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Innovative Service Mode of Smart Library in 5G Era

Jinbai Zhang

JiLin Engineering Normal University, Changchun, China
zhangjinbai@126.com

ABSTRACT. *The user's demand for the library's intelligent service accelerates the innovation and change of the library's service mode, and the intelligent library with both intelligence and personalization is more and more favored by users. This paper establishes an intelligent library service mode based on 5G network, which integrates a variety of advanced network algorithms into the library service mode, and realizes the Intelligent Library in the environment of 5G rapid information transmission. In this paper, through collaborative application of sensor technology, face recognition, Internet of things, 5G And other technologies, such as building, personnel, paper books, facilities and equipment and other elements of a comprehensive perception of real-time monitoring data collection, combined with the inspection robot to monitor and inspect each functional area, collect data and synchronously transmit them to the data storage and processing library, use collaborative computing technology to integrate, analyze and mine massive and multi-source data, and then act on the management and operation of physical entities. The results show that the smart library carries the professional knowledge of Library and information, scientific research knowledge, management knowledge, foreign language knowledge and computer knowledge. The load coefficient of the first three is above 0.8, and that of the last two is above 0.7, which reflects the importance of various knowledge in the era of Smart Library.*

KEYWORDS: *5G Network Technology, Smart Library, Innovative Service Mode, Deep Learning Technology*

1. Introduction

By building maker space, the library can stimulate students' creative interest and cultivate their creative ability, and make use of 5G Smart Library Technology to highly simulate the real scene or related entities, which can provide immersive visualization scene for makers, and provide repeated trial and error opportunities for users to explore and try. It can not only help makers through dynamic simulation model in the early stage of creative product design Based on different parameters to inspect the performance of the product, to verify, optimize, change, and optimize the design, in the product production stage, highly restore the product development space, can be based on the parameters and indicators of real-time monitoring of its

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state, the internal invisible parts accurate virtual construction, help users control every detail.

Mcciellanddc pointed out that smart library is a new type of library that can sense the needs of users at any time, is not limited by time and space, and provides resources for users at any time. However, at that time, "Smart Library" was not given a clear connotation [1]. Watson JD, a scholar who first proposed the concept of Smart Library, believes that smart library changes the way users access resources by virtue of modern information means such as Internet of things and cloud computing [2]. 5G smart library technology is applied to maker space, with the help of highly simulated virtual scene / virtual entity, which can optimize user cognition and cultivate user's innovation and creativity [3, 4]. In order to realize the whole process of data collection, behavior matching and user portrait matching, etc., the technology has been widely used. In addition, the application of new technology drives the library to innovate the reading service mode and pay attention to the user's reading experience. With the support of 5G Smart Library, virtual reality, simulation, artificial intelligence and other technologies, great progress will be made in the fields of reading behavior analysis and virtual reading resource development, such as providing users with VR / AR Books enable users to switch freely between real paper books and virtual reality books [5, 6]. Reading books in reality can also enter the virtual scene, experience the scenes described in the book, enhance users' immersive and interactive reading experience, and enhance users' interest in using the library [7, 8]. In addition, the intelligent computing ability of 5G Smart Library can mine user behavior data, resource data, circulation data, etc., and explore the hidden valuable information [9, 10].

In this paper, based on real-time data, the actual operation state of the smart library space is simulated and analyzed, and the results are applied to the physical library space for regulation and optimization, so as to realize the optimal control of service process and equipment operation. The Smart Library and the physical library operate in the same step and interact in real time, and complete the common iteration and optimization in the continuous interaction. In the early stage of library construction, space planning and other projects, the twin model is constantly used for simulation to achieve the correction, improvement and optimization of the scheme and plan.

2. Innovative Service Mode of Smart Library

2.1 Necessity of Smart Library Construction

With the increasing internal and external pressure on the living environment of the library and the popularity of the theory of Library demise, it is an effective channel to alleviate the pressure of Library survival and achieve innovative development to promote the upgrading and development of the library with the help of new technologies and provide users with deep-seated intelligent services [11]. The digital twin technology provides support for the fine management of virtual and

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real synchronous library, the user oriented full sensory immersion interactive experience, and the in-depth insight and monitoring of the whole elements of the library, so as to promote the development of the Smart Library to the advanced wisdom stage. In addition, we should build a digital twin for the total elements of the library, build a smart library, join in the construction of the digital twin city, integrate into the rapid development of the smart city, activate the library to provide services for the society, and play the role of Library Knowledge Resource Center and think tank [12].

The need of Smart Library Construction in the construction of Smart Library, there are still many problems, for example, in the application system, the integration effect between the application systems is poor, there are certain barriers, the information interconnection between the systems is insufficient, there is information island phenomenon. In the management, the library business is modularized, the online and offline business is fragmented, and the use and operation status of library space / equipment cannot be monitored comprehensively and in real time [13]. In terms of data storage and processing, massive resources, users, sensors and so on continue to generate a large amount of data, which has higher requirements for storage capacity and storage security. The collaborative use of edge computing and cloud computing alleviates the pressure of storage and computing. Digital twin technology has great influence on the overall coordination of library elements, the whole process management of business, the integrated management of all media resources, and the real-time response of user needs some advantages [14]. It is difficult for library users to find their own implicit needs independently. Libraries need to use various technologies to meet the explicit needs of users with high efficiency and quality, mine the implicit needs, predict the future needs of users, find the changing trend of user needs, provide predictive services for them, timely and appropriately push the relevant knowledge products and intelligent services, and improve user satisfaction. In addition, users' pursuit of seamless switching between virtual and real space and full sensory immersion interactive experience, the demand for high-quality digital reading products with rich content, and the demand for new reading methods such as visual reading and virtual and real reading all drive libraries to actively adopt digital twin technology innovation services to provide users with high-quality reading experience.

2.2 5G Smart Library Service Model

There is no unified understanding of the definition of 5G Smart Library, mostly from the model dimension, data dimension, connection dimension, service application dimension and physical dimension. 5G Smart Library is a three-dimensional model. 5G Smart Library is based on model data dual drive to realize dynamic real-time mapping of the physical world. Through the digital modeling of physical entities and the analysis, mining, integration and fusion of real-time data and historical storage data of the whole life cycle, whole process, all elements and whole business

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$$\ln(\frac{PI_{it}}{PI_{it}-1}) = \alpha + \beta \ln PI_{it} - 1 + v_i + \Im_t \tag{1}$$

$$N = \frac{k}{1+e^{a-rt}} \tag{2}$$

The realization of digital expression, description and modeling in simulation, operation monitoring, resources, space, equipment, personnel, activities, etc. is a technological innovation for the construction of Smart Library. 5G Smart Library integrates the whole elements, whole business process and whole life cycle data of physical library and library twin model, and uses relevant information technology under data drive to build smart library digital mapping of library is completed in information space:

$$\ln(\frac{k-n}{N}) = a - rt \tag{3}$$

Visualization reflects the whole life cycle process of the corresponding entity, and realizes the closed-loop optimization of the business process. The construction of twin library platform can maximize the application of Library big data and inject new vitality into the construction and service of Smart Library. 5G Smart Library has the characteristics of accurate mapping, full factor life cycle monitoring, virtual real interaction, iterative optimization and so on:

$$y = d + \frac{e-d}{1+(\frac{x}{c})^b} \tag{4}$$

5G Smart Library, full realism, through 3R Digital expression and modeling of all elements in the physical space of the library are carried out by the technology of identification, simulation and so on. The physical space of the library is truly restored in the virtual space. The real-time operation data of the library is obtained through the identification technology and sensor technology, and the physical space of the library is truly recorded in the whole process, all elements and the whole life cycle of the virtual space. Through the comprehensive digital modeling of library elements, the accurate information expression and parallel mapping of all elements of Library entity space are completed, and the real-time perception and visual monitoring of library operation state are realized. Secondly, the characteristics of virtual real interaction and iterative optimization are mainly reflected in: accurate mapping of physical space and virtual space of library:

$$P = \sigma t = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(FI_{it} - FI_{it})^2}}{FI_{it}} \tag{5}$$

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3. Experimental Design

3.1 Content

This paper establishes an intelligent library service mode based on 5G network, which integrates a variety of advanced network algorithms into the library service mode, and realizes the Intelligent Library in the environment of 5G rapid information transmission.

3.2 Methods of Smart Library

In this paper, through collaborative application of sensor technology, face recognition, Internet of things, 5G And other technologies, such as building, personnel, paper books, facilities and equipment and other elements of a comprehensive perception of real-time monitoring data collection, combined with the inspection robot to monitor and inspect each functional area, collect data and synchronously transmit them to the data storage and processing library, use collaborative computing technology to integrate, analyze and mine massive and multi-source data, and then act on the management and operation of physical entities. Through the comprehensive perception and overall control of the operation status of the library, it is convenient for all departments of the library to share and interconnect information, form an integrated prevention and control early warning system, support the monitoring of crowd density in different areas, reflect the crowd density with different colors, real-time pre alarm beyond the threshold, and remind the management personnel to send more librarians; It supports comprehensive and intuitive perception of library operation status, accurate identification and real-time feedback of potential risk problems, which is convenient for librarians to solve problems quickly and accurately.

With the help of 5G Smart Library, Internet of things and GIS In the construction process, based on the relevant engineering historical data, real-time process data, geological data, scheme design data and other modeling, through video monitoring, data acquisition terminal, sensor equipment and other ways to collect data according to the real-time visual simulation and control of the project implementation, we can compare the actual progress with the planned progress, query the differences between the virtual entities in each period and the construction information, optimize and promote the construction scheme, and also support the monitoring of the construction process to avoid risks. In addition, when carrying out the space planning and layout design of the library, the virtual simulation of the venue can be realized with the help of 5G Smart Library Technology. By simply changing the height of the floor, the setting of the functional area, the spacing of the bookshelves, and the light conditions, a variety of design schemes can be viewed in real time from any angle, so as to select the most suitable space layout scheme.

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4. Innovative Service Mode of Smart Library

As shown in Figure 1, the construction of a library based on 5G smart library technology will produce a large amount of data, which is transmitted to the Cloud Computing Center for analysis. The response speed is limited, and both management and service require real-time response. The emergence of edge computing relieves the computing pressure of the cloud computing center, and the sensing terminal collects data and transmits it to the edge layer the device nodes with storage and computing capabilities can process and analyze the data in real time near the data source, and then only transmit the valuable data resources to the cloud computing center. The cloud computing center is responsible for accepting the big data analysis and mining of edge layer reported data, business data, stored historical data, etc., and running to play the role of algorithms, rules, and models. This kind of collaborative edge computing and cloud computing can be realized the way of computing resources has a strong application potential in the library, which can realize the rapid processing of data, rapid response to user requests, and truly achieve "zero delay" response.

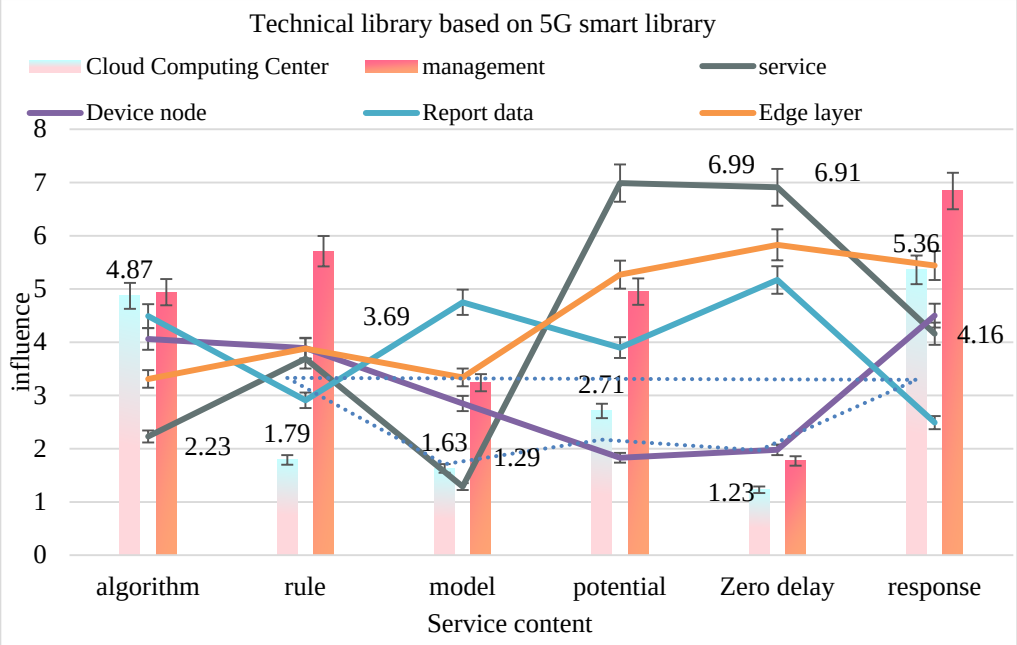

Figure 1.*Technical library based on 5G smart library*

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Table 1. *Quickly process library operation data*

Item	Cloud Computing Center	Management	Service	Device node	Report data	Edge Layer
Algorithm	4.87	4.94	2.23	4.06	4.49	3.31
Rule	1.79	5.71	3.69	3.89	2.91	3.88
Model	1.63	3.24	1.29	2.85	4.75	3.34
Potential	2.71	4.95	6.99	1.83	3.9	5.27
Zero delay	1.23	1.77	6.91	1.98	5.17	5.83
Response	5.36	6.84	4.16	4.5	2.49	5.44

As shown in Table 1, collaborative computing can process the operation data of the library as quickly as possible, which is of great value to assist in real-time accurate decision-making. Edge computing nodes combined with artificial intelligence algorithm can be used in the library, the pre-processing of environmental data transmitted by RFID, sensors and monitoring equipment can carry out environmental monitoring, real-time monitoring and early warning, and accurately identify and predict potential risks and faults. Smart library carries professional knowledge of Library and information, scientific research knowledge, management knowledge, foreign language knowledge and computer knowledge. The load coefficient of the first three is above 0.8, and that of the last two is above 0.7, which reflects the importance of various knowledge in the era of Smart Library.

Table 2. *Deep learning technology applied to 5G smart library library*

Item	Algorithm	Rule	Model	Potential	Zero delay	Response
height	2.62	5.8	4.02	4.52	5.85	5.14
Material	5.78	4.31	2.08	1.66	2.42	2.53
colour	4.62	2.65	4.76	2.55	2.69	4.65
Bookshelf spacing	5.17	4.9	5.79	4.04	5.19	1.2
Light conditions	5.83	1.79	2.11	2.03	3.71	4.65
Edge Layer	5.58	2.84	5.86	2.53	6.99	5.24

As shown in Table 2, the application of deep learning technology in 5G Smart Library can play a role in massive data processing, system operation optimization, demand pre perception and other aspects. It can process massive unstructured data structurally. The ability of deep learning self optimization can improve the operation efficiency of the algorithm, promote the system self optimization and adapt to the changing field, which supports the continuous iterative optimization, automatic upgrading and self-improvement between the virtual 5G Smart Library and the physical library, so as to quickly respond to the changing environment and build an efficient and intelligent operation mode of the library.

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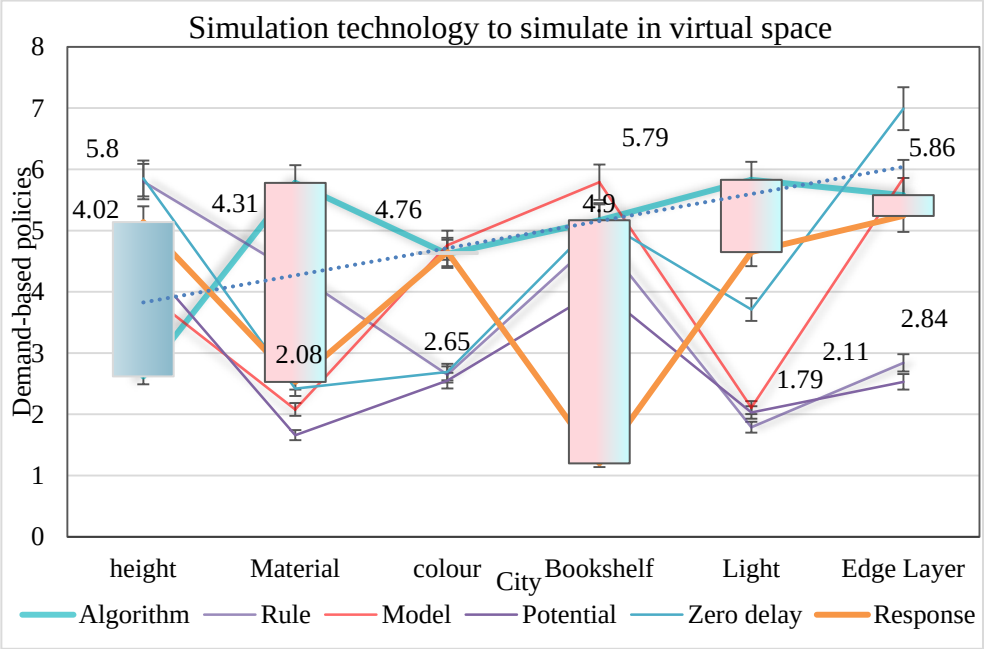

Figure 2. *Simulation technology to simulate in virtual space*

As shown in Figure 2, using simulation technology to simulate in the virtual space and execute in the physical space helps to reduce the actual operation errors and drive the library to run in a more efficient and intelligent way. The simulation of various physical entities, activities and events, including the virtual simulation of architectural design, changes the building height, material, color, bookshelf spacing, lighting and so on, which is helpful to the layout planning of the library more quickly and effectively; the simulation of crowd activities, which provides a reference for the activity planning; the simulation of library activities, which provides a reference for the activity planning; The simulation of emergency and emergency plan can assist scientific decision-making and help the library allocate resources reasonably and scientifically.

5. Conclusions

Under the joint action of multiple technologies such as artificial intelligence and 5G, smart library can not only create a virtual experience library space that supports the integration of virtual and real, ubiquitous intelligence, multi-dimensional perception and multi-sensory holographic interaction, but also enable maker space, innovate reading services, support teaching and scientific research, provide health services, build a new library scene, and shorten the gap between readers and

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resources the distance between source, equipment and space provides multiple services for users. In addition, with the help of sensor technology and network transmission, all intelligent devices and books can be monitored and managed in real time, providing services such as intelligent venue management, intelligent security management, visual control of projects under construction, emergency management, digitization of cultural heritage, and helping intelligent city construction. To realize the requirements of intelligent management, intelligent management of library elements is one of the bases for the library to provide intelligent services for users. With the help of technological innovation, it is the only way to realize intelligent management and improve the efficiency of library management.

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