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Application of Big Data Analysis in Smart City Research and Planning

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Abstract: ***With the continuous improvement of economic strength, urban development in China has entered a new stage. However, traditional urban development and planning models are struggling to keep up with the direction of modernization. In the continuous development of information technology, more cities have started investing in the construction of smart cities. Nevertheless, the construction of smart cities heavily relies on technology. Whether it is smart transportation, smart communities, or smart healthcare, all of these aspects are inseparable from the support and guarantee of big data technology, establishing a brand-new development path for cities. Against this backdrop, this paper provides a detailed discussion on the application of big data technology in smart city planning, which will contribute to accelerating the construction of smart cities.***

Keywords: Smart City; Big data technology; Application.

1. INTRODUCTION

With the rapid development of big data technology, the application scope of this technology is also continuously expanding. The country has placed the development of this technology in an important position, attempting to change various aspects of people's life and production through the application of this technology, using science and technology to change the world. While the level of urban development has been significantly improved, many major cities have initiated the construction of smart cities and achieved outstanding results on this basis. Through the implementation of projects beneficial to people's livelihood, such as smart transportation and smart healthcare, the comprehensive service level of cities has been significantly improved. Big data technology is of great significance to the planning of smart cities, but some cities still have deficiencies in the application of big data technology, which needs further improvement to enhance the construction level of smart cities. Li, Evans, and Zhang [1] pioneered interactive data exploration frameworks for smart city analytics, emphasizing human-AI collaboration in urban decision-making. In healthcare informatics, Yuan [2] developed transformer-based methods to process medical texts in legal documents, addressing challenges in multimodal data alignment. Speech-enabled interfaces have also advanced, as Song [3] optimized warehouse management systems through automatic speech recognition, while Song [4] further demonstrated AI's role in enhancing e-commerce operational efficiency via user-centric internal tools. Geospatial applications are explored by Chen [5], who proposed neural networks incorporating location intelligence for smart city development. Legal and industrial applications show diverse AI implementations. Wang [6] analyzed the balance between enterprise naming rights and prior legal protections, providing crucial insights for commercial AI deployments. In manufacturing, Zhao et al. [7] achieved 12% efficiency gains in steel production through deep learning scheduling optimization. Retail innovations are highlighted by Ji et al. [8], who created AI-driven personalized marketing strategies combining consumer behavior analytics and reinforcement learning. Cross-domain risk management is addressed by Yang et al. [9], integrating large language models (LLMs) for real-time monitoring across financial markets. Medical AI advancements continue with Yuan's [10] self-supervised multimodal learning system for tumor classification, achieving 94.3% accuracy in chest radiography analysis. Architectural and urban planning domains reveal synergistic AI applications. He, Meng, and Xu [11] developed neural network-based solutions for optimizing modern building designs and energy efficiency. Complementing this, Ge, Zhang, and Qian [12] established AI-powered urban planning frameworks incorporating green building technologies through global case studies. Sustainable development is further enhanced by Zhou et al. [13], who improved garbage recognition models using ResNet-50 and weakly supervised CNNs, achieving 89.7% classification accuracy for smart waste management systems.

2. THE ROLE OF BIG DATA IN SMART CITY RESEARCH AND PLANNING

2.1 Clarify the direction for urban planning

With the continuous changes in domestic and international situations, people's quality of life has been continuously improved. Against this backdrop of development, people's demand for living environments has also been increasing. In order to provide better public services for people, smart cities are also gaining increasing attention. In the process of urban modernization, smart cities have become a major development trend in various cities. Despite notable achievements in the construction of some large cities, there are still some issues, such as a lack of clear understanding of the goals, content, and paths of construction, which leads to difficulties in fully reflecting the service function advantages of smart city construction after it is completed and put into operation. Therefore, with the increasing application of big data technology in smart cities, under the guidance of technology, people can gradually understand the profound connotation of smart cities. This also provides a direction for scientific urban planning. Relevant departments can ensure the scientific and rationality of urban planning under the guidance of this direction when carrying out urban planning [1].

2.2 Provide technical support

Big data technology is a brand-new technology that exhibits characteristics of technological integration and integration. Due to the extensive content involved in urban planning, comprehensive analysis of existing data and information in the city is necessary to ensure the scientific nature of planning. However, due to the wide variety and vast quantity of data, it is impossible to extract useful information from a large amount of data resources using traditional manual processing techniques. Therefore, big data technology is required. Introducing big data technology into the construction of smart cities can provide technical support for the construction and development of smart cities, thereby improving the efficiency and quality of urban planning.

2.3 Implement people-oriented urban planning

With the support of big data technology, the construction and planning of smart cities always adhere to the people-oriented principle, ensuring that people's basic needs are met in every aspect. Applying big data technology to the construction of smart cities enables efficient collection of information on pedestrian flow, vehicle flow, logistics, and other aspects within the city. Through analysis of various data, it becomes possible to understand what services need to be provided to residents in the city, thereby utilizing big data to improve the city's service model and enhance its development level.

3. APPLICATION APPROACH OF BIG DATA TECHNOLOGY IN SMART CITY PLANNING

In the process of applying big data technology to smart cities, the core issue is to fully leverage the advantages of big data in data collection and processing. By scientifically processing various data, it can assist in urban planning and decision-making. The application process of big data in smart city planning is relatively complex. To ensure its effectiveness and promote the rapid development of smart cities, we can follow the following approach [2].

3.1 Construction of a multi-planning coordination system

In the planning process of smart cities, it is crucial to establish a multi-planning coordination system. However, to ensure the effectiveness of these systems, it is necessary to strengthen the application of big data technology. With the support of big data technology, various urban information can be integrated, and a smart coordination system for the city can be established from multiple aspects. In the process of urban construction in China, traditional urban planning work is usually carried out under the leadership of multiple departments. It is easily influenced by administrative management in planning work. There are issues such as too many management entities, chaotic planning systems, insufficient data protection, and sometimes overlapping planning content and systems. These issues have a significant impact on urban development. Therefore, from the above perspectives, when conducting urban planning, it is important to pay attention to the coordination between land use and social development. To achieve this goal, the application of big data technology in this field should be strengthened, and the advantage of big data in integrating data should be fully utilized. The original planning achievements within the city should be comprehensively applied to formulate practical, scientific, and reasonable planning schemes. With the support of big data, comprehensive analysis of relevant planning criteria should be conducted, and corresponding coordinated development mechanisms should be established. The construction of smart cities needs to be based on the overall planning of urban space. During planning work, resources within the city can be reasonably allocated and utilized according to the concepts of intelligence, environmental protection, and energy conservation.

3.2 Urban spatial planning

With the continuous development of society and economy, more and more people have moved into cities. At the same time, the flow of resources within cities is becoming faster, and interactions with the outside world are becoming more frequent. Under such circumstances, a wealth of information resources will also emerge. In order to ensure that the construction of smart cities meets current development requirements, it is necessary to pay attention to collecting various information resources during planning work, and to directly apply these information resources to future planning work in subsequent planning stages. Based on this, resources within the city can be allocated reasonably. In traditional urban planning work, the focus is on detailed analysis of the space in each place, which is clearly not keeping up with the construction speed of smart cities. Therefore, in order to ensure the effectiveness of smart city construction, each city needs to establish a brand-new urban spatial system under the unified regulations of the country. Under this system, data information can be fully utilized to achieve the goal of optimizing and adjusting the urban spatial system.

When conducting spatial planning for smart cities, it is necessary to apply big data in practice. This requires a clear indication of the direction of urban transformation and an overall control of urban spatial planning. With the support of big data technology, relevant personnel can analyze both urban space and various behaviors within the city, making the construction of smart transportation and industries more scientific, thereby ensuring the stable and healthy development of the city. To enhance the scientific nature of urban planning and design, professional planners need to establish a scientific urban social network information evaluation system, forming an effective evaluation index system. In the subsequent urban planning process, the evaluation index system can provide practical guidance for evaluating the quality of urban planning, enabling urban planning work to proceed more efficiently and orderly. After obtaining reliable evaluation results, problems existing in smart city planning can be identified, allowing for effective improvements. Under the combined effects of the overall urban planning goals and the connectivity between adjacent urban elements, big data technology can be used for scientific regulation, achieving the goal of optimizing the allocation of internal urban resources.

4. PRACTICAL APPLICATION OF BIG DATA IN THE CONSTRUCTION AND PLANNING OF SMART CITIES

The application of big data technology in smart city planning hinges on data collection and utilization. However, in cities with lower technological levels, numerous issues often arise during data collection and processing. To address this situation in future smart city construction, we can begin by addressing deficiencies in data collection and storage, fully leveraging big data for data integration and mining. With an abundance of data information, relevant personnel in urban planning can effectively coordinate in areas such as land information, smart operations, and urban surveying and mapping according to overall planning needs [3].
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4.1 Smart Transportation

In the current urbanization process, many cities are facing significant traffic pressure. To enhance urban traffic efficiency, it is necessary to design intelligent transportation systems during the construction of smart cities, establishing an intelligent and integrated transportation system within the city. When constructing smart transportation systems, the focus is on utilizing modern technologies such as big data and the Internet of Things (IoT) to build an intelligent information collection and control system in the city. Through a big data intelligent platform for traffic management, real-time and intelligent monitoring of all traffic in the city can be achieved, enabling round-the-clock information collection. This allows for the collection of traffic information at different time periods. Through comprehensive analysis of various urban traffic information, traffic departments can provide timely guidance on traffic flow and intelligently control vehicles at each intersection, thereby identifying valuable traffic information. By grasping the real-time status of vehicles and roads, drivers can promptly discover road conditions and congestion situations in the city and adjust their driving routes accordingly. Through the big data platform, real-time traffic information can be provided to drivers, helping them adjust their travel modes based on road conditions in real time, thereby enhancing the efficiency and safety of their journeys. The information collected by the big data platform during city operations can be uploaded to the IoT in real time, and through terminal devices, this traffic information can be visualized and directly displayed to drivers. Drivers can adjust their driving routes accordingly, avoiding congested road sections and reducing travel time waste.

4.2 Smart community

There are numerous communities within the city. As people's living standards continue to improve, community management should be conducted in accordance with modern management concepts and implemented intelligently. The application of big data technology in smart city planning can also promote the construction of smart communities. Through the construction of smart communities, the management model of the community can be changed, thereby satisfying urban residents' pursuit of a high-quality life, enhancing their happiness index, and providing more efficient and scientific community services to residents. After the completion of smart community construction, big data technology can be used to conduct comprehensive monitoring of community roads, allowing for timely detection of safety threats present on these roads. The smart community platform can also monitor the street environment of the community, and if it is found to be substandard, relevant system modules can immediately dispatch specially-assigned personnel to the scene for cleaning. Driven by sustainable development goals, China's requirements for community hygiene are constantly increasing, and there is a strong advocacy for waste sorting. Therefore, when conducting waste sorting, it is necessary to classify waste according to its characteristics. In smart communities, cameras will be installed on trash bins, which can recognize residents when they dispose of waste. After confirming their identity, the trash bin will automatically open, and residents will receive point rewards for disposing of recyclable waste. After establishing network connectivity with the trash bins, basic information such as their location, temperature, and environment can be monitored. If there is a problem with the trash bin during use, the system can immediately report and quickly arrange for repairs.

5. CONCLUSION

Currently, in the process of urban development, major cities have increased their investment in funds, technology, and talents for the construction of smart cities, and some of these smart cities have achieved remarkable results. However, there are still some issues in the construction of smart cities. In order to provide better services to urban residents through the construction of smart cities, major cities must strengthen the application of big data technology in smart city planning, thereby improving the level of urban planning.

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