

Urban Informatics for Smart City: A Case Study of Beijing

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Abstract

This report takes Beijing as an example to discuss the applications of urban informatics in smart cities. It mainly discusses urban sensing and urban computing in urban informatics. Firstly, the development of smart city and its definition by different scholars are briefly introduced. Secondly, the methods and applications of city calculation and city perception adopted by Beijing are introduced. Finally, suggestions are simply proposed for these methods and technologies and how they can be applied to the construction of smart cities.

Keywords

Urban informatics; Smart City; Urban sensing and urban computing.

1. The Development and Definition of Smart City

In 1997, Droege P. defined a smart city as a virtual city or a virtual rebuilt city. [1]

Komninos N studied the basic conditions for building a smart city in 2006, and proposed that smart cities should be implemented on the basis of resident creativity, knowledge creation systems, and digital infrastructure [2]. In 2008, IBM proposed the "smart city", which attaches great importance to the management of cities by using the advantages of information technology. IT mainly USES IT enterprises to develop an urban management system with machine interconnectedness as a tool, and then makes full use of urban physical space and resources, based on the core of information technology and system, to give full play to the advantages of IT enterprises.

Different scholars have given different definitions based on the development of smart cities in China. Gang Song believes that smart cities are not just about science and technology, including the application of computing and the Internet of things. They also attach importance to the fundamental nature of people, advocate active participation of users and realize collaborative openness [3]. Deren Li proposed that smart city belongs to the sum of digital city, Internet of things and cloud computing, and has basically formed a digital city. Smart city should be built by using grid, intelligent transportation and urban security emergency [4]. Yongmin Zhang made an in-depth analysis of the close relationship between information, software, organization and other resources and smart city, and believed that only by actively building digital cities can it lay the foundation for the construction and development of smart cities [5]. According to the concept of developing emerging cities and the requirements of innovative

cities and low- carbon cities, China is now building smart cities. The construction of smart cities is actively carried out by the public, economy, mobility, governance, life and environment. Living and working needs, give full play to the role of the city government in order to better build a smart city.

Therefore, it can be known from the definition that the construction of smart city requires multiple technologies and methods to interact with each other. Here, the technology application of smart city construction in Beijing can be divided into two parts: urban sensing and urban computing.

2. Technology and Application of Urban Sensing and Urban Computing

2.1. Urban Sensing

2.1.1. 3D GIS Technology and Application

From the perspective of GIS, the data waveform is a general description of a group of spatial entities and their relationships, and is an abstract expression of the real world. Different from the traditional two-dimensional GIS technology, three- dimensional GIS can not only express the planar relationship and vertical relationship between spatial objects, but also perform three-dimensional spatial [6] analysis and operation on it. The acquisition of three-dimensional spatial data mainly comes from two categories: point mode data acquisition technology and planar mode data acquisition technology. The former uses astronomical geodetic surveys, total stations, GPS receivers and other conventional ground surveying methods, while the latter uses aviation and aerospace remote sensing methods to acquire large-area image records and extract geometric and physical characteristics from them. Then it use AutoCAD to establish the geometric model, and carry out real photo texture mapping on the model to generate a true "3D" model.

In the construction of a smart city spatial-temporal information cloud platform, real-time 3D GIS technology can be used to build virtual models and panoramic shots of real-world scenes. It can establish a close relationship between time and space, events and people to achieve dynamic management of information. For example, the Fire Bureau of Changping District in Beijing uses real-time three- dimensional GIS technology to simulate the on-site environment, establish a three-dimensional virtual environment, and analyze, predict, and process the on-site situation. Through the construction of three-dimensional scenes, relevant personnel can observe and analyze the on-site environment in an all-round way, and can formulate corresponding solutions by integrating various factors, which can effectively reduce the disaster situation and make the decision-making more scientific. In addition, real-time three-dimensional GIS technology can also be used in the fields of water regime monitoring, transportation, agricultural construction, etc., and it can promote the construction of intelligent cities.

2.1.2. Remote Sensing Technology and Application

Remote sensing is the technique of collecting electromagnetic radiation information from surface objects on satellites, aircraft or other aircraft to identify the earth's environment and resources. It is a comprehensive sexual- measurement technique which was formed gradually with the development of aerospace technology and electronic computer technology on the basis of aerial photography and interpretation in the 1960s. Any object has different characteristics of electromagnetic reflection or radiation. Any object has different electromagnetic wave reflection or radiation characteristics. Remote sensing technology is a kind of detection technology. According to the theory of electromagnetic wave, the application of a variety of sensing instruments to the distant target of the radiation and reflection of the electromagnetic

wave information, to collect, processing, and finally imaging, so as to detect and identify [7] various scenes on the ground a comprehensive technology.

Remote sensing is used for large-scale, high-resolution, and rapid information acquisition. "RS" technology is applied to traffic system information collection, processing, and analysis. It can implement dynamic monitoring of pavement design and traffic conditions and greatly improve the technical content, thereby improving project quality and efficiency. The modern remote sensing technology provides a brand-new technical means for the transportation system with its high resolution, all-weather, multi-phase, wide coverage, and intelligence. The application of satellite remote sensing for evaluation and analysis has the advantages of rich information, high efficiency and high accuracy, and can obtain regional live information in a short time. For example, the Tongzhou North Ring Tunnel adopts an underground three-story structure, namely a traffic floor, an equipment mezzanine and an integrated management gallery. Real-time monitoring of road surface information through remote sensing technology can realize car-free, vacuum transportation of garbage and intelligent transportation systems.

2.2. Urban Computing

2.2.1. 5G

The 5G network is a digital cellular network. In this network, the service area covered by the provider is divided into many small geographic areas called cells. Analog signals representing sound and images are digitized in mobile phones, converted by analog-to-digital converters and transmitted as bit streams[8]. All 5G wireless devices in the cell communicate with the local antenna array and low- power automatic transceivers (transmitter and receiver) in the cell via radio waves. The transceiver allocates channels from a common frequency pool, which can be reused in geographically separated cells. The local antenna is connected to the telephone network and the Internet through a high-bandwidth optical fiber or wireless backhaul connection, which forms a mobile data network that is inseparable from the current human life. Large-capacity, low-latency network transmission is a symbol and dividend of the 5G era. This not only improves the actual network transmission speed, but also means the arrival of the massive Internet of things which is close to real-time interaction. Humanity will enter the era of interconnection of everything, and the construction of smart cities will also enter a new stage. 5G will provide better solutions for smart grids, smart transportation and smart security, and bring many social and economic benefits. In Beijing, the 5G signal entered 16 office buildings in Wangjing area for the first time. Employees will experience the 5G rate of more than 700Mbps in the downlink and more than 90Mbps in the uplink through mobile phones or computers through wifi or network cable. Beijing Mobile will pilot part of the real estate enterprise project to build a 5G network, so that the enterprises in the building can experience 5G services faster, and provide innovative solutions in the fields of smart buildings and mobile offices to realize the application of AI video surveillance and VR viewing . In addition, Yuyuantan Park in Beijing uses 5G network The features of high speed, large broadband, and low latency solve the problems of online ticket purchases and congestion scan codes for tourists during peak hours; 31 high-definition AI cameras are installed to ensure the safety of the tour.

2.2.2. Cloud Computing

Cloud computing is a type of distributed computing, which refers to the decomposition of huge data calculation processing programs into countless small programs through the network "cloud". Then, these small programs are processed and analyzed by a system composed of multiple servers to obtain results and [9] return to the user. Through this technology, you can complete the processing of tens of thousands of data in a short time, so as to achieve a powerful network service.

Cloud computing achieves cross-departmental data sharing through resource integration, further promoting the development of regional informatization. Smart city is a comprehensive system composed of multiple applications, multiple industries and complex systems. There is information sharing and information exchange among multiple application systems. Different application systems need to jointly extract data for comprehensive calculation and provide comprehensive results, which is an important requirement of smart city system. A number of powerful information processing centers have emerged to cope with such a complex system. In the construction of smart city, a public cloud computing data center is established by integrating various government resources such as medical treatment, tax and transportation. The segmentation of each functional system in the city is alleviated, the repeated construction of resources is reduced, the utilization rate of resources is greatly improved, and information sharing is realized. For example, bank of Beijing, in cooperation with Maislin group and many other professional exit service agencies, has launched the "Yuexing visa" agency business, which helps customers to complete the whole process of submitting visa materials, signing in person and signing out easily and quickly, covering 38 countries and regions.

3. Suggestions on Urban Sensing and Urban Computing Technology and its Role

3.1. Regulation Mechanism of Smart City Construction

In fact, all the results of urban sensing and urban computing are interactive and interact with each other to affect the construction of smart city. Therefore, the construction management system of smart city should be constructed from three aspects: process control, environmental monitoring and management mechanism construction. Meanwhile, the interaction, interaction and restriction among the systems should be considered to increase the integrity of the system. For example, both 3D GIS technology and remote sensing can work together on transportation systems. However, any technology and software are not error-free, and they need to be monitored. Therefore, it is necessary to anticipate possible problems, risks, and propose solutions to estimate the resources, time, and capital required for smart city construction. This includes monitoring the operation of smart projects, whether they promote economic development, technological security, and managing the funding of smart projects to ensure the safety of smart projects. The focus of management is the potential risks caused by defects in smart projects. At the same time, a management control and feedback mechanism should also be formed, and the effectiveness evaluation after the operation and commissioning should be completed to provide a valuable reference for the comprehensive operation of the smart city construction.

3.2. Monitoring the Construction Process of Smart City

The process control of the construction of a smart city is mainly internal, and externally mainly for environmental monitoring. For urban computing, monitoring the environment is critical. Because the purpose of building a smart city is to make the city develop better and faster. If there is an economic downturn, social instability, and information security issues, then the establishment of a smart city is meaningless. For example, artificial intelligence technology in urban computing, cloud computing, or all information technology using the Internet may be hacked. And in this process, the application of these technologies can not be accepted if it cannot meet the requirements of urban residents. Then, these technologies need to be monitored externally.

The monitoring environment can be divided into economic environment, social environment and legal environment. The economic environment is the macro- economic and micro-economic environment in which the smart city construction project is located, which may have

certain influence or fluctuation on its development. Social environment refers to the social environment in which local cultural customs, citizens' quality and social progress may influence the construction of smart cities. For the social environment, monitoring management focuses on how to translate all potential uncertainties into quantifiable indicators. The legal environment includes the combination of laws and regulations observed and referred to in the planning, construction, operation and debugging of smart city construction projects.

3.2.1. The Evaluation Mechanism

The evaluation mechanism of smart city construction level includes the use of evaluation model and expert decision system to monitor and evaluate the environment and technology of smart city construction process on a regular basis, the rapid notification to relevant units through the designated platform, and the formation of a record, on which the corresponding reward and punishment system and incentive mechanism are established.

3.2.2. Feedback Mechanism

The feedback application mechanism is a key link in the smart city construction management system and an important factor to measure the effectiveness of smart city construction management. The feedback application mechanism of management in smart city construction refers to the expression and diffusion of technical information in the process of construction monitoring, so that it will constantly react on the construction and new smart projects. For example, when the traffic system fails, the problem is found through the supervision mechanism, and then the problem is diffused through the feedback application mechanism to solve the problem.

3.2.3. Emergency Response Mechanism

Emergency response mechanism means that by formulating corresponding emergency plans in advance, when the risks caused by the mutation of risk factors in the construction of smart cities occur and cause losses, relevant institutions can quickly make management decisions to control the risk losses to a minimum level. In the process of smart city construction, the changes of various uncertain factors are often uncertain, so it is inevitable that some sudden events, such as new network viruses and network attacks, quickly gather a large number of risk factors in a very short time. And even quickly turned into a direct economic loss. At this time, the corresponding emergency plan should be initiated, the intensity of management and monitoring should be increased, and full support and guarantee should be provided on personnel, funds, technology and equipment, so that various management measures can be implemented in the shortest time.

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