

Exploration of the application of wireless communication Internet in the child-friendly public space

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Abstract

In the design and establishment of child-oriented public spaces, the pervasive use of wireless communication technologies via the internet is a cornerstone in fostering a safe and educational milieu. The convergence of high-speed Wi-Fi, mobile apps, IoT devices, and precise location tracking builds a holistic platform for children's enjoyment and development. Real-time wireless monitoring gives parents unparalleled assurance of their children's safety. Mobile apps integrated with public amenities offer interactive games and educational content, fostering an enriching learning environment. IoT devices, such as intelligent cameras and emergency response buttons, further bolster security measures, providing additional protection for children. Wireless tech in public spaces gathers behavioral data, deepening understanding of kids' needs. This data optimizes spaces, enhancing their experience. Wireless tech in child-friendly spaces boosts security, engagement, and blends education with entertainment. As tech evolves, future spaces will prioritize kids' growth, transforming into havens for holistic development.

Keywords: wireless communication, Internet, child-friendly public space, technological innovation

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Introduction

In today's society, wireless communication and internet technology are pivotal in driving societal progress. Beyond merely revolutionizing our daily lives, it introduces boundless prospects for innovative public space design. In the specific realm of child-friendly public spaces, wireless communication internet technology has ushered in a novel frontier of exploration [28]. This paper explores the role of wireless communication internet in fostering such spaces and how its utilization can cultivate a safer, more captivating, and educational environment for children.

Wireless communication and internet technology can significantly bolster children's security within public spaces [17]. Surveillance cameras and AI analysis monitor kids' activities, detecting hazards in real-time. Parents can remotely track their kids' locations via an app, ensuring peace of mind. Beyond security, wireless communication and internet technology can enhance children's interactive

experiences in public spaces. AR and VR bring immersive games to parks and playgrounds, blending entertainment with science and history to foster learning through play [22]. Furthermore, wireless communication and internet technology can foster social interaction among children. Establishing dedicated social platforms tailored for children enables them to communicate via the wireless internet, share game experiences, and exchange toys within public spaces [21]. Such platforms cultivate children's communication skills and team spirit, fostering valuable interpersonal relationships.

The application of wireless communication Internet in child-friendly public space also faces some challenges. The first is the issue of privacy protection [11]. How to ensure the safety of children without infringing on their privacy is an issue that needs to be carefully considered. The second is the issue of network security. Children may be exposed to inappropriate content when using wireless networks, so strict network supervision measures are needed [10]. Finally, it is the

problem of technology popularization. The level of economic development in different regions is different. How to ensure that all children can enjoy the convenience brought by the wireless communication Internet is a goal that needs the joint efforts of the whole society. The application of wireless communication Internet technology in child-friendly public space has great potential and value. Through reasonable design and technical implementation, we can create a safe and fun environment for learning and growth. Of course, this requires the cooperation of the government, enterprises and all sectors of society to continuously explore and improve relevant technologies and management strategies to ensure that wireless communication Internet technology can truly serve the healthy growth of children.

1. Wireless communication Internet and child-friendly public space theoretical framework

1.1 Wireless communication and Internet research

1.1.1 Basic concept of wireless communication and Internet

The wireless communication internet represents a transformative communication network that leverages radio waves or infrared rays to facilitate data transmission. Wireless networks boast simplified wiring, effortless installation, and seamless scalability, unlike traditional wired networks [5]. Wireless networks have profoundly propelled the evolution of mobile communication and the internet, introducing immense convenience to individuals in their lives and work. Wireless networks can be categorized along multiple dimensions, including coverage and communication technology [20]. Based on coverage, they are segmented into wireless wide area networks (WWAN), wireless local area networks (WLAN), wireless metropolitan area networks (WMAN), and wireless personal area networks (WPAN). From a communication technology perspective, wireless networks encompass WLAN, Bluetooth, mobile communication, and other variants.

The ubiquity of wireless networks has led to their widespread adoption across diverse domains of production, education, and daily life [3]. These include mobile offices, smart homes, and smart cities. The evolution of wireless networks has empowered individuals to roam freely within their coverage areas, accessing network resources unfettered by the constraints of traditional wired networks. With science and tech advancing, wireless communication is now a cornerstone of modern life. 5G, the latest iteration, offers breathtaking speed, ultralow latency, and vast connectivity, surpassing 4G [30]. This enables applications in autonomous driving, telemedicine, and smart cities. Wireless communication offers unmatched convenience, flexibility, real-time capabilities, and expansive coverage, freeing us from cables

and adapting to complex environments. It fulfills real-time requirements through rapid data transmission. Furthermore, wireless communication technology achieves broad coverage, accommodating the diverse demands of numerous scenarios[26].

1.1.2 Difference between WLAN, WMAN, and WPAN in the wireless communication Internet

WLAN, or wireless local area network, is a short-range wireless tech for offices, homes, and schools. It enables routers and devices for Internet, file transfers, printer sharing, etc [15]. It covers up to hundreds of meters, follows IEEE 802.11 standards like Wi-Fi, and offers flexibility and easy deployment over wired networks. However, they also pose challenges regarding security and susceptibility to wireless interference. Meanwhile, WMAN, or a wireless metropolitan area network, serves as a medium-range wireless communication system, often spanning tens to hundreds of kilometers. WMAN is mainly used for wireless communication in cities or regions, such as urban broadband network, wireless monitoring system, etc. Common WMAN technologies include WiMAX, Mesh network, etc [1]. WMAN has the advantages of high speed, large capacity and low cost, which is suitable for the construction of large-scale wireless communication network.

WPAN, the wireless personal area network, is a short-range wireless communication network commonly used for wireless connections of individuals or small devices. WPAN is mainly used for the communication between intelligent terminal devices, such as mobile phones, tablet computers, smart wearable devices, etc. Common WPAN technologies include Bluetooth, ZigBee, NFC and so on [16]. WPAN has the advantages of low power consumption, low cost and high reliability, which is suitable for the application scenarios of close range wireless data transmission [23]. The main differences between WLAN, WMAN, and WPAN are their coverage, application scenarios, and technical standards for use. WLAN is for indoor or small range wireless connections, WMAN for urban or area-wide wireless communications, and WPAN for close range wireless connections between personal devices.

1.2 Child-friendly public space

Child-friendly public Spaces are urban areas that provide children with safe, interesting and beneficial venues, taking into account their needs and interests [6]. This spatial design usually follows the concept of "seeing the city at 1 meter height", meaning that from the perspective of children, ensuring that the urban planning and design conform to their body size and cognitive level [12]. The theoretical research of child-friendly public space mainly focuses on how to provide a safe, comfortable and interesting activity environment for children to meet children's growth needs while promoting parent-child interaction. This spatial design is not only the construction of the physical environment, but also includes

the understanding and consideration of children's psychological needs and behavioral characteristics [27].

In China, the Jinan Municipal Bureau of Natural Resources and Planning has launched the Guidelines for The Planning of Jinan Children-Friendly Cities, aiming to promote the integration of child-friendly concepts into urban planning and construction [4]. The guide emphasizes classified construction exemplary guidance, pays attention to the whole cycle of children's growth, and the integration of spring water and culture, highlighting the characteristics of "spring city" [2]. In addition, it emphasizes adapting measures to local conditions, differentiated measures, and orderly implementation to adapt to the characteristics and needs of different urban areas.

1.3 Research method of integration of wireless communication Internet and child-friendly public space

Research on integrating wireless communication, the Internet, and child-friendly public spaces involves many fields, including urban planning, child psychology, information technology, etc [8]. This integration aims to promote the comprehensive development of children by providing a safe, exciting, and educational public space through advanced wireless communication technology. Such fusion research significantly improves children's quality of life and promotes healthy growth [13]. Figure 1 shows the construction of the internal principle of the wireless communication Internet. Through wireless communication Internet technology, children can provide rich learning resources and interactive experience, while ensuring the safety of children in public space. Moreover, such research can also help to fill the gap in child-friendly public space and promote the optimization and renewal of urban public space.

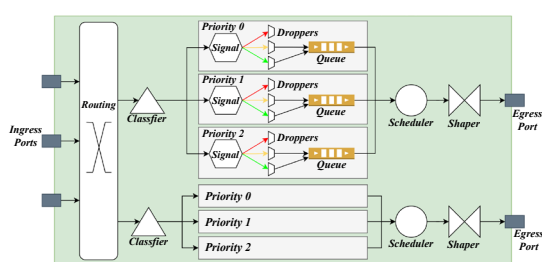


Figure 1. Construction of the internal principle of the wireless communication Internet

Digital transformation of child-friendly city construction. With the diversification of digital media and the trend of widespread media spread, the construction of child-friendly cities should also keep pace with The Times, integrate the combination of digital media into public places such as parks and libraries, and carry out the space "fitness" transformation [7]. Through the development of children friendly city App, provide children's activities booking, child safety tips, and other functions, at the same time can set up in public children

intelligent guidance system, in the form of children popular urban culture, create different media culture scene for children children social real space, through online barriers, help children out of the network addiction and information cocoon room "digital island" [24].

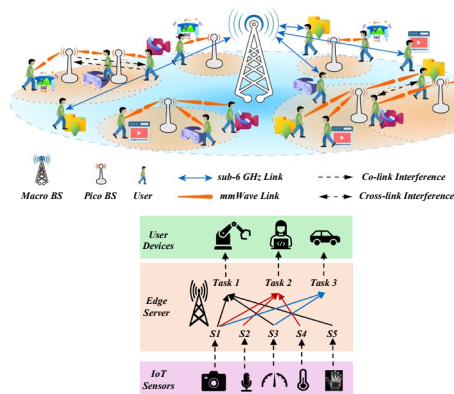


Figure 2. Wireless communication Internet and child-friendly public space integration construction

Figure 2 shows the integration of wireless communication Internet and child-friendly public space, into which the application of intelligent education is integrated. With a new perspective, smart education brings new experiences to children, teachers and parents, and plays a positive role in promoting the reform and development of kindergartens. Game as the main way of children's learning, how to information technology and children's games, teaching activities, make conforms to the characteristics of the development of wisdom learning game environment, play to the role of wisdom education, promote education teaching, improve teaching quality, is the current every preschool education workers need to think [18]. The integration of science and technology and social responsibility. For the practice of corporate social responsibility, promote the integration of science and technology and social responsibility, let the flowers of the motherland can feel the pulse of time development, sharing the joy of scientific and technological progress, on June 1, China mobile communications group co., LTD., Henan Xinxiang branch to carry out the "child 'exploration' move'boring" public welfare activities, invite Xinxiang welfare center, children to visit Xinxiang mobile, feel the new experience of 5G technology, innovation technology for children to open a window to understand the world, with love together water the flower of the motherland.

The integration of wireless communication Internet and children's public space can be realized through digital transformation, smart education application, integration of technology and social responsibility, and children's experience in smart city operation center, so as to create a safer, more interesting and educational children's public space [25].

2. Experimental design and analysis

2.1 Construction of the scheme and index system

The integration of wireless communication Internet and children's public Spaces must ensure the safety of children. This includes both physical security and network security. Physical security involves the personal safety of children in the public space, while network security involves the data security and privacy protection of children when using the Internet [19]. Therefore, the scheme should include intelligent management and safety monitoring of children's activity facilities, as well as encryption protection of children's personal information. The suitability. The integration scheme should take into account the age characteristics and cognitive level of the children and provide appropriate content and services [14]. For example, the child-friendly city App can provide functions such as children's activity reservation and child safety tips, and the intelligent guidance system for children can be set up in public places to popularize the city diversity in a way that children like interactivity. Fusion programs should encourage children's interaction with the environment and provide a rich interactive experience. For example, the Internet of Things technology can be used to realize intelligent management and safety monitoring of children's activity facilities, and big data technology can be used to analyze children's urban activities data, understand children's demand preferences for urban planning and construction, and provide support for urban planning and decision-making.

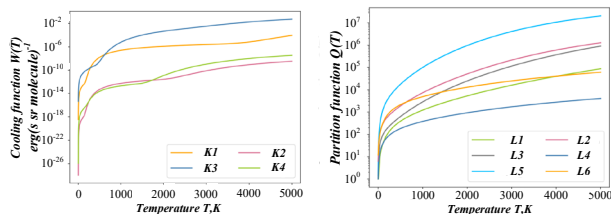


Figure 3. Data analysis of the scheme index system construction

Figure 3 shows the data analysis of the scheme index system. The fusion scheme proposed in this paper should have educational significance to help children learn and grow. For example, through network resources, it can not only extend children's classroom knowledge content, learn new knowledge related to textbook knowledge, but also open up new learning areas.sustainability. The integration scheme should consider the feasibility of long-term operation and maintenance to ensure the stability and scalability of the system [9]. For example, enterprises and research institutions can be encouraged to develop technological products suitable for them, such as smart readers and educational robots, in child-friendly cities, so that new technologies can better empower the construction of child-friendly cities. Social support. The integration plan should focus on providing social

support services for children and families, actively link social resources from all sides, carry out work in child protection, social assistance, public welfare and charity, provide parental parenting support, pay attention to the development needs of children in difficulties, and promote social integration of children.

2.2 Scheme design implementation

The design and implementation of the scheme aim to verify the application effect of wireless communication via the Internet in children's public spaces and formulate corresponding standards according to wireless network technology. Specific public spaces such as children's parks, libraries, and schools are selected as experimental locations, and service facilities are transformed and upgraded in combination with wireless network technology and child-friendly design principles. Data on children's activities in public Spaces are collected and analyzed through sensors, surveillance cameras, and other devices. The experimental steps include requirements research, technology deployment, service design, test and evaluation, and iterative optimization to ensure that wireless network services better meet the needs and expectations of children and their parents.

3. Experimental analyses of the application of wireless communication Internet in child-friendly public space

3.1 Analysis of experimental data

The trial aims to explore the application of wireless communication and Internet technology in children's public space, and to evaluate the impact of technology integration on children's activities, safety, learning and other aspects through data collection and analysis.

Table 1: Impact of communication technology integration

Data category	Metric	Average value	Standard deviation
Enviromental parameter	temperature	25°C	2°C
Enviromental parameter	humidity	50%	10%
Behavioral data	degree of latitude	10m ²	5m ²
Behavioral data	exercise intensity	300J/min	100J/min
Access to data	Access frequency	Three times a day	One time
Access to data	residence time	30 Minutes	10 Minutes

Table 1 shows the influence of communication technology integrating child-friendly space. Figure 4 shows the comparative analysis of traditional space and non-traditional space. Through data analysis, the following conclusions are drawn: children's activity range and exercise intensity in public space fluctuate to a certain extent, but the whole remains at a stable level [29]. Environmental parameters have a certain impact on children's activities, and the appropriate temperature and humidity are conducive to children's outdoor activities. The frequency and duration of children visiting the public space suggest that space design and facility attractiveness have a significant impact on children's use behavior.

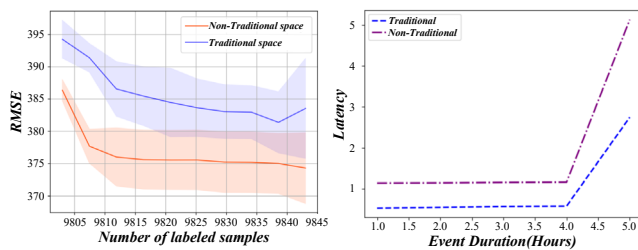


Figure 4. Comparative analysis of traditional space and non-traditional space

Table 2: Influence of child-friendly space satisfaction in communication technology integration

Age group	Network coverage	Network speed	Safety	Interactive experience	Educational resources
<12	4	3	5	4	3
> 18	5	4	4	3	4
<12	3	2	3	3	2
> 18	4	3	4	4	3
> 18	5	5	5	4	5
<12	3	2	2	3	3

Table 2 shows the impact of the satisfaction of child-friendly space by integrating communication technology. Overall, participants' satisfaction with wireless communication Internet services is moderate, with more room for improvement in terms of network speed and educational resources. The ences in gender and roles suggest that different groups of participants have different concerns and needs. In order to improve satisfaction, it is suggested to increase more interactive content and educational resources for children, while strengthening the function of network security and parental control.

Table 3: Safety impact of child-friendly space

Age group	Specific model	Average usage time per day (hours)	Maximum electromagnetic radiation level ($\mu W / cm^2$)	Network security awareness score (10)
3-6	Tablet Pro	1.5	0.5	3
7-10	Mini Pad	2.5	0.9	6
11-14	SmartPhone X	3.5	1.5	7
11-14	Phone Lite	3.0	1.3	8

Table 3 shows the safety impact of child-friendly space. It can be found that time of use: with age and independence, children spend more time using wireless communication devices. This may mean that their exposure to electromagnetic radiation is also increasing. Electromagnetic radiation levels: Although radiation levels on all devices are within the safe range, radiation levels vary with the type of device, with smartphones having the highest radiation levels. Figure 5 shows the analysis of the impact of child-friendly spatial security of communication technology integration. Children's network security awareness is obvious with the growth of age, but the overall level is still low, so relevant education needs to be strengthened.

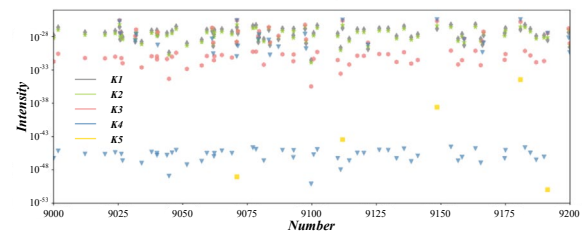


Figure 5. Safety impact analysis of child-friendly space with communication technology integration

Table 4: Educational influence of child-friendly space

Date	Type of activity	Number of children involved	Average usage time (minutes)	Satisfaction Score (1-10)
2023-06-01	online learning	15	30	8
2023-06-08	game	20	45	9
2023-06-15	Social interaction	10	20	7
2023-06-22	Video watch	18	35	8

2023-06-29	Music appreciation	12	25	7
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Table 4 shows the analysis of the educational impact of communication technology integration in child-friendly space. Engagement analysis: In terms of the number of children involved, the participation in game activities was the highest, reaching 20, while the lowest participation in social interaction was only 10. Use length analysis: The average use length of game activity was 45 minutes, while the average use length of social interaction was the shortest, 20 minutes. Figure 6 shows the satisfaction analysis of children using wireless Internet in a public space. Games had the highest satisfaction score of 9, while music appreciation was the lowest satisfaction score of 7. When children use wireless Internet in public Spaces, games are the most popular among children, with high participation and satisfaction. Different types of activities have different attractions for children. Although educational online learning activities are less engaged than games, their satisfaction is still at a high level. Low engagement and satisfaction with social interactions may require further exploration to improve the attractiveness of such activities.

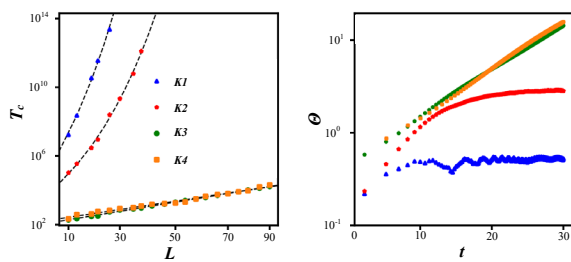


Figure 6. Satisfaction analysis of children using wireless Internet in a public space

Table 5: Communication technology integration of child-friendly spatial sustainability impact

Public space	Wireless communication coverage	Frequency of children's activities	The number of social interactions	Number of security incidents
park A	not have	10 Times / day	Five times per day	0 Times
park B	have	15 Times / day	8 Times / day	One time
library C	not have	8 Times / day	4 times / day	0 Times
library D	have	12 Times / day	Six times per day	0 Times
school E	not have	12 Times / day	Six times per day	One time

school F	have	18 Times / day	10 Times / day	Two times
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Table 5 shows the impact analysis of child-friendly spatial sustainability of communication technology integration. Activity frequency: in the public space covered by wireless communication, the activity frequency of children is generally higher than that of the space without wireless communication coverage. Social interaction: Similarly, children interact more socially in public Spaces covered by wireless communication. Security incidents: Although children were more active in public spaces with wireless communication coverage, the number of security incidents did not increase significantly, or even decreased in some cases (e. g., library D). Preliminary data suggest that the introduction of a wireless communication Internet may have boosted children's activities and social interactions in public Spaces, without significantly increasing security risks. However, this conclusion still needs further research and data to support it, especially for the specific analysis of safety events and the assessment of the long-term impact.

3.2 Comparison of this scheme with other programs

Table 6 shows the comparison between the integration of wireless communication Internet and children's public space and the traditional public space. The integration of wireless communication Internet and children's public space shows obvious advantages in technology application, interaction, educational resources, security, accessibility, personalized service, environmental adaptability and sustainable development. Figure 7 shows the comparison of this scheme with other schemes. The integration of this scheme helps to create a safer, more interesting, educational and environmentally friendly space for children's activities, and can also meet the diversified needs of modern children.

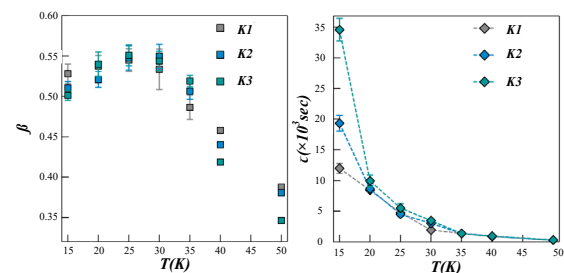


Figure 7. Comparison of the effects between this scheme and other programs

Table 6: Comparison of wireless communication Internet and children's public space

<i>Contrast dimensions</i>	Wireless communication Internet and children's public space integration	Traditional children's public space
<i>Technology application</i>	Integrated wireless network technology to provide Wi-Fi coverage	Mainly relies on physical facilities and human services
<i>Interactivity</i>	Through APP, intelligent system to provide interactive experience	Interaction is limited
<i>Educational resources</i>	Provide online education resources	Reliance on traditional teaching materials
<i>Safety</i>	Improve the child safety level through network monitoring and data analysis	Depend on adult monitoring and physical protection
<i>Accessibility</i>	Expand the range of children's activities	Restricted by the geographical location
<i>personalized service</i>	Personalized recommendations and services based on children's behavior and preferences	Service is relatively standardized, and it is difficult to meet the individual differences

3.3 Scheme implementation case

3.3.1 Zhaoqing city children's park wireless network construction

Zhaoqing Children's Park is a large-scale comprehensive children's park project. In order to meet the needs of various activities in the park, the park has decided to provide full Wi-Fi coverage for indoor amusement parks, libraries, multi-functional rooms and other indoor places. The project adopts high-performance audit gateway, gigabit three-layer core switch, Gigabit access layer PoE switch, audit AP and other equipment to achieve 5 G Wi-Fi coverage, supports high-density Wi-Fi access, and supports WX small program certification, to meet the requirements of free Wi-Fi Internet audit in public places. In addition, all the equipment is uniformly managed by the Nebula Platform, which improves the operation and maintenance efficiency of the staff.

3.3.2 Beijing Zhuzhuang Kindergarten IP network broadcasting system

Beijing Zhuzhuang Kindergarten adopts the IP network broadcasting system, which includes three parts: teaching radio, daily public radio and kindergarten radio station, realizing the full digitalization and IP network. The system supports regular playback of music bells for class and class, computer operation and control of the kindergarten broadcasting system, to realize the unattended automatic

broadcasting function. Public area broadcast zoning management, allows for the independent control of different areas, to meet the needs of different activities. The system also has the functions of regular playing of music ringing bell, one-click opening of temporary broadcasting, and automatic strong cutting of emergency broadcasting, which improves the safety management level of the kindergarten.

3.3.3 5G + intelligent preschool education project of Jiangsu Mobile Xuzhou Branch

Jiangsu Mobile Xuzhou Branch built the Ziyutai Kindergarten Intelligent Preschool Education project for Xuzhou Yunsheng Pro Education Technology Development Co., LTD. Through precision design, optimization and integration of intelligent AI video surveillance system and IP network broadcasting system, to create a comfortable and intelligent campus environment for children. The intelligent AI video surveillance system covers the kindergarten in all aspects, and the built-in algorithm can analyze and track the targets in the scene, which improves the security prevention ability of the park. The IP network broadcasting system ensures the stability and practicability of the digital IP broadcasting system, and can automatically play the bells and background music without manual duty.

These cases demonstrate a variety of ways the wireless Internet integrates with children's public Spaces, including providing stable network coverage, enabling security monitoring, and improving educational and entertainment experiences. Through the application of these technologies, children's public space can better serve children's growth and learning needs.

Conclusion and future works

The development of wireless communication technology has greatly promoted the popularization and application of the Internet in children's public space. Through smartphones, tablets and special devices, children can access the Internet in public places such as parks, libraries and schools, access educational resources, participate in interactive learning, and even conduct distance education. The application of this technology not only enriches children's learning experience, but also promotes their social skills and creativity. However, this also presents challenges in cybersecurity and privacy protection, requiring the joint efforts of parents, educators, and policymakers to keep children safe when using the Internet.

In the future, with the promotion of 5G and other new-generation network technologies, the application of wireless communication Internet in children's public spaces will be more extensive and in-depth. More intelligent toys and educational robots will likely be introduced into children's lives, providing them with personalized and interactive learning experiences. At the same time, AI and extensive data analysis will play an essential role in children's education and

growth monitoring, helping parents and educators better understand and support children's development needs. In short, the wireless communication Internet will continue to be essential in shaping children's public space. However, its development must also be accompanied by continuous attention to and protection of children's rights, interests, and safety.

Declaration

Data Availability

The data supporting this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding this study.

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Author Contribution

Gaoyang Liu contributed to the conceptualization, writing, and final approval of the manuscript.

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