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Research on the Construction of Smart, Safe and Resilient Cities

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Abstract: The research on the construction of smart safe and resilient cities mainly focuses on how to use advanced information technology and data analysis means to build urban systems that can predict, respond to and adapt to various natural disasters and man-made risks through appropriate methods, so as to improve the city's ability to respond to emergencies and resilience. The main significance of this study is that with the acceleration of global climate change and urbanization, cities are facing increasing security threats, so it is particularly urgent to build a resilient city that can effectively manage these risks and protect residents' life and property safety. Through the analysis of the experimental data, it can be seen that the data recognition rate of the smart safe and resilient city system in the four aspects of household risk rate, social risk discovery rate, residential risk rate and information risk discovery rate ranges from 77.24% to 84.31%, and the comfortable voting rate of the system is 72.45%, which is the highest compared with other subjects in the experiment. It can be seen that the construction of smart, safe and resilient cities can build a relatively safe and sustainable urban environment.

1. Introduction

With the acceleration of urbanization and the continuous development of technology, many cities are facing increasingly complex security and sustainability challenges, such as natural disasters, terrorist attacks, traffic congestion, and environmental pollution. In this context, the construction of smart, safe and resilient cities has become an important research direction in urban planning and management. Through the use of advanced information technology and urban management means, this method can optimize the real-time monitoring and analysis of urban operation status to a certain extent, and improve the city's ability to cope with various risks and challenges to a certain extent.

The importance of this study lies in the fact that since the acceleration of global climate change and the increase of urbanization rate, cities continue to suffer from security challenges. In this context, it is particularly important to develop a resilient city that can effectively control such risks and ensure the life and property safety of urban residents. Through the integration of advanced technologies such as the Internet of Things and data analysis, the monitoring, early warning and other capabilities of the city can be significantly enhanced, so as to control the optimal allocation of

resources to minimize risks, and thus create a safe urban ecology. In this way, it can not only improve the efficiency of urban operation, but also increase the sense of security and satisfaction of residents, and ultimately maintain the sustainable development goal of the city.

2. Related Work

In the context of the Internet of everything, the application and industry of Internet of Things technology are ushering in vigorous development [1], which is found by Dai Chunping through research. This technology has been widely used in various industries [2], which were mentioned by WANG Shengbin in his academic research in the same year. Liu Yinxi more specifically reflects the importance of smart city: With the continuous progress of technology, smart city, as a global model of urban development, governance and transformation, has become a theoretical frontier constantly explored in urban research [3]. Shi Xiaojing's research results are more specific. He believes that the current smart city construction is in a stage of rapid development, which not only involves the application of technology, but also relates to the change of people's lifestyle [4].

With the improvement of people's needs from material to spiritual level, Liao Yitong mentioned in his article that creating a sense of security in the city had become an important aspect of the sound development of society [5]. Zhao Ji, also a scholar who studies urban security, said that urban security was very important, and urban security was the cornerstone of national security and social stability [6]. This further highlights the importance of building smart, safe and resilient cities. In this context, big data analysis technology, as the product of the rapid development of information, is the current focus of research. ZHENG Chunhui believes that the application of big data analysis technology in the construction of smart cities plays a crucial role, especially in improving the resilience of urban safety [7]. Through the above remarks, we can analyze the importance and urgency of the construction of smart, safe and resilient cities.

3. The Construction of Smart, Safe and Resilient Cities

3.1 Construction Status of Smart, Safe and Resilient Cities

Smart city construction will have a profound impact on urban development and regional pattern [8]. With the rapid development of science and technology, smart city construction has increasingly become a hot topic in today's urban development. With information technology as the core, smart cities will achieve efficient operation in urban management, public services, resource utilization and other aspects through intelligent and digital means to improve residents' quality of life and urban competitiveness.

Table 1: Construction status data of smart safe and resilient cities

Aspect	Peculiarity	Resource utilization rate	Resource vacancy rate	Resource waste rate
Smart energy	Energy intelligence	85.89%	12.25%	1.86%
Intelligent environment	Environmental monitoring and management	68.45%	13.07%	18.48%
Smart security	Safety assurance technology	75.63%	12.13%	12.24%
Smart healthcare	Medical technology innovation	70.84%	18.38%	10.78%
Intelligent transportation	Traffic intelligence	67.58%	16.57%	15.85%

Based on the actual situation in Table 1, it can be found that the construction of smart cities has

been carried out on a global scale, and many cities have achieved certain results. First of all, smart transportation is an important part of smart city construction. The application of intelligent traffic management system reduces traffic congestion, optimizes the allocation of traffic resources, and improves traffic safety. It has become the goal of efficient road traffic in many cities, but the resource utilization rate in only traffic is only 67.58%, and the resource vacancy rate and resource waste rate are high.

Urban security is an important indicator of urban construction and a microcosm of national security construction [9], among which the application of smart energy has gradually become the focus of smart city construction. Smart energy mainly refers to the smart grid, through renewable energy recycling and other technical means to improve energy efficiency to reduce energy waste, to achieve sustainable energy development. For example, some cities have applied intelligent energy management systems to rationally distribute energy and reduce energy consumption, but the resource vacancy rate of intelligent energy reaches 12.25%, and the overall vacancy rate is relatively high.

Urban safety is one of the important issues in the construction of smart cities [10], and the construction of smart cities also includes smart environment, smart security, smart medical treatment and other aspects. Smart environment attaches importance to improving the level of environmental monitoring and management, and realizing urban environment optimization and ecological protection. Smart security focuses on urban safety issues, such as the use of big data analysis technology to improve the level of security prevention and control. Smart healthcare uses information technology to improve the quality and efficiency of healthcare services, for example, through telemedicine services and smart medical equipment, residents can more conveniently access medical resources, and medical institutions can more effectively manage and use medical data, which promotes the rapid development of smart cities.

3.2 Construction System of Smart, Safe and Resilient City

With the vigorous development of the Internet of Things technology [11], the concept of safe and resilient cities promoted by the Internet of Things has gradually attracted wide attention. Originally a concept in the fields of physics and mechanics, toughness refers to the elasticity of deformation of an object or material after being affected by external forces. With the popularity of the concept of “resilience”, there is increasing concern about resilience in the field of security. In this process, the combination of toughness and system safety becomes even closer. The safety of the system is the key guarantee to maintain the operation of the system, and the concept of toughness is closely related to this. As a complex system of economy, society and natural environment, the construction of a safe and resilient city has attracted much attention.

With the continuous progress of science and technology, the Internet of Things has entered people’s daily life [12]. As shown in Figure 1, through the construction of smart safe resilient cities combined with iot technologies, cities are able to maintain strong security capabilities, avoid damaging losses, protect productivity and quality of life, and even achieve security without external support. The system can also optimize the safety and construction of communities and societies to ensure that acceptable levels of functioning can be achieved or maintained after a disaster. These two definitions complement each other and together build an understanding of the resilience of urban security [13]. In addition, the Internet of Things technology, with its powerful connectivity and intelligent application, is also promoting the development of digital transformation and intelligent society [14-15].

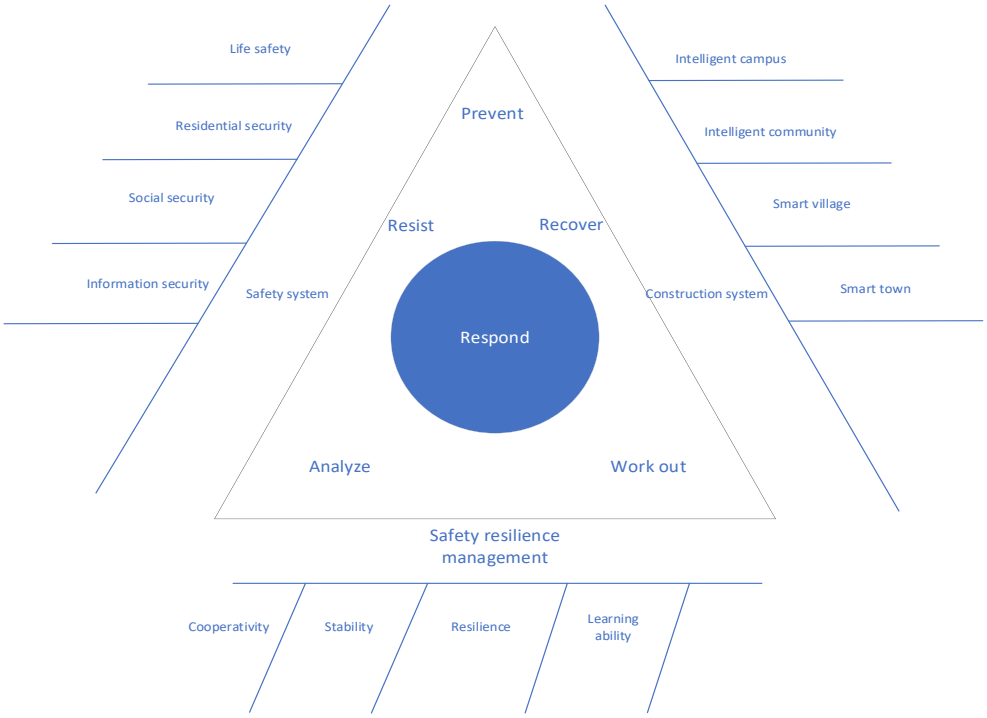

Figure 1: System framework for building smart, safe and resilient cities

Whether the construction system of a city is effective in population growth is an important criterion for judging. The judgment method is shown in formula (1).

$$P(t) = P_0 \times (1 + r)^t \tag{1}$$

In formula (1), $P(t)$represents the population at time t, P_0 is the population at the initial moment or before the system is used, r is the population growth rate, and t is the time spent in the test. The function of formula (1) is to calculate the amount of population growth in a given area without resource constraints or external interference.

After determining the urban population situation, it is necessary to judge the urban environmental situation, in which air quality is an extremely important judgment standard, and the calculation method is shown in formula (2).

$$AIQ = \frac{I_H - I_L}{B_P - B_L}(C_P - B_L) + I_L \tag{2}$$

In formula (2), AIQ represents the air quality index, I_H and $I_L$are the upper and lower limits of the expected air concentration interval index, B_P and B_L are the upper and lower limits of the actual air concentration, and C_P is the measured pollutant concentration.

4. System Use Test

4.1 Smart City Resilience Safety Test

This experiment aims to test the effectiveness of the system framework in urban construction safety. Through the comparison test with the security of another traditional urban construction system area, the household risk rate, social risk discovery rate, residential risk rate and information risk discovery rate of the two areas were detected for one month. By comparing the risk detection and processing rate of the two regions, the practical application effect of the system framework was evaluated.

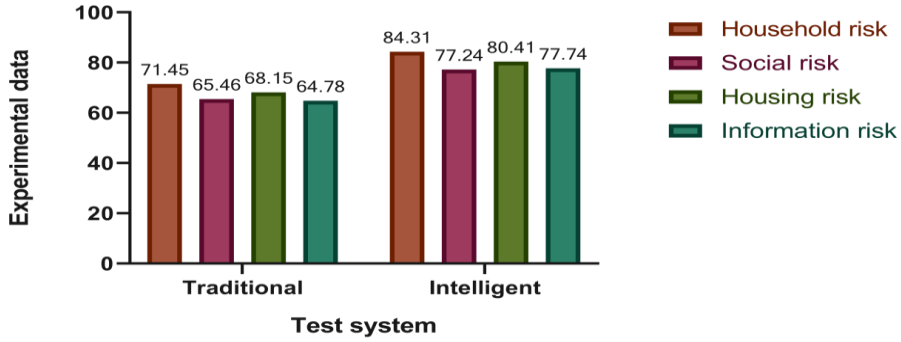

Figure 2: Safety identification test data

As can be seen from the data analysis in Figure 2, the four recognition rates of the traditional wisdom system ranged from 64.78% to 71.45%, while the data recognition rates of the smart safe and resilient city system in the four aspects of household risk rate, social risk discovery rate, residential risk rate and information risk discovery rate ranged from 77.24% to 84.31%. Compared with the traditional system, the identification accuracy of the smart safe and resilient city system has been significantly improved. This improvement is of great significance to the safety of urban residents and is expected to bring a significant increase in the level of urban safety.

4.2 Resident Satisfaction Test

The experiment still chooses the two areas above. Similarly, one region uses a smart safe resilient city system, one region chooses a traditional city system, and another region does not use a city management system. The satisfaction of residents of the two systems is judged by the democratic voting of residents of each region for their own region, and the voting of residents is: comfortable, uncomfortable, and unfeeling. The effect of using the system is judged by three voting ratios of residents' satisfaction.

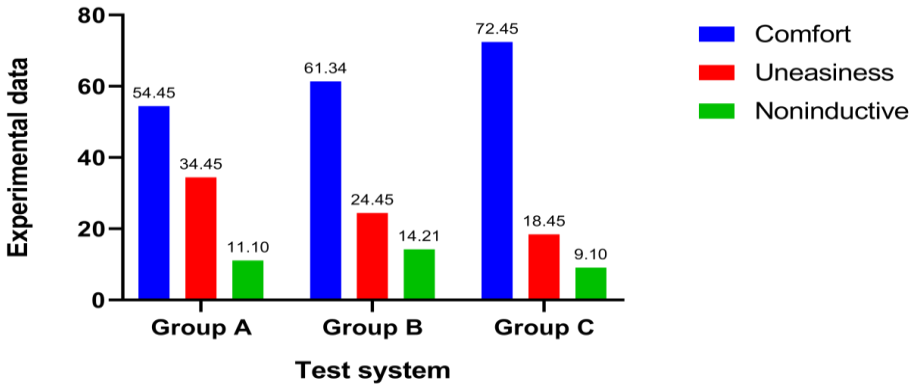

Figure 3: Resident satisfaction test

In Figure 3, Group A is the area that does not use the urban management system, group B is the area that uses the traditional urban management system, and group C is the area that uses the smart safe and resilient urban system. According to the experimental data, the comfortable voting rate of group A was 54.45%, the uncomfortable rate was 34.45%, and the indifferent voting rate was 11.10%. In group B, the comfortable voting rate was 61.34%, the uncomfortable voting rate was

24.45%, and the indifferent voting rate was 14.21%. The comfortable voting rate of group C was 72.45%, the uncomfortable voting rate was 18.45%, and the indifferent voting rate was 9.10%. By comparing the voting data of the three systems, it can be seen that the comfortable voting rate of the smart safe and resilient city system is the highest, and the uncomfortable ratio and insensitive voting ratio are the lowest, so the overall comfort recognition degree of residents of the smart safe and resilient city system is the highest.

5. Conclusion

Through the analysis of this paper, we can see that the construction of smart, safe and resilient cities is of great significance to urban development. Experimental data show that the system can not only predict and respond to some safety problems, but also help protect the lives and property of residents, while promoting sustainable development of the city. In the future, there will be more technological innovations in the construction of smart, safe and resilient cities, which will provide more ideas and possibilities for this research. In addition, the subsequent construction of smart, safe and resilient cities also needs to fully consider the requirements of environmental protection and efficient use of resources, so as to achieve the coordinated development of economy, society and the environment in various aspects, and ultimately achieve the happy life of residents and the harmonious development of society.

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