Key Technologies and Development Status of Smart City

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Abstract. In the 21st century, the rapid development of Internet information technology has provided a trend and direction for breaking the construction concept of traditional cities and building new smart cities. However, with the rapid development of smart cities, timely attention and research on the key technologies and development status of global smart cities, so as to provide directions and references for the further research of smart cities, has become a research hotspot of smart cities in the new century. Firstly, this paper studies the development status of smart cities by studying a large number of domestic and foreign literatures. Secondly, it further studies several key technologies and their development status. Through the research, it is concluded that the rapid development of smart cities at the present stage has achieved outstanding achievements in various application fields of smart cities, but it is urgent to break the bottleneck of key technologies and help the further development of smart cities by combining with the application of key technologies of smart cities in the new era.

1. Introduction
As is known to all, with the rapid development of the new generation of Internet technology and its wide application in various fields of urban construction, smart city has become a new concept and practice of urban construction, and this model has been gradually recognized by various countries[1-2]. Smart city is based on the new generation of information technology. By using information, communication and other technical means, the data in the city is perceived, analyzed, integrated and applied in order to timely, comprehensively and effectively regulate various resources of the city, and finally the harmonious interaction between people and the city is realized[3-8]. As Michael Batty said in his article, every aspect of life has been permeated by the new concept of smart city, quietly changing the cultural, economic and material structure of human life and providing a new concept of urban development[9]. In Jean Philippe's article ICT can be used for environmental monitoring in smart cities[10]. Some American scholars focus on the concept of humanism. SaskiaSassen[10] emphasizes that the influencing factors that directly affect the construction effect of smart cities are the participation and ideas of citizens and the urbanization of technology, while Hall focuses on the relationship between "wisdom" and enterprises, communities, academia and government institutions. As smart cities are based on the new ideas of the new generation of information technology, it is very important to solve the problem of personal information security. Hyung-minlim et al. studied an integrated authentication system (UCIAS) on the U-City platform in order to effectively protect information privacy and malicious attacks [11].

It is urgent for a smart city to break through the bottleneck of key technologies in various fields and help the further development of a smart city by combining with the application of key technologies of a smart city in the new era[12]. By studying a large number of domestic and foreign literatures, this
paper studies the development status of smart cities. Secondly, it further studies the five key technologies of Internet of Things, big data, cloud computing, artificial intelligence and 5G as well as their development status, so as to provide directions and references for further research and improvement of smart cities.

2. Key Technologies and Development Status

2.1. The Internet of Things

The Internet of Things technology contains three basic key technologies: sensor technology, RFID technology and embedded technology, among which mobile swarm intelligence perception plays a key role in smart cities (See Figure 1). However, smart cities mostly rely on a large amount of data generated in Internet of Things technology, and the three-layer network architecture system of Internet of Things technology closely related to a large amount of data is divided into three layers: perception layer, network layer and application layer [12]. The current second-generation ID card and the emerging transportation card, etc., all reflect the support of Internet of Things technology [13]. In terms of health care, the idea of Health care 4.0 was proposed to continuously improve the availability and quality of medical software, and the global health budget was effectively reduced by reducing the number of hospitalizations and unnecessary and inappropriate drugs through the analysis of new generation of information technology data [13-14]. In road traffic, the combination of Internet of Things, remote management system and GPS positioning can collect traffic information, conduct scientific management, realize remote command, and curb traffic accidents. The Cutting-edge Report on Internet of Vehicles Technology, Standards and Industrial Development Trend of China Communication Society points out that the Internet of vehicles in smart city traffic focuses on the application of autonomous driving, active safety, car-sharing and other aspects [15]. In terms of logistics services, the combination of a large number of sensors and RADIO frequency identification and artificial intelligence produces a large number of intelligent logistics systems [16-17]. Lee et al. developed a resource allocation system using fuzzy logic method to manage the resource utilization of clothing manufacturing companies [18]. In terms of intelligent education, the Internet of Things can be combined with computer technology to control the system to connect devices, switches and broadcasts in the classroom [19]. Agricultural Internet of Things (SMART Agriculture) Through the Internet of Things technology can collect soil, crops, equipment, people and images and other data for analysis, which can effectively reduce agricultural risks and increase the output of agricultural products and farmers' income. To sum up, Internet of Things technology is one of the indispensable technologies for the development and construction of smart cities, which can better serve the construction of smart cities. Through the application of sensors, transmission, perception and other technologies in the Internet of Things, the construction of smart cities in various fields can be more efficient and harmonious.
2.2. Big Data

Big data, as the name suggests, is a massive data resource. It refers to a set of data that cannot be acquired, managed and processed by conventional software within an effective time. Instead, software in cloud computing is needed to realize the statistics and calculation of data and integrate them into scientific information data [12]. The concept of big data, which is formed by combining the massive structured and semi-structured information data, fully embodies its advantages in the construction of modern intelligence. As one of the symbols of smart cities, big data technology almost covers the information data needed for the construction of smart cities in all fields. Based on the rules of information data and the characteristics of massive data, big data technology can make more accurate predictions on the derivation direction and future development and construction of data information of smart cities in the future. In the industrial field, big data can collect a large amount of information data existing in the industry, obtain useful data and then apply it to industrial production. This makes things that should have taken workers a long time to complete can be completed in a very short time, greatly improving the efficiency of the industrial field [14]. In the field of education services, big data can be used to track students' catering data and growth path data, so as to facilitate accurate assistance to poor students and accurate development reports for students. In addition, teachers can make special teaching plans according to the data of students' learning interest and learning behavior, so as to improve the teaching quality. In the field of transportation, intelligent analysis of big data and cloud computing can help citizens plan the optimal route and reduce travel time, thus improving the traffic efficiency of the road. Moreover, according to traffic data, big data can predict traffic events, help traffic police deal with emergencies, improve the level of traffic management, and improve the adverse impact of traditional traffic system [14]. Medical treatment is quite prominent in the public system. The big data analysis tool used for healthcare by the Kingdom of Saudi Arabia (KSA), named Sehaa, USES Naive Bayes, Logistic Regression and multiple feature extraction methods to detect various diseases that analyze Twitter data [4].

To sum up, with the functional advantages of big data technology, in-depth and accurate analysis and research of professional scientific information generated in various fields and correct decisions are made to promote the asset-based transformation of massive data, so as to continuously promote the construction of smart cities.

2.3. Cloud Computing

Cloud computing can unify management and planning of a large number of computing resources through the network and provide on-demand services to users. Some services may require payment. In other words, the computing power of cloud computing is regarded as a commodity that can be circulated and sold online for easy access. Cloud computing, with its advantages of high flexibility, strong scalability, rapid computing and on-demand deployment, gives full play to its features of convenience, speed, economy and efficiency, and provides a new computing mode for the intelligent development of modern city construction. The massive data of smart cities hinders the construction of smart cities to some extent. Therefore, the ability of cloud computing to store data centrally and many backup and security means improve the security of data and reduce the potential security risks such as data leakage and illegal tampering. Therefore, the analysis of data in smart cities by cloud computing can reasonably allocate resources for smart city construction [20-22]. H Hammami et al. used privacy protection Data mining in the homomorphic encrypted computing Cloud computing environment and proposed the Meta Cloud Data Storage architecture to protect Data in the Cloud computing environment. This framework can ensure efficient Data mining in the Cloud computing environment and gain more business insights [23-25]. In the medical field, cloud computing can use WeChat small program or APP to make remote hospitalization registration and medical appointment, so as to improve the medical treatment efficiency. In terms of smart community, cloud computing can play a basic supporting role in the community big data module of smart community comprehensive information service platform. The system can intuitively display the operation situation of smart community, and provide information data for management planning through targeted analysis of residents' information in the community. To sum up, when building a mass computer platform, cloud
computing technology should be reasonably used to obtain, store, process and apply professional information data in various fields of smart city, and methods should be proposed according to the problems to ensure the normal construction of smart city.

2.4. Artificial Intelligence

Artificial Intelligence (AI) is technically a powerful conceptual level still in its infancy, with "Intelligence" at its core. AI can be regarded as a tool with the ability to learn data, adapt to specific situational goals through this learning ability, and then give this ability to machines to solve practical problems. This learning ability is called deep learning [26]. AI technology is a traditional industrial city to avoid the disadvantages in developing a key technique, if reasonable use, there are expected to become an active construction of city becomes a powerful tool for wisdom, from semi-automatic driving a car on the road to our robot vacuum cleaner in the home, from health care to education, entertainment and security, is not only a simple concept [10]. Genetic algorithm (GAs) in artificial intelligence plays an important role [27]. In literature [28], GA is applied to find accurate design solutions for product development. Regarding the application of AI in education, Hammami H[29] et al. reflected the application of ARTIFICIAL intelligence in education and compared technology with the real-time communication between students and teachers. The literature suggested that the relationship between students and teachers could be programming. In the field of transportation, AI technology can coordinate and coordinate the relationship between vehicles, drivers and infrastructure, and drive the development of semi-automatic driving and automatic driving. In terms of medical treatment, medical robots can improve the working efficiency of hospitals, accelerate drug research and development by using artificial intelligence, and make medical diagnosis on medical images, which are all applications of artificial intelligence in medical treatment. AI technology is also used in public security law enforcement case, in the process of law enforcement case AI technology does not replace the civilian police personnel core position, but in the data sharing, evidence to guide, review, automatic division, the respect such as intelligent record (as shown in figure 4), auxiliary play a good role, essence is to implement policing ability and intelligent modern police system. In conclusion, we should not only focus on the significance of THE formation of AI, but combine AI with big data, Internet of Things and other technologies as the engine to promote the construction of smart cities. In the future, AI will play a great role in the transformation of smart city development.

![Diagram](image)

**Figure 2. Application of artificial intelligence system in public security law enforcement and case handling.**

2.5. 5G

5G is a new technology with the characteristics of ultra-high speed, ultra-low delay and ultra-large connection in the new era. There are three application scenarios (as shown in Table 3): one is the PEOPLE-ORIENTED eMBB (Enhanced mobile broadband) scenario, which conforms to the core concept of smart city construction; The second is the uRLLC(high reliability and low delay connection) scenario in a special field requiring quick response; Finally, mMTC(mass connection of things) scenario is realized. As one of the technologies for the development of smart cities, 5G has not only become a key driving force for the realization of the Internet of everything in the fields of Internet of vehicles and industrial Internet, but also a new construction force for smart cities through the combination of 5G and the Internet of Things. In the field of intelligent transportation, literature [12]
points out whether real-time interaction between vehicles and vehicles and between vehicles and roads can be realized in the future. In order to avoid traffic congestion, 5G technology is utilized to build a "living" intelligent transportation system for cities through artificial intelligence and big data prediction model. In terms of smart home, literature [30] builds a 5G smart home system by effectively integrating smart speakers, gateways, curtains, air conditioners, door locks and other devices to improve information perception, monitoring and management capabilities in daily life. In literature [15], the 5G-based ecosystem proposed provides a theoretical basis for building a green and recyclable ecological environment. To sum up, although the emerging technology 5G is in the early stage of exploration, 5G+ smart city is bound to be the hot spot in the intelligent application of the new era. In the future, the focus of attention should be shifted to the intelligent application that cannot be broken through by 4G, so as to build a smart city that 5G and intelligent application perfectly match.

| Three scenarios | Subdivided application scenario | Scene classification |
|-----------------|---------------------------------|----------------------|
| eMBB            | AR, Smart Bank                  | Consumer grade application |
| URLLC           | Smart Grid, Telemedicine, Smart Travel | Industry level application |
| mMTC            | Smart Home, Smart City          |                      |

3. Conclusion
At present, we need to seize the opportunity of several key technologies in the new era to promote the construction of smart city. However, under the new challenges, each key technology is interdependent and inseparable. In the future, it is necessary to give full play to its absolute advantages in the construction of smart city according to the advantages and characteristics of each key technology, so as to promote the modernization of smart city.

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