surely become the mainstream predictive and early warning method in the future.

4.2. Research on the Policing Situation Prediction Technology Analysis Based on the New Generation of Artificial Intelligence Science and Technology

Prediction and early warning actually require to make full use of a large amount of historical data, establish a big data analysis model, summarize and classify massive data, form the in-depth exploration, analysis and judgment, as well as search for high-value information hidden in massive data to better predict possible events. At the same time, it is very also necessary to conduct the detailed analysis of data transmitted on the Internet and specific objects, especially promptly alerting to prevent vicious incidents. However, with such a huge amount of data, it is far from enough to only rely on the human wisdom, but also require the strong technological leadership. Through the use of neural networks, machine learning and other intelligent methods, it can help analyze and transform various information and knowledge in a huge database into high-value information, so as to obtain useful information for predicting cases. For example, the visual intelligent analysis model displays various data in the form of graphics, fully describes and displays the association between data in the forms of social network diagrams, cloud diagrams, radar diagrams and heat maps, and further relies on different graphic analysis methods (such as path analysis, spatial analysis, network analysis, correlation analysis and time series analysis) to discover and reveal the public elements hidden in the data. Thus, it finally indicates important and key information, time evolution and development routes. At the same time, it also provides necessary support for evolution analysis, decision-making scenario element analysis, technology development path analysis and trend predication analysis to visually display the influencing factors involved in decision-making and the relationship between the elements, in order to further improve the effectiveness of rapid response [17].

Currently, with the rapid development of information technology, many management and control services have not fully integrated with the increasingly matured intelligent technology. Therefore, the existing science and technology still requires to be strengthened urgently. Based on artificial intelligence analysis methods of machine learning and deep exploration [18], it is very necessary to utilize the advantages to continuously improve new technologies, and further create a series of high-quality prediction technologies and practical police operations suitable for our country.

4.3. Establish a Big Data Resource System that Adapts to Policing Situation Awareness

The formation of a complete information resource service chain covering data collection, quality monitoring, operation and maintenance by building a standardized public security information resource service platform can effectively alleviate data problems caused by differences in technical capabilities. Especially the standardized integration, distributed storage, data integration and other technologies can further consolidate and improve the

data foundation. Through unified data services, it simplifies the application system's access to heterogeneous data layers and improves the efficiency of application development, so that the police can mainly focus on the business application requirements, use various new technologies, new methods and new methods to meet practical requirements and improve application capabilities. The information resource service platform simplifies the information sharing architecture, establishes an available information shared bus, realizes the centralized management, standardized management, quantitative auditing and security control of various data services, such as query, retrieval, comparison, subscription, statistics and relationship analysis. What's more, the establishment of a series of information resource standardization and professional operation maintenance systems can further improve and develop the data resource sharing application level, the operation maintenance management level, as well as various data service demand response speed.

5. Conclusion

Through referring to foreign advanced policing analysis, early warning theories and technical research results, this paper proposes a policing situation awareness model based on artificial intelligence, and even the concept, application scenarios, model processes, guarantee research and the path of future development related to the policing situation awareness. In the future, driven by the comprehensive reforms of public security, those public security organs rely on the policing situation awareness model to grasp the intelligent trend of information analysis systems, seize opportunities for historical development, learn and apply big data and intelligent technologies in a timely manner to solve industry common and key issues, lay a solid foundation of predicting and early warning of policing situation, and finally build an efficient and intelligent situation awareness system.

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