International Core Journal of Engineering Volume 12 Issue 4, 2026
ISSN: 2414-1895 DOI: 10.6919/ICJE.202604_12(4).0006

Research on Empowering Ecological Environment Construction with Smart Technology under the Background of Park City

Xuanrui Chen, Xufeng Li, Tianju Zhong, and Shixin Zheng

School of Hope, Southwest Jiaotong University, Chengdu 610400, China

Abstract

Guided by the concept of park city, smart technology is deeply integrated into ecological environment construction and has become a key force in promoting urban sustainable development and improving ecological quality. This article analyzes the application cases of smart technology in environmental monitoring, resource management, ecological protection, and other fields, revealing how it optimizes ecological environment governance through precise perception, intelligent decision-making, and efficient execution. The research results indicate that smart technology not only improves the timeliness and accuracy of ecological monitoring, but also achieves efficient resource utilization and precise pollution prevention and control through intelligent irrigation, pollution tracing and other means. In the future, it is necessary to further strengthen technological integration, data sharing, and standard construction, and use smart technology to drive the ecological environment construction of park cities to a higher level.

Keywords

Park City; Smart Technology; Ecological Environment Construction; Ecological Monitoring.

1. Introduction to Resource Management

As a new concept of urban and rural living environment construction, Park City regards urban green space system and park system parkification as the fundamental and prerequisite configuration elements of urban and rural development and construction, and regards the optimization and harmony of the relationship between "citizens park city" [1]as an important content of creating a better life. Its core is the development concept led by ecological civilization, the values centered on the people, the ecological concept that highlights the construction of a community of life in mountains, waters, forests, fields, lakes, and cities, and the highly harmonious and unified form of a beautiful city with people, city, environment, and industry.

In the construction of park cities, ecological environment construction is a key link. A good ecological environment can not only meet the growing demand for a beautiful ecological environment among the people, but also enhance the livability and comprehensive competitiveness of the city[2]. As an important component of modern information technology, smart technology provides new ideas and methods for ecological environment construction. Through the application of technologies such as the Internet of Things, big data, cloud computing, and artificial intelligence, precise monitoring, scientific management, and efficient protection of the ecological environment can be achieved, promoting the development of ecological environment construction towards intelligence and refinement[3]. Therefore, the study of smart technology empowering ecological environment construction in the context of park cities has important theoretical and practical significance.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202604_12(4).0006

2. The Relationship between Park Cities and Ecological Environment Construction

2.1 Requirements of Park Cities for Ecological Environment Construction

The concept of park cities emphasizes ecological priority and green development, and puts forward higher requirements for ecological environment construction[4,5]. In terms of urban layout, it is required to achieve more optimization, enrich green and public spaces, and provide more ecological welfare for residents. In terms of ecological balance, it is necessary to ensure the rational allocation and coordinated optimization between mountains, waters, forests, fields, lakes, and cities, build an integrated relationship between humans and nature, and maintain the stability and integrity of the ecosystem. In terms of public services, it is necessary to provide more balanced ecological services, meet the needs of different groups of people for the ecological environment, and enhance residents' sense of ecological gain and happiness.

2.2 The Significance of Ecological Environment Construction for Park Cities

Ecological environment construction is one of the core contents of park city construction and plays an important supporting role in the development of park cities[6]. A good ecological environment is an important symbol of a park city, which can enhance the image and quality of the city, attract talent and investment, and promote the economic development of the city. At the same time, ecological environment construction can also improve the quality of urban ecological environment, reduce pollution and disasters, and ensure the physical health and safety of residents. In addition, ecological environment construction can promote the sustainable development of cities and achieve coordinated development of economy, society, and environment.

3. The Application Status of Smart Technology in Ecological Environment Construction

3.1 Environmental Monitoring In the Field of Environmental Monitoring

The application of smart technology has achieved significant results. Taking Xiong'an New Area as an example, it has developed a surface water reconnaissance monitoring system based on water pollution fingerprint warning and traceability technology. The system introduces the idea of fingerprint identification of suspect in criminal investigation of public security organs into the identification of water pollution discharge sources[7]. Through online monitoring of transboundary water quality, the system realizes timely early warning and rapid traceability of water quality abnormalities. When there is an abnormality in water quality, the system can quickly issue a warning and use online detection of water quality fingerprints to compare and analyze the pollution source water quality fingerprint database, trace the pollution source, and provide industry information on the pollution source. Combined with conventional water quality monitoring data, the suspected polluting industry is located and traced using the pollution path method. Samples are taken at key nodes upstream of the river for comparative analysis of water quality fingerprints. Based on similarity, the scope is quickly narrowed down until the suspected pollution source is identified, providing important directional information for environmental supervision and law enforcement.

In addition, Xinwu District in Wuxi City has built the first set of district and county-level automated water quality monitoring laboratories in Jiangsu Province, achieving full coverage of surface water environmental quality monitoring in Xinwu District and radiating to surrounding districts and counties. The laboratory has established a new paperless monitoring mode for the entire process of "procurement, transportation, measurement, and management"[8] by deploying an intelligent control platform and combining it with intelligent control terminals, reducing the potential errors caused by manual participation. At the same time, achieving fully automated, batch based, and unmanned monitoring of multiple water quality parameters significantly enhances the ecological environment monitoring capabilities of districts and counties. 300 samples can be analyzed at full capacity per day,

ISSN: 2414-1895 DOI: 10.6919/ICJE.202604_12(4).0006

and all samples collected on the same day can be issued the next day, greatly improving data timeliness.

3.2 In the Field of Resource Management

Smart technology also plays an important role. Taking intelligent irrigation systems as an example, many parks have adopted intelligent irrigation systems in the construction of park cities. The system automatically adjusts the amount and frequency of irrigation based on factors such as soil moisture and climate conditions, achieving efficient utilization of water resources. For example, by installing sensors in the soil to monitor soil moisture in real time, when the soil moisture is below the set value, the system automatically turns on the irrigation equipment for irrigation; When the soil moisture reaches the set value, the system automatically shuts down the irrigation equipment to avoid wasting water resources[9].

Intelligent lighting systems have been widely used in energy management. The system automatically adjusts lighting equipment based on light intensity and tourist flow to reduce energy consumption. When there is sufficient sunlight during the day, the system automatically reduces the brightness of lighting equipment or turns off some lighting equipment; When there is a large flow of tourists at night, the system automatically increases the brightness of the lighting equipment to provide a good lighting environment for tourists. At the same time, some parks have also adopted solar power generation technology, using solar panels to power the facilities in the park, reducing dependence on traditional energy and achieving sustainable energy utilization.

3.3 In the Field of Ecological Protection

Smart technology provides strong support for the protection and restoration of ecosystems. Taking Xiong'an New Area as an example, it utilizes hyperspectral unmanned aerial vehicles and satellite remote sensing technology to achieve rapid monitoring and control of air to lake and air to ground, innovates Baiyangdian ecological protection monitoring technology, and forms a new model of intelligent supervision for hyperspectral unmanned aerial vehicle inspection that can be promoted. Through hyperspectral unmanned aerial vehicles and satellite remote sensing technology, real-time information on water quality, vegetation coverage, wetland changes, and other aspects of Baiyangdian can be obtained, enabling the timely detection of ecological problems and the adoption of corresponding protective measures.

In terms of biodiversity conservation, some parks have adopted intelligent monitoring devices to monitor wildlife. For example, by installing infrared cameras, sound sensors, and other devices in the park, real-time monitoring of the activity trajectory, population size, and other information of wild animals can provide scientific basis for biodiversity conservation. At the same time, big data analysis technology is used to analyze monitoring data, understand the ecological habits and habitat needs of wildlife, and develop more scientific and reasonable protection strategies.

4. The Advantages of Empowering Ecological Environment Construction with Smart Technology

4.1 Improving Management Efficiency Smart Technology Achieves Intelligent

Improving management efficiency Smart technology achieves intelligent, automated, and refined garden management through modern information technologies such as the Internet of Things, big data, and cloud computing. In the construction of park cities, management personnel can obtain real-time environmental information, facility operation status, and other data within the park through intelligent devices, and discover and solve problems in a timely manner. For example, by installing sensors in the park to monitor air quality, soil moisture, plant growth status, etc. in real time, once an abnormal situation is detected, the system will automatically issue an alarm, and management personnel can take timely measures to deal with it, avoiding the problem from escalating. At the same time, utilizing big data analysis technology to analyze monitoring data provides managers with scientific decision-making basis and improves management efficiency.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202604_12(4).0006

4.2 Reducing Operating Costs

The application of smart technology can reduce labor costs and lower operation and maintenance expenses. Taking intelligent irrigation systems as an example, traditional irrigation methods require manual scheduled inspections and operations, which are not only inefficient but also prone to waste of water resources. The intelligent irrigation system can automatically adjust the amount and frequency of irrigation based on soil moisture and climate conditions, without the need for manual intervention, greatly reducing labor costs. At the same time, intelligent irrigation systems can also achieve precise utilization of water resources, avoid waste of water resources, and reduce operating costs.

In terms of facility management, the use of IoT technology enables remote monitoring, fault diagnosis, and maintenance of facilities within the park, ensuring their normal operation. When a facility malfunctions, the system will automatically sound an alarm and locate the fault location. Maintenance personnel can quickly arrive at the site for repairs based on the information provided by the system, reducing repair time and costs.

4.3 Improving Ecological Quality

Improving Ecological Quality Smart Technology can adjust the landscape in real time to ensure the best landscape effect. In the construction of park cities, through intelligent lighting systems, intelligent fountain systems and other equipment, the landscape effect can be automatically adjusted according to different time periods, weather conditions and tourist flow, providing visitors with a more beautiful park environment. For example, at night, the intelligent lighting system can automatically adjust the brightness and color of the lighting according to the distribution of tourists, creating a romantic and warm atmosphere; The intelligent fountain system can automatically adjust the height and shape of the fountain according to the rhythm and melody of music, increasing the fun and ornamental value of the landscape.

Meanwhile, smart technology can also promote the balance and stability of ecosystems. Real time monitoring of dynamic changes in the ecosystem through intelligent monitoring devices, timely detection of ecological problems, and adoption of corresponding protective measures. For example, when an abnormal decrease in the population of a certain plant is detected, measures such as artificial propagation and planting can be taken in a timely manner for protection; When abnormal activity trajectories of a certain animal are detected, the cause can be investigated in a timely manner and corresponding protective measures can be taken to maintain the balance and stability of the ecosystem.

4.4 Promoting Sustainable Development

Smart technologies can help achieve the conservation and recycling of water resources and energy, and promote the sustainable development of the landscaping industry. In the construction of park cities, the application of intelligent irrigation systems, intelligent lighting systems and other equipment can effectively reduce the consumption of water resources and energy. At the same time, some parks have also adopted technologies such as rainwater harvesting and solar power generation to achieve water resource recycling and energy self-sufficiency. For example, rainwater is collected through a rainwater harvesting system and treated for irrigation, flushing, etc., reducing dependence on urban water supply systems; By using solar power generation systems to convert solar energy into electrical energy, the facilities in the park can be powered, reducing reliance on traditional energy sources.

In addition, smart technology can also promote the resource utilization of garden waste. By using intelligent classification devices to classify and process garden waste, recyclable waste can be recycled and reused, while non recyclable waste can be treated harmlessly to reduce environmental pollution.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202604_12(4).0006

5. The Challenges Faced by Smart Technology in Empowering Ecological Environment Construction

5.1 Technology Integration Issues

Effectively integrating different technologies and achieving collaborative work between technologies is an important challenge faced by smart technology in empowering ecological environment construction. In the construction of park cities, various technologies such as the Internet of Things, big data, cloud computing, and artificial intelligence are involved. These technologies require data sharing and interaction to achieve maximum efficiency. However, there are still certain difficulties in the integration of different technologies, such as inconsistent data formats and incompatible interfaces, which result in poor collaborative work between technologies.

5.2 Data Security Issues

Data Security Issues In the application process of smart technology, data security is an issue that cannot be ignored. Ecological environment data involves multiple aspects such as urban ecological security and residents' privacy. Once the data is leaked or tampered with, it will bring serious consequences. However, there are still certain security risks in the transmission, storage, and processing of data, such as network attacks, data leaks, etc. Effective measures need to be taken to strengthen data security protection.

5.3 Cost control While Ensuring the Progressiveness of Technology

Cost control While ensuring the progressiveness of technology, controlling project cost is another challenge for the construction of smart technology enabled ecological environment. The application of smart technology requires significant investment in equipment procurement, system development, personnel training, and other aspects, resulting in high costs. How to reduce project costs and improve project cost-effectiveness while ensuring technical effectiveness is an important issue that needs to be addressed.

The application of smart technology in ecological environment construction requires policy support from the government and relevant departments. At present, although the government has introduced some relevant policies to support smart cities and ecological environment construction, the policies in empowering ecological environment construction with smart technology are not yet perfect, such as the lack of clear industry standards, financial subsidy policies, etc., and further policy support is needed.

6. The Development Strategy of Empowering Ecological Environment Construction with Smart Technology

6.1 Strengthening Technology Integration

Strengthening technology integration Strengthening the integration between different technologies and achieving collaborative work between technologies is the key to empowering ecological environment construction with smart technology. By establishing unified technical standards and interface specifications, compatibility and interoperability between different technologies can be promoted. At the same time, we will strengthen industry university research cooperation, integrate technological resources from universities, research institutions, and enterprises, jointly carry out technological research and innovation, and promote deep integration between different technologies.

6.2 Strengthening Data Security Protection Strengthening Data Security Protection

Strengthening Data Security Protection Strengthening data security protection is an important guarantee for smart technology to empower ecological environment construction. Encryption technology, access control technology, data backup technology, and other means can be used to enhance the security of data during transmission, storage, and processing. At the same time, establish

ISSN: 2414-1895 DOI: 10.6919/ICJE.202604_12(4).0006

a sound data security management system, strengthen the management and supervision of data security, and ensure the security and reliability of data.

6.3 Optimizing Cost Control

Optimizing cost control is an important task of empowering ecological environment construction with smart technology. Equipment procurement costs can be reduced by adopting open source technology, sharing devices, and other methods; Reduce system development costs by optimizing system design and improving system efficiency; Reduce personnel training costs by strengthening personnel training and improving personnel quality. At the same time, in the process of project planning and implementation, scientific cost budgeting and cost control should be carried out to ensure that the project is completed within the budget range.

6.4 Seeking Policy Support

Seeking policy support from the government and relevant departments is an important guarantee for smart technology to empower ecological environment construction. The government can introduce relevant industry standards to regulate the application of smart technology in ecological environment construction; Provide financial subsidy policies to encourage enterprises and units to adopt smart technologies for ecological environment construction; Strengthen policy guidance and promote the widespread application of smart technologies in ecological environment construction**.**

7. Conclusion

Under the background of park cities, empowering ecological environment construction with smart technology has important significance and broad prospects. The application of smart technology in environmental monitoring, resource management, ecological protection and other fields has achieved significant results, with advantages such as improving management efficiency, reducing operating costs, enhancing ecological quality, and promoting sustainable development. However, empowering ecological environment construction with smart technology also faces challenges in technology integration, data security, cost control, and policy support. In order to promote the further development of smart technology empowering ecological environment construction, it is necessary to strengthen technology integration, enhance data security protection, optimize cost control, and strive for policy support and other development strategies. In the future, with the continuous advancement and deepening of technology applications, smart technology will play a more important role in the ecological environment construction of park cities, making greater contributions to creating a more livable, business friendly, and tourism friendly urban environment.

Acknowledgments

Project Source: 2025 Sichuan Province College Students Innovation and Entrepreneurship Training Program Project, Project Number: S202514262073, Course Name: Route Selection Design.

References

[1] Gong Xiwei, Lu Man, Ma Fuliang, etc Research on the Application of Smart Technology in Urban Ecological Landscape Green Belt [J]. Theoretical Research on Urban Construction (Electronic Version), 2025 (1): 76-78

[2] Wang Chao Exploration of Teaching Mode for Railway Route Selection Based on BIM Technology [J]. Higher Education Research, 2016 (6): 123-126

[3] Zhou Guanghui, Lu Changbing, Zhang Xiaoxuan, etc Research on the Construction Framework of Smart Park - Taking the Smart Transformation of Haidian Park in Beijing as an Example [J]. Landscape Architecture, 2023 (1): 45-50

[4] Yu Wenjie Research on the Intelligent Construction of Urban Parks in Deyang City - Taking Deyang Stone Carving Park as an Example [D]. Sichuan Agricultural University, 2024

ISSN: 2414-1895 DOI: 10.6919/ICJE.202604_12(4).0006

[5] Li Wenyang, Zhang Wei, Wang Lei Research on the Reform of Railway Route Selection and Design Curriculum Based on BIM Technology [J]. Geological Education, 2021 (2): 89-92

[6] Zhang Yongming Research on the Relationship between Smart Technology and Smart Cities [J]. Urban Development Research, 2010 (5): 34-38

[7] CITIC Guoan Urban Operation Technology Co., Ltd Research Report on Smart City Solutions [R]. 2020

[8] Chen Siyu, Liu Xiaodong Research on Information Security Issues in Smart City Construction [J]. Information Security and Technology, 2019 (8): 45-48

[9] Wang Jianguo, Li Ming Discussion on Ecological Construction and Management of Urban Parks [J]. Low Carbon World, 2021 (2): 112-114