Development Strategy of Smart Cities Based on Artificial Intelligence

Chonghui Li(✉)

School of Information and Business Management, Chengdu Nfeusoft University, Chengdu, Sichuan, China
lichonghui@nsu.edu.cn

Abstract. The rapid development of technologies such as big data, cloud computing and AI has laid the foundation for solving contemporary urban governance problems, and at the same time, has enabled the development of "smart cities" in a deeper way. The "wisdom" of a smart city is mainly expressed in the interconnection of various factors within the city, making the city an organic whole and enabling more accurate and intelligent decision-making. In today's information age, smart cities are seen as a new way of thinking about urban governance and the future direction of urban construction. The aim of this paper is to investigate smart city development strategies based on artificial intelligence. From a "people-centred" perspective, the development strategy of smart cities and artificial intelligence technologies are analysed. The project's practical results show the effectiveness of the platform design and implementation.

Keywords: Artificial Intelligence · Smart City · Development Strategy · Video Surveillance

1 Introduction

Smart city will bring the evolution and update of management mode to the development of modern industrial city, and also bring unexpected changes to the living and production mode of urban residents. Smart city is a new form of urban development that has continued since the industrial revolution. It is established by utilizing the achievements of human civilization. Relying on technological media such as big data and artificial intelligence, smart city can effectively integrate the information of urban life and urban development, and promote the informatization and wisdom of human society through the city. It is also an important option to solve problems in urban development [1, 2]. At the same time, systematically applying smart city to specific cases in theory, defining its concept and grasping the specific forms of smart city application are conducive to strengthening the understanding of smart city development mechanism, enriching urban construction theories and smart city development models, and promoting relevant theoretical research of smart city [3, 4].

Given the increasing global population, the construction of smart cities has become critical, aiming to improve urban flow management with efficient information and communication technologies (ICTs) [5]. Vehicle-mounted sensor networks (VSNS) play a

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crucial role in keeping smart cities running efficiently. Of course, there are a number of challenges that need to be addressed before virtual storage networks can be introduced on a large scale, including the concept of accurate topological analysis methods and beneficial collaborative mechanisms in the city-wide information sharing process. Hedi Haddad constructed a VSN-assisted smart city model and evaluated a range of smart applications in public services and urban flow management. Then, the information source selection algorithm of complex network and the city information sharing mechanism based on reinforcement learning are considered, supplemented by a series of open challenges [6]. With the rise and development of the Internet of Things as a new form of sustainable development, the concept of a "smart city" has gained considerable development. Smart cities are based on autonomous and distributed infrastructure, including heterogeneous network infrastructure for intelligent information processing and control systems, as well as ubiquitous sensing involving millions of information sources. However, due to the continuous growth in the amount of data and the number of Internet-of-Things devices, high latency, bandwidth bottlenecks, security and privacy, and scalability appear in the current smart city network architecture [7]. To address the limitations of today's smart city networks, an efficient, secure and scalable distributed architecture needs to be designed by bringing computing and storage resources close to endpoints. Siddhant Jain has proposed a new hybrid network architecture for smart cities, taking advantage of emerging software-defined networking and blockchain technologies. To achieve efficiency and address current limitations, their architecture is divided into two parts: the core network and the edge network. By designing a hybrid architecture, they propose an architecture that inherits the advantages of both centralized and distributed network architectures. They also proposed a proof of work scheme in the model to ensure security and privacy. In order to evaluate the feasibility and performance of the proposed model, they evaluated it based on various performance indicators. The evaluation results show the validity of their proposed model [8].

At present, scholars at home and abroad have conducted a large number of researches on smart cities, but most of the achievements focus on the "wisdom" level and pay insufficient attention to the human factor. In contrast, this paper explores and analyzes the development principles and strategies of smart city construction from a new perspective of "people-oriented", and proposes a video and image application platform for the construction of a new smart city in M County.

2 Artificial Intelligence Technology and Smart City Development Strategy

2.1 People-Oriented Development Principle

The understanding of the connotation of "people-oriented" should start from "people" and "this". Only by fully understanding the meaning of "people" and "this" can we better understand the meaning of "people-oriented" [9].

The "people-oriented" mentioned in this paper refers to the "people" living in the urban ecosystem. Smart city provides all-round services for "people", so that urban residents can enjoy efficient, convenient, safe and green urban life. This requires that

the construction of new smart cities must take the actual needs of "people" as the main body to increase their happiness and satisfaction. Through the innovative application of modern information technology, urban information exchange and business cooperation can be realized, so that citizens can better understand the city and improve the comfort and efficiency of urban life. To be specific, urban development should be achieved through public participation, and attention should be paid to meeting the needs of citizens both materially and spiritually, paying attention to the personality and characteristics of cities.

2.2 Development Strategies of Smart Cities

(1) Strengthen data resource management and promote data sharing and openness

By establishing a data resource management platform, we can promote the storage and sharing of massive data in cities, and realize the convergence, governance, analysis and opening of data. Relying on the underlying big data platform to provide hierarchical storage space for data, the data is unified and aggregated to guide people within the scope of system management [10, 11]. Analyze data quality indicators according to the transportation industry data standard system, and provide data cleaning tools, views and other data governance tools to continuously improve data quality. By comparing and analyzing the data stored, associated and collected, the system of data consanguinity and data relationship is established. Finally, data permission management is used to orderly open the data. Combined with intelligent transportation storage data resources, expand the range of data collection, exchange and sharing [12, 13].

(2) Develop innovative technologies such as digital retina to effectively extract key data

The intelligent level is improved through video parsing pre-processing and end-to-end cloud collaborative transformation. Different from the way that traditional cameras process video at the back end, digital retina identifies the feature images of "people, cars, non-images" obtained from video data stream based on multi-service requirements. Then, the encoded video stream is stored locally and uploaded to the cloud on demand, and all compact feature streams are synchronized to the cloud in real time [14]. In this way, not only can the retrieval and storage capabilities of the system be improved, manpower input in the later stage be saved, but also the delay caused by system response in emergency events can be greatly shortened [15].

2.3 Artificial Intelligence Technology

(1) Video management platform

In intelligent video surveillance, it is based on network and centered on image processing. The construction of video surveillance system greatly depends on the integration and upgrading of management platform, especially in the large system, the role of platform is increasingly prominent. And video surveillance system also gradually from the scope of security surveillance, extended to other fields.

(2) AR technology

AugmentedReality (AR) is an emerging technology that integrates image acquisition and processing with human-computer interaction. Its realization process is to enhance the

real environment by effectively matching the virtual information generated by computers with the real environment.

One of the key processes of the augmented reality system to achieve information enhancement is the recognition and matching of the target image, one of the key processes of the augmented reality system to achieve information enhancement is the recognition and matching of the target image, SIFT algorithm for the rotation of the image has a good adaptability, for the outside light changes and radiation also has a high stability.

If I(x, y) is an initial given image and G(x, y, δ) is a Gaussian function that can change accordingly in the scale space, then the scale space of the initial given image can be expressed as:

$$L(x, y, \delta) = G(x, y, \delta) \times I(x, y) \tag{1}$$

In the above Eq. (1), δ represents the size of the scale space, and the value of δ is inversely proportional to the blur degree of the image. The larger the value of δ, the general appearance of the image; The smaller the value of delta, the clearer the detail of the image. The Gaussian function G(x, y, δ) is:

$$G(x, y, \delta) = \frac{1}{2\pi\delta^2} e^{-\frac{(x^2+y^2)}{2\delta^2}} \tag{2}$$

After a series of scale space transformation steps and a series of operations such as double downsampling, the final Gaussian pyramid can be obtained. Gaussian difference (DOG) can find a series of stable and invariant extremum point σ in the scale space. Gaussian difference (DOG) function function is generally defined as:

$$G(x, y, \delta) = L(x, y, k\delta) - L(x, y, \delta) \tag{3}$$

where, kδ and δ represent the smooth scale of two consecutive images. Feature points are generally composed of some local extreme points in DOG space.

3 The Realization of Smart City Development Strategy

3.1 Operating Environment Design

The running environment of the central system platform should first be built on a server with a well configured environment. If you choose IE8 or above, you can realize the operation of the system platform. In addition to Oracle, Tomcat and Java Jdk need to be installed and configured. These software are used to support the operation of the system platform.

3.2 Video Image Application Platform Design

Video and image application platform is a unified entrance, which can provide various government departments and units with video intelligent application services based on video, pictures, face, human body, vehicle structured data and model data, including basic video application, query and retrieval application, distribution and alarm application, etc. The functional architecture of the video image application platform is shown in Fig. 1.

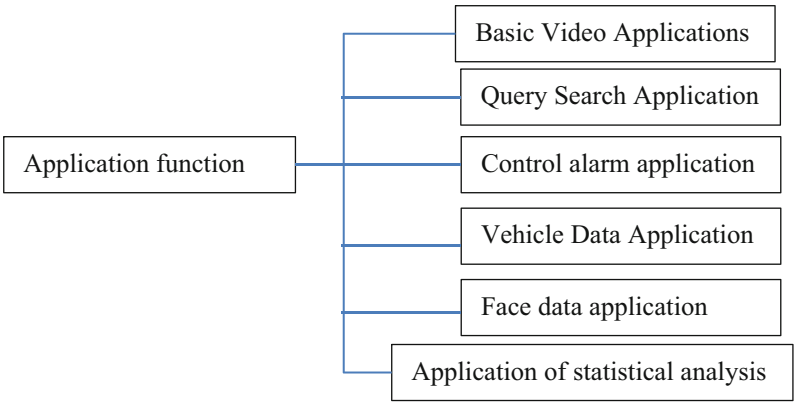

Fig. 1. Functional architecture diagram of video image application platform

3.3 Functional Architecture Design of Video Image Information Database

Data acquisition is mainly to provide a standard interface for the video surveillance system of each functional unit to synchronize the collection of image data. By using mature cloud computing technology, a large number of valuable data is stored and shared, and it is divided into subject libraries to provide support for related commercial applications. Data management is the classification, data processing, file sharing, data seriation processing of the data stored in the image database. In the aspect of system data query, rapid query of the data in the system using advanced full-text retrieval technology, in the aspect of system management, including user management, log management, dictionary management, and status monitoring of the system.

4 Practice Verification

4.1 Background

In 2022, M County was listed as the pilot county for the innovation and reform of grassroots social governance mechanism. Driven by AI deep learning, the project completed the integration of comprehensive governance information network, public safety video surveillance network, comprehensive governance visual network, people hotline integration and comprehensive emergency response in Tonglu smart governance Information Center in accordance with the construction and management norms of comprehensive governance center. To build a people-oriented smart city center system featuring "integration of civil air defense + technical defense, and online + offline linkage".

4.2 AR Live Command

The panoramic camera and AR/VR video map command combat platform are adopted. Based on the 4K video images of the real road, various traffic information such as video surveillance and bayonet are superimposed to realize the functions of AR panoramic

real-time video, AR panoramic video linkage and joint control, and visual management of distribution control and alarm, so as to build a new experience of three-dimensional and precise command and combat system.

The functions of cloud image AR real scene command include multi-picture layered display, real-time preview of panoramic video, linkage and joint control of panoramic video, real-time display of alarm data, joint linkage of GIS map, automatic patrol of AR scene, high-low linkage of AR scene, high-altitude linkage of AR scene, automatic target tracking and other functions. The effect of panoramic video linkage control is shown in Fig. 2.

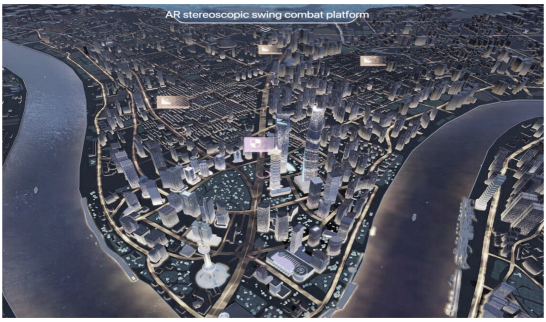

Fig. 2. Schematic diagram of panoramic video linkage and joint control effect

4.3 Urban Traffic Operation Monitoring

Through the study of this project, the intercity transport system such as passenger station, toll station, airport and so on can be comprehensively monitored. Urban traffic operation monitoring can be the urban traffic high-speed toll station, passenger station, train station, airport location, and it with passenger flow, traffic flow, video and other relevant information displayed on the map. By analyzing the data, the annual and monthly passenger data of urban traffic can be displayed, and the changes of monthly traffic trips can be studied. The monitoring of urban traffic operation is shown in Table 1.

Table 1. Monthly Passenger Traffic Volume (Unit: 10000 person times)

Time	Civil aviation	High speed	Highway	Railway
January	57	89	104	65
February	44	88	101	52
March	46	80	94	50
April	41	79	80	44
May	58	92	112	60

5 Conclusions

In the process of smart city construction, video surveillance system is an essential core part. This paper aims to analyze the existing problems of smart city construction in M County from a new perspective of "people-oriented", and put forward corresponding countermeasures and suggestions for implementing the "people-oriented" concept and improving the new smart city. The establishment of video surveillance system is inseparable from the development and accumulation of computer technology, network technology, storage technology and chip technology. IT is because of the development and accumulation of these basic IT technologies step by step, to ensure the upgrading of video surveillance system supporting equipment, so as to promote the upgrade of the whole video surveillance system. Similar to the application of traditional communication products, the wireless transmission of video surveillance system is conducive to the wider and more flexible application of the system. The wireless transmission technology based on ordinary SIM and UIM cards can further promote the wireless penetration of video surveillance system.

References

1. Fontaine, P., Minner, S., Schiffer, M.: Smart and sustainable city logistics: design, consolidation, and regulation. Eur. J. Oper. Res. **307**(3), 1071–1084 (2023)
2. Gordon, E., Harlow, J., Teng, M., Christoferetti, E.: Toward a collaborative smart city: a play-based urban living laboratory in Boston. Int. J. Human–Comput. Interact. **39**(2), 302–318 (2023). https://doi.org/10.1080/10447318.2021.2012384
3. Fadda, M., Anedda, M., Girau, R., Pau, G., Giusto, D.D.: A social internet of things smart city solution for traffic and pollution monitoring in Cagliari. IEEE Internet Things J. **10**(3), 2373–2390 (2023)
4. Rahman, M.A., Shamim Hossain, M., Showail, A.J., Alrajeh, N.A., Ghoneim, A.: AI-enabled IIoT for live smart city event monitoring. IEEE Internet Things J. **10**(4), 2872–2880 (2023). https://doi.org/10.1109/JIOT.2021.3109435
5. Sachan, A., Kumar, N.: SDN control-enabled and time-quantum-driven max-pressure approach for intersection management in smart city. IEEE Syst. J. **17**(1), 1694–1702 (2023)
6. Haddad, H., Bouyahia, Z., Horchani, L., Jabeur, N., Gharrad, H.: A connected mobility scheme for taxi supply-demand balancing in a smart city context. Comput. Inform. **41**(2), 550–570 (2022)
7. Abbas, S., Khan, M.A., Athar, A., Shan, S.A., Saeed, A., Alyas, T.: Enabling smart city with intelligent congestion control using hops with a hybrid computational approach. Comput. J. **65**(3), 484–494 (2022). https://doi.org/10.1093/comjnl/bxaa068
8. Jain, S., ShashankGupta, K.K.S., Rodrigues, J.J.P.C.: Fog computing in enabling 5G-driven emerging technologies for development of sustainable smart city infrastructures. Cluster Comput. **25**(2), 1111–1154 (2021). https://doi.org/10.1007/s10586-021-03496-w
9. Sharma, R., Arya, R.: A secure authentication technique for connecting different IoT devices in the smart city infrastructure. Clust. Comput. **25**(4), 2333–2349 (2022)
10. Conde, J., Munoz-Arcentales, A., Choque, J., Huecas, G., Alonso, Á.: Overcoming the barriers of using linked open data in smart city applications. Computer **55**(12), 109–118 (2022)
11. Kostic, Z., et al.: Smart city intersections: intelligence nodes for future metropolises. Computer **55**(12), 74–85 (2022)

12. DeHart, J.: Understanding equity and diversity in smart city infrastructures: Chicago, IL, USA. XRDS **28**(3), 60–61 (2022)
13. Kataria, A., Puri, V.: AI- and IoT-based hybrid model for air quality prediction in a smart city with network assistance. IET Netw. **11**(6), 221–233 (2022)
14. Jadric, M., Mijac, T., Cukusic, M.: End-user approach to evaluating costs and benefits of smart city applications. Int. J. E Serv. Mob. Appl. **14**(1), 1–15 (2022)
15. Mohanty, A., et al.: Identification and evaluation of the effective criteria for detection of congestion in a smart city. IET Commun. **16**(5), 560–570 (2022). https://doi.org/10.1049/cmu2.12344