

# Contactless Services

## A Survey of the Practices of Large Public Libraries in China

Yajun Guo, Zinan Yang, Yiming Yuan, Huifang Ma, and Yan Quan Liu

### ABSTRACT

*Contactless services have become a common way for public libraries to provide services. As a result, the strategy used by public libraries in China will effectively stop the spread of epidemics caused by human touch and will serve as a model for other libraries throughout the world. The primary goal of this study is to gain a deeper understanding of the contactless service measures provided by large Chinese public libraries for users in the pandemic era, as well as the challenges and countermeasures for providing such services. The data for this study was obtained using a combination of website investigation, content analysis, and telephone interviews for an analytical survey study of 128 large public libraries in China. The study finds that touch-free information dissemination, remote resources use, no-touch interaction self-services, network services, online reference, and smart services without personal interactions are among the contactless services available in Chinese public libraries. Exploring the current state of contactless services in large public libraries in China will help to fill a need for empirical attention to contactless services in libraries and the public sector. Up-to-date information to assist libraries all over the world in improving their contactless services implementation and practices is provided.*

### INTRODUCTION

The spread of COVID-19 began in 2020, and people all over the world are still fighting the severity of its spread, the breadth of its impact, and the extent of its endurance.

The virus's continued spread has had a wide-ranging impact on industry sectors worldwide, including libraries. The growth of public libraries has also seen significant changes as a result of COVID-19, resulting in added patron services, including contactless services. Contactless services are those that patrons can use without having to interact face to face with librarians. These services transcend time and geographical constraints, as well as lower the danger of disease transmission through human interaction.

Since the COVID-19 pandemic, contactless or touch-free interaction services are emerging in Chinese public libraries. This service model can also serve as a reference for other libraries. This study evaluates and analyzes contactless service patterns in large public libraries in China, and then suggests a contactless service framework for public libraries, which is currently in the process of being implemented.

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## LITERATURE REVIEW

The available literature shows that the term “non-contact” appeared as early as 1916 in the article “Identification of the Meningococcus in the Naso-pharynx with Special Reference to Serological Reactions” and described a patient’s infection in the context of medical research.<sup>1</sup> In recent years, with the widespread application of “Internet +” and the development and promotion of technologies such as the Internet of Things, cloud computing, and artificial intelligence, the contactless economy has grown by leaps and bounds, and so has the research on library contactless services.<sup>2</sup> Library contactless services encompass a wide range of services such as self-services, online reference, and smart services without personal interactions.

Library self-service has become a major service model for contact-free services. The self-service model was first adopted in American public libraries in the 1970s with the emergence of self-service borrowing and returning practices.<sup>3</sup> Many public libraries have since adopted stand-alone, fully automated self-service halls, self-service counters, etc.<sup>4</sup> By the 1990s, a range of commercial self-service kiosks and self-service products had been introduced.<sup>5</sup> Currently, the most mature self-service type used by the library community is the circulation self-service product.<sup>6</sup> In addition to self-service borrowing and returning of titles, libraries have launched self-service printing systems, self-service computer systems, and self-service booking of study spaces.<sup>7</sup> As an example, patrons can complete printing operations using a self-service system and can offer payment by bank card, Alipay, WeChat, and other means.<sup>8</sup> A face recognition system can also be used to borrow and return books, a solution for patrons who forget their library cards.<sup>9</sup> These library self-service system elements are confined to simple, repetitive, and routine tasks such as conducting book inventories, book handling, circulating books, and the like, whose development stems from the widespread application of electronic magnetic stripe technology and radio frequency identification (RFID), optical character recognition (OCR) technology, and face recognition.<sup>10</sup> New applications of technology continue to advance the development of contactless services in libraries. The overall work and service processes of the library have been made intelligent to varying degrees.

Online reference is an important service in the contactless service program. Researchers have started to study the current state of library reference services. Interactive online reference services support patrons using the library, including how to search for literature, locate and renew books, schedule a study or seminar room, and participate in other library activities, such as seminars, lectures, etc.<sup>11</sup> In response to the problem of how patrons access various library service abilities, digital reference systems need to have functions such as automated semantic processing, automated scene awareness, through automatic calculation and adaptive matching, understanding of patrons’ interests preferences and needs, and the ability to recommend the most suitable information resources for them.<sup>12</sup> At present, most library reference services in China mainly include the use of telephone, email, WeChat, robot librarians/interactive communication, microblogs, and QQ, an instant messaging software popular in China. During the past two years, most public libraries in China have essentially implemented the use of the aforementioned reference tools to communicate and interact with patrons, with WeChat having a 55.6% adoption rate when compared to other instant reference tools.<sup>13</sup> The use of online chat in reference services has allowed librarians to help patrons from anywhere and at any time through embedding chat plug-ins into multiple pages of the library website and directing patrons to ask questions based on the specific page they are viewing, setting up automatic pop-up chat windows, and changing patrons’ passive waiting to active engagement.<sup>14</sup> In terms of technology, emerging technologies

such as patron profiling, natural language processing, and contextual awareness can support the development of reference advisory services in libraries.<sup>15</sup> The online reference service provides a 24/7, high-quality, efficient, and personalized service that connects libraries more closely with society and is an important window in the future smart library service system.

Smart services without personal interactions may become the most popular form of library services development for the future, and research on library smart services has gradually deepened. In terms of conceptual definition, the library community generally understands the concept of library smart services as mobile library services that are not limited by time and space and can help patrons find books and other types of materials in the library by connecting to the wireless Internet.<sup>16</sup> Apart from this, there are two other ways to define library smart services. One discusses the meaning of smart services in an abstract way, such as library smart services that should be an advanced library form dedicated to knowledge services through human-computer interaction, a comprehensive ecosystem.<sup>17</sup> The other concretizes the extension of this concept expressed with a formula “smart library = library + Internet of things + cloud computing + smart devices.”<sup>18</sup>

Applied technology research is an important part of smart services in libraries. Library smart services have three main features: digitization, networking, and clustering. Among them, digitization provides the technical basis, networking provides the information guarantee, and clustering provides the library management model of resources sharing, complementary advantages, and common development among libraries.<sup>19</sup> The key breakthrough in the development of smart services is the applications deployment of smart technologies to truly realize a new form of integration of online and offline, virtual and reality.<sup>20</sup> The integration of face recognition technology in traditional libraries, as well as its application to services like access control management, book borrowing and returning, and wallet payment, can help libraries build smart services faster.<sup>21</sup> The integration of deep learning into a mobile visual search system for library smart services can play an important role in integrating multiple sources of heterogeneous visual data and the personalized preferences of patrons.<sup>22</sup> Blockchain technology, born out of the impact of the new wave of information technology, has also been applied to the construction of smart library information systems because of its decentralized and secure features.<sup>23</sup> Library smart services can leverage new technologies and smart devices to enhance the efficiency of library contact-free services and provide new opportunities for knowledge innovation, knowledge sharing, and universal participation, thereby enabling innovation in service models.

Additional research on the development of contactless services in service areas such as library self-services, online reference, and smart services is discussed. In particular, the research and construction of smart library services have been enriched with the advent of big data and artificial intelligence. However, non-contact service has not been systematically researched and elaborated in domestic and international librarianship. The emergence and prevalence of COVID-19 has enabled libraries in many countries to practice various types of touch-free services, such as the introduction of postal delivery, storage deposit, and click-and-collect in Australian libraries; curbside pickup service or build a book bag service in US public libraries; and delivery book to the building services in Chinese university libraries.<sup>24</sup> Therefore, a systematic investigation and study of contactless services in public libraries in the pandemic is of great importance for the adaptation and innovation of library services.

## METHODS

### *Survey samples*

The survey selected some of the most typical public libraries for the study. The selection criteria were those large public libraries in the more economically and culturally developed regions of China. A total of 128 large public libraries were identified, including national libraries, 32 provincial public libraries, and municipal public libraries in the top 100 cities by GDP ranking in 2020, of which five public libraries, including the Capital Library and Nanjing Library, are both top 100 city libraries and provincial libraries. These 128 large public libraries can more obviously reflect the current service level of the better developed public libraries in China, and represent the highest level of public library construction in China. (See table 1 for a list of the libraries studied.)

**Table 1.** A list of the 128 public libraries that were studied

No.	Library	No.	Library
1.	National Library of China	2.	Hebei Library
3.	Shanxi Library	4.	Liaoning Provincial Library
5.	Jilin Province Library	6.	Heilongjiang Provincial Library
7.	Zhejiang Library	8.	Anhui Provincial Library
9.	Fujian Provincial Library	10.	Jiangxi Provincial Library
11.	Shandong Library	12.	Henan Provincial Library
13.	Hubei Provincial Library	14.	Hunan Library
15.	Guangzhou Library	16.	Hainan Library
17.	Sichuan Library	18.	Guizhou Library
19.	Yunnan Provincial Library	20.	Shanxi Library
21.	Gansu Provincial Library	22.	Qinghai Library
23.	Guangxi Library	24.	Inner Mongolia Library
25.	Tibet Library	26.	Ningxia Library
27.	Xinjiang Library	28.	Shanghai Library
29.	Capital Library of China	30.	Shenzhen Library
31.	Guangzhou Digital Library	32.	Chongqing Library
33.	Tianjin Library	34.	Suzhou Library
35.	Chengdu Public Library	36.	Wuhan Library
37.	Hangzhou Public Library	38.	Nanjing Library
39.	Qingdao Library	40.	Wuxi Library
41.	Changsha Library	42.	Ningbo Library
43.	Foshan Library	44.	Zhengzhou Library
45.	Nantong Library	46.	Dongguan Library
47.	Yantai Library	48.	Quanzhou Library
49.	Dalian Library	50.	Jinan Library
51.	Xi'an Public Library	52.	Hefei City Library
53.	Fuzhou Library	54.	Tangshan Library
55.	Changzhou Library	56.	Changchun Library
57.	Guilin Library	58.	Harbin Library
59.	Xuzhou Library	60.	Shijiazhuang Library
61.	Weifang Library	62.	Shenyang Library
63.	Wenzhou Library	64.	Shaoxing Library

No.	Library	No.	Library
65.	Yangzhou Library	66.	Yancheng Library
67.	Nanchang Library	68.	Zibo Library
69.	Kunming Library	70.	Taizhou Library
71.	ErDOS City Library	72.	Public Library of Jining
73.	Taizhou Library	74.	Linyi Library
75.	Luoyang Library	76.	Xiamen Library
77.	Dongying Library	78.	Nanning Library
79.	Zhenjiang Library	80.	Jiaying Library
81.	Xiangyang Library	82.	Jinhua Library
83.	Yichang Library	84.	Huizhou TSZ WAN Library
85.	Cangzhou Digital Library	86.	Zhangzhou Library
87.	Weihai Library	88.	Digital Library of Handan
89.	Guiyang Library	90.	Sun Yat-sen Library of Guangdong Province
91.	Ganzhou Library	92.	Baotou Library
93.	Huaian Library	94.	Yulin Digital Library
95.	Dezhou Network Library	96.	Yuyang Library
97.	Changde Library	98.	Baoding Library
99.	The Library of Jiujiang City	100.	Taiyuan Library
101.	Hohhot Library	102.	Wuhu Library
103.	Langfang Library	104.	National Library of Hengyang City
105.	Maoming Library	106.	Nanyang Library
107.	Heze Library	108.	Urumqi Library
109.	Zhanjiang Library	110.	Zunyi Library
111.	Shangqiu Library	112.	Jiangmen Library
113.	Liuzhou Library	114.	Zhuzhou Library
115.	Xuchang Library	116.	Chuzhou Library
117.	Lianyungang Library	118.	Suqian Library
119.	Mianyang Library	120.	Zhuhai Library
121.	Xinyang Library	122.	Zhoukou Library
123.	Zhumadian Library	124.	Huzhou Library
125.	Lanzhou Library	126.	Fuyang Library
127.	Xinxiang Library	128.	Jiaozuo Library

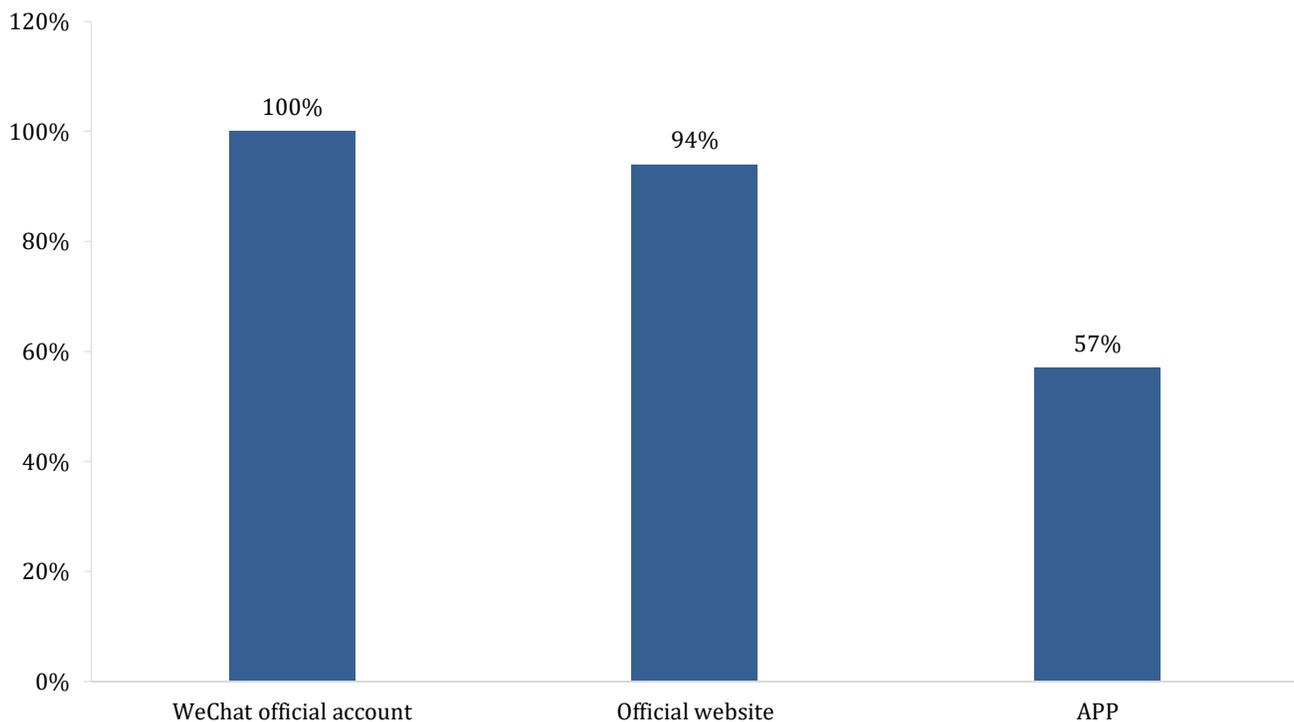
### ***Survey methods***

Web-based investigation, content analysis, and interviews with librarians were used to assess 128 public libraries in China. The survey was carried out between March 10 and September 15 in 2021. First, the authors identified the media platforms for sharing information about each public library's contactless services, including an official website, a social networking account on WeChat, or a library-developed app. The authors investigated whether these media platforms were updated with information about the contactless services and if they provided various information about these services. Next, the authors searched the various contactless services offered by this library through these media platforms and recorded them. Finally, the authors reviewed the data and findings from the survey to minimize errors and ensure the accuracy of the findings.

## FINDINGS

### *Touch-free information distribution*

The distribution of library information is generally carried out in a touch-free manner. There are three commonly used information media in libraries: official website, WeChat official account, and library-developed app. The adoption rate of each information medium by libraries is determined by investigating whether libraries have opened information media platforms and whether the opened platforms are updated with service information. The results showed that the information medium with the highest adoption rate was the WeChat official account, reaching 100%. The library's official website showed an adoption rate of 94%. Only 57% of libraries use apps to distribute contactless information (see fig. 1).



**Figure 1.** Percentage of touch-free information distribution platforms in large public libraries in China.

Patron services must provide timely and convenient access if public libraries want to effectively expand their patron base or increase library usage. WeChat is better adapted to user convenience than websites, which explains the greater utilization rate as a contactless information dissemination tool for libraries.

As a public service institution, the Chinese public library has an incomparable impact on politics, economy, and culture. Libraries have a great influence on the cultural popularization and educational development of the public. Therefore, touch-free information dissemination plays an important role in improving the efficiency of information dissemination. WeChat has been fully integrated into China's public library services as a communication tool, allowing libraries to better foster cultural growth. In the process of cultural growth, libraries need to emphasize interactive public participation and combine public culture, social topics, citizen interaction and media communication, bringing innovative value to promote urban vitality and urban humanism. The

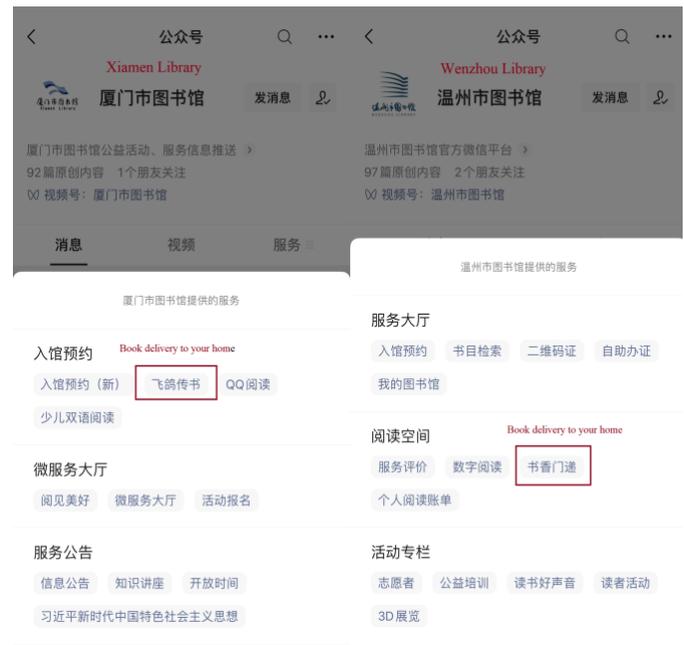
widespread use of WeChat helps users stay up to date on the newest information and access library resources services more conveniently.

### Remote resources services

Restrictions on the use of digital resources are closely related to the frequency of patrons' use. Restrictive measures that posed obstacles to patrons using digital resources were identified. Among the 128 large public libraries surveyed, 42% of libraries require reader card authentication by patrons before they can access remote resources services; 8% of libraries do not require users to have reader cards for services. Patrons can use the remote resources services available in the remaining 49% of public libraries without needing to register for a user account or patron ID on the library website. To reduce the risk of infection between librarians and patrons, some libraries adopted noncontact paper document delivery services for users in urgent need of paper books during the pandemic. For example, the Peking University Library's Book Delivery to Building Service (see fig. 2) and Xiamen Library and Wenzhou Library's Book Delivery to Home (see fig. 3) allow patrons to reserve books online, and librarians will express mail the books to patrons' homes according to their needs.



**Figure 2.** Peking University Library's book delivery service to the building.

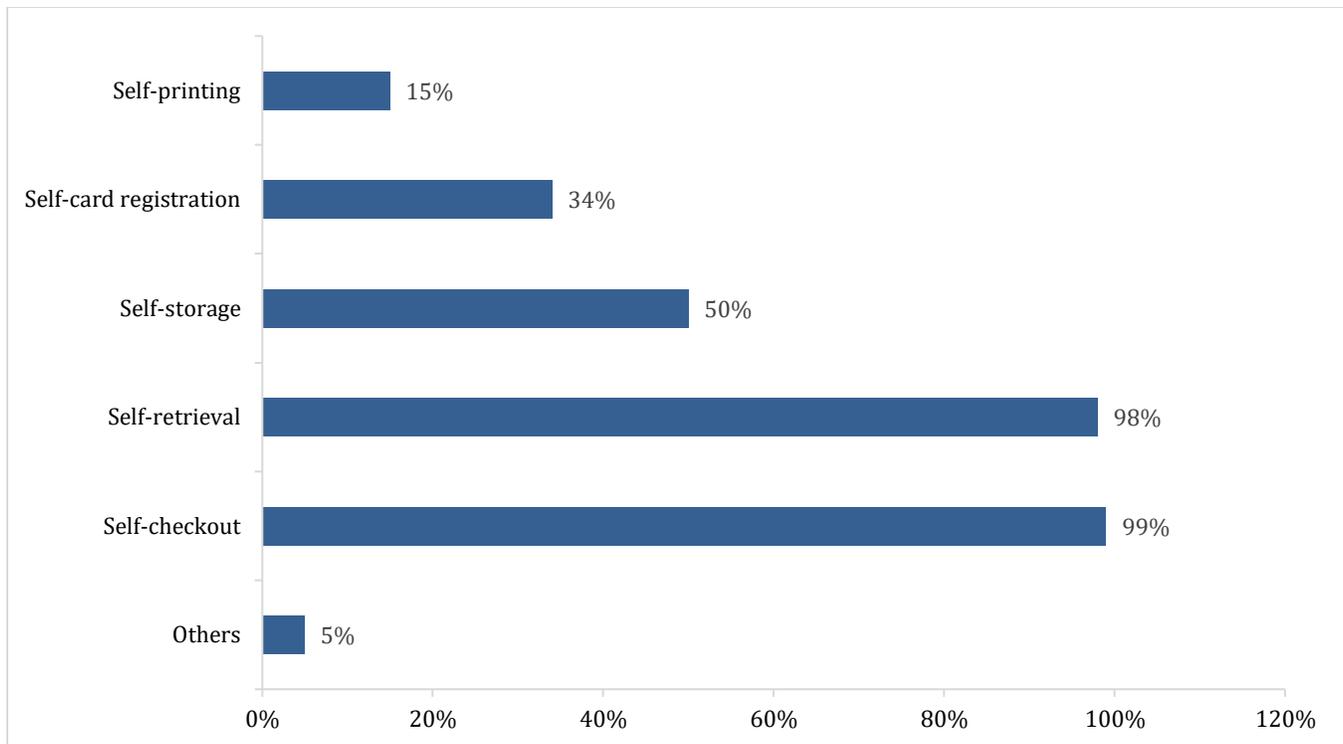


**Figure 3.** Book Delivery Service of Xiamen Library and Wenzhou Library.

Contactless services have two outstanding advantages: services can be obtained without contact with people, and convenience. However, if the use of remote resources is restricted in many ways, it will lead to a decrease in the utilization of digital resources in libraries. While intellectual property requirements and concerns must be appropriately managed, public libraries should strive to provide patrons with unlimited access to digital materials and physical print books.

### No-touch interaction self-services

No-touch interaction self-services in Chinese public libraries mainly include self-checkout, self-retrieval, self-storage, self-printing, self-card registration, and other self-service services, such as self-payment, and self-reservation of study rooms or seminar rooms (see fig. 4).



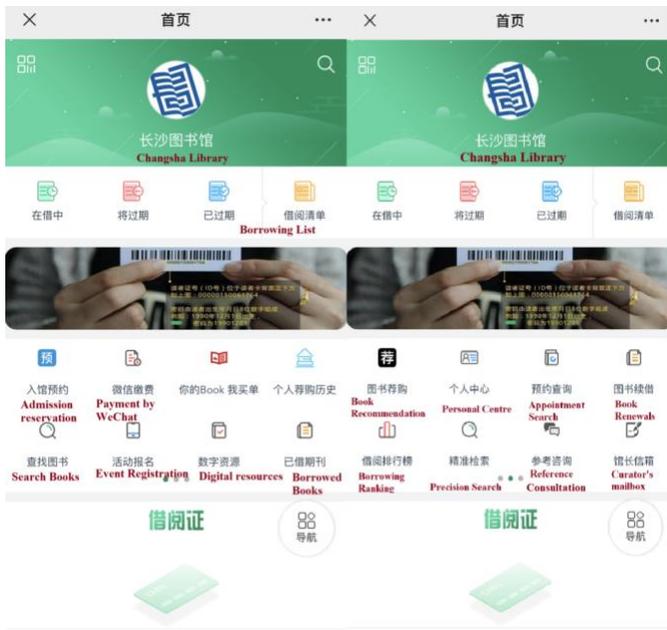
**Figure 4.** Percentage of large public libraries in China that provide contactless self-service.

The survey of large public libraries in China shows that the majority offer self-checkout and self-retrieval services. The percentage of public libraries offering self-storage, self-certification and self-printing is low, with only 50% or less usage. Self-storage, as one of the earlier self-services, has a usage rate of 50%. Only 34 percent of public libraries offered self-card registration. The self-service card registration machine has four main functions: reader card registration, payment, password modification, and renewal. For example, when patrons need to pay deposits or overdue fines, they can use the self-service card registration machine to swipe their cards and payment to facilitate subsequent borrowing of various resources. The machine supports face recognition technology for card application and online deposit recharge, catering to the needs of patrons in many aspects of operation (see fig. 5). The proportion of self-printing is even lower available at only 15% of libraries. Self-card registration and self-printing are both emerging self-service options that require strong financial and technical support and are therefore not widely available.

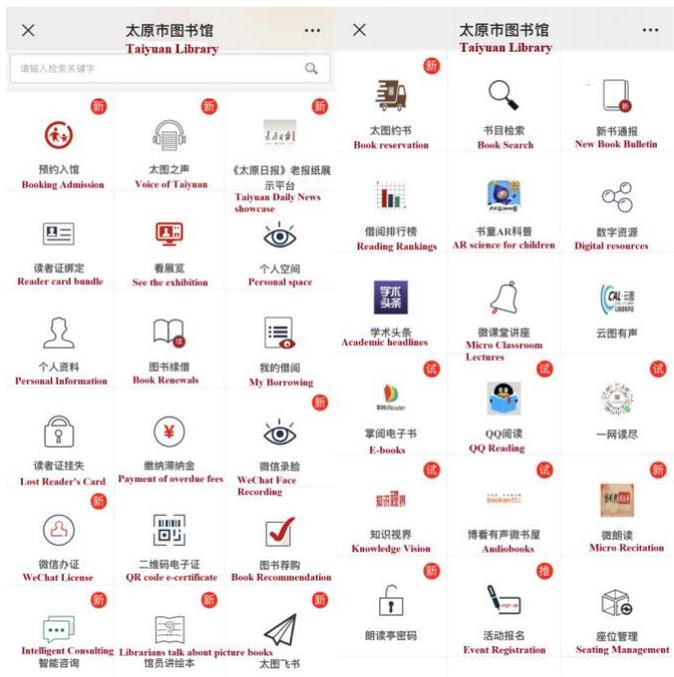


**Figure 5.** Self-service card registration machine in Chinese large public libraries.

Most public libraries in China have set up dedicated self-service libraries or microservice halls on the WeChat public account platform in addition to further promoting library contactless services and enabling users to enjoy self-service library services anytime, anywhere. For example, the Changsha Library (see fig. 6) and the Taiyuan Library (see fig. 7) have both set up a microservice hall column on their WeChat public numbers, containing services such as personal appointment, book renewal, event registration, and digital resources. The emergence of online self-service library services has greatly contributed to the development of equalization and standardization of public library services.



**Figure 6.** Changsha Library no-touch interaction self-service hall.



**Figure 7.** Taiyuan Library no-touch interaction self-Service hall.

**24-hour self-service library**

The 24-hour Self-Service Library, a contactless phenomenon in China’s public libraries, was introduced in 2006 and officially launched in 2007 by Dongguan Library and followed by Shenzhen Library’s initial batch of ten self-service libraries. The success of the Shenzhen model has sparked a boom in the construction of self-service libraries in China, with 77% of the Chinese public libraries surveyed having opened self-help libraries.

The development of self-service libraries is divided into two types of service models: space-based self-service libraries (see fig. 8), i.e., unattended libraries with a certain amount of space for use, in which patrons can freely select books and read for leisure, such as 24-hour city bookstores; and a cabinet-type self-service library (see fig. 9), similar to a bank ATM with an operating panel and similar in appearance to a bookcase, which allows real-time data interaction with the central library via the network. The eight self-service libraries in Taiyuan Library in Shanxi can provide self-service book borrowing services through the new model of Library + Internet + Credit, which allows patrons to apply for a reader’s card without a deposit and make reservations online and deliver books to the counter (see fig. 10). By cross-referencing the reader’s card with the patron’s face information, the Guangzhou Self-Service Library provides self-service borrowing and returning services for patrons through face recognition. There are many similar self-service libraries in China, which provide various types of patron services in different forms, largely reducing direct contact between patrons and librarians, and between patrons and readers. For example, when the pandemic was most severe, data collected from the Ningbo self-service library showed that 7,022 physical books were borrowed and returned from January to March 2020, 50% more than in a normal year.<sup>25</sup>



**Figure 8.** Space-based self-service libraries.



**Figure 9.** Cabinet type self-service library.



**Figure 10.** Taiyuan self-service library.

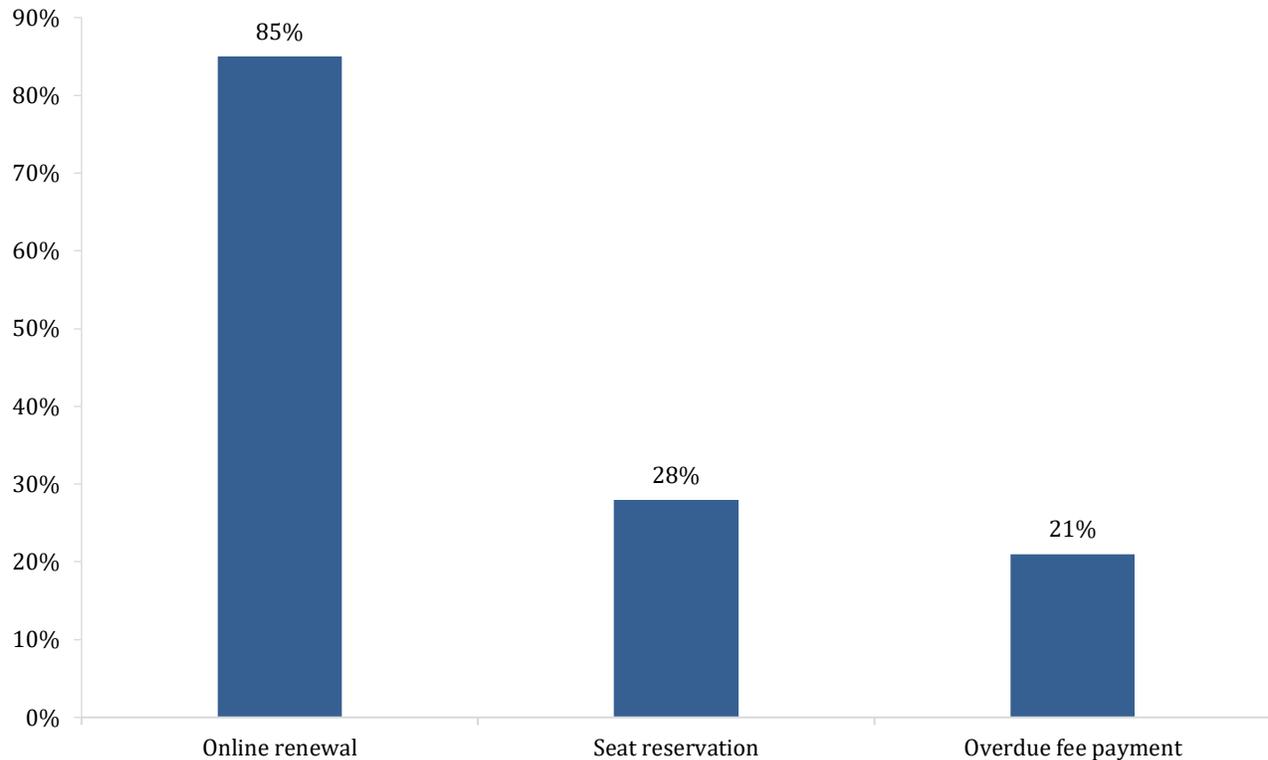
The popularity of 24-hour self-service libraries in China is first and foremost due to the strong support and financial investment of government departments in the construction of self-service libraries. Secondly, the features of self-service libraries, which are convenient, time-independent, time-saving, efficient, and diversified, are in line with modern lifestyles, integrating public library services into people's lives, increasing the visibility and penetration of public library patron services, and maximizing patrons' needs in reading.

### **Network services**

There is a wide range of network services but the most common are seat reservation, online renewal, and overdue fee payment (see fig. 11). The survey found that 89% of Chinese public libraries offer at least one of these network services, indicating a high adoption rate of network services.

In 2002, online renewals began to appear in China and then gradually became popular. Most of the public libraries in China provide this service in the personal library or WeChat official account. The rate of adoption of network service is as high as 85% in the 128 public libraries surveyed.

The prevalence of seat reservation services is not high. Only 28% of the public libraries surveyed offered seat reservation services.



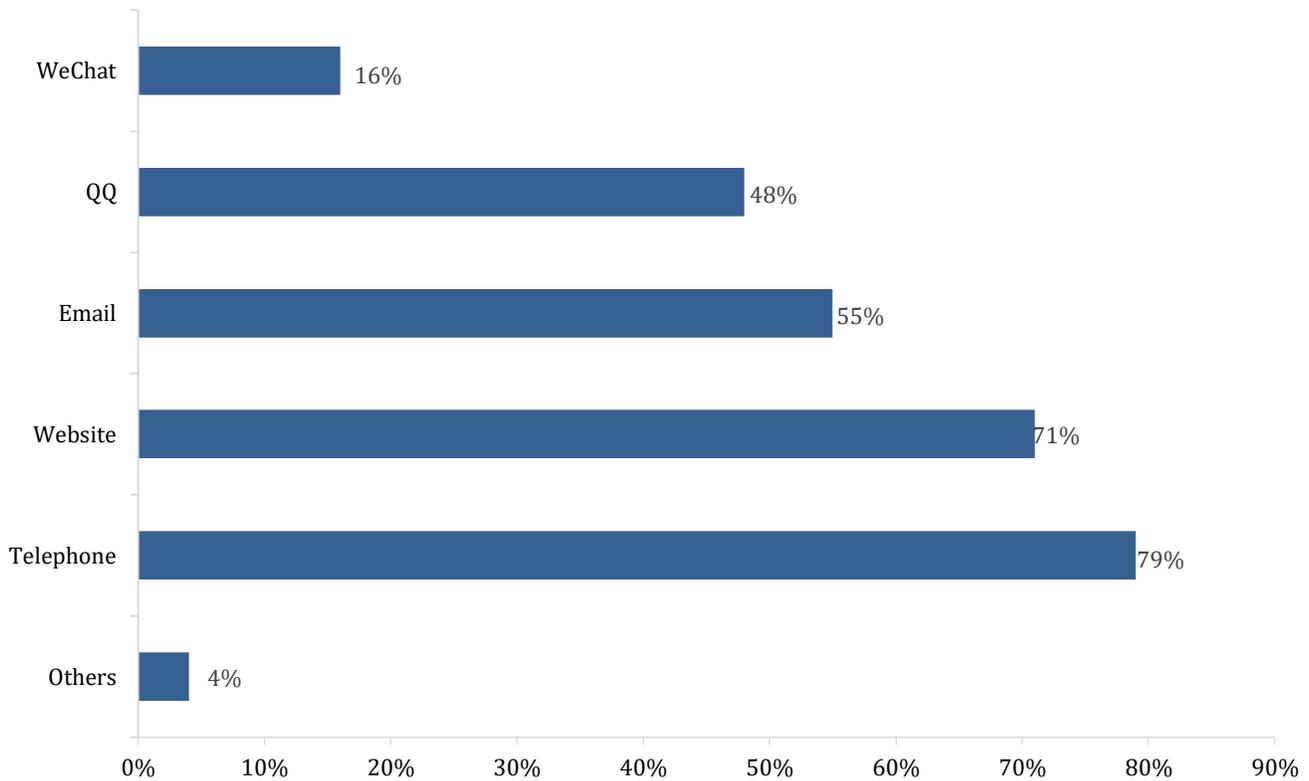
**Figure 11.** Percentage of large Chinese public libraries that provide network services.

Coverage of the online overdue fee payment service was even lower with only 21% of public libraries providing access. However, some libraries have replaced the overdue fee system with other methods, such as the Shantou Library's Lending Points System. In the system, the initial number of points on a patron's account is 100, with two points added for each book borrowed and one point deducted for each day a book is overdue. When the number of points deducted on the account reaches zero, the reader's card will be frozen for seven days and cannot be used to borrow books. After the freeze is lifted, the number of points will be reset to 20.<sup>26</sup> In summary, contactless services in China's public libraries are moving in a more humane direction.

### ***Online reference services***

As a type of contactless service, online reference services are extremely helpful in developing access to documentary information resources. The survey shows that 94% of public libraries provide online reference services. Online reference services are available by telephone, website, email, QQ, and WeChat.

Telephone reference and website reference are the earliest forms of contactless service, with the highest usage rates of 79% and 71% respectively among public libraries surveyed. This is followed by slightly lower coverage of email reference and QQ reference at 55% and 48% respectively. WeChat reference coverage rate is the lowest with only 16% (see fig. 12). QQ and WeChat are both Tencent's instant messengers, but QQ's file function is slightly stronger than WeChat's. QQ can send large files of over 1GB and files do not expire, making it easy for the reference librarians to communicate with patrons.



**Figure 12.** Percentage of large public libraries in China that provided online reference service tools.

Other online reference methods such as microblog reference and intelligent robot reference are present in Chinese large public libraries. Real-time reference is labor-intensive and time-consuming, and where librarians may be unavailable to provide an immediate response, intelligent robotic referencing can make up for the problem of consultants being online full time. Applying intelligent robots to library reference can also provide accurate and personalized consultation services according to patrons' needs and behavioral patterns, greatly improving the quality, effectiveness, and satisfaction of consultation services. For example, the Zhejiang Library has an online reference service which includes online 24-hour robot reference and offline message modules. Patrons can also choose expert reference and see available reference experts in the expert list and their details, including name, library, title, specialties, status, etc.<sup>27</sup> In addition, the Hunan Library provides joint online reference, which is a public welfare platform of the Hunan Provincial Literature and Information Resources Common Construction and Sharing Collaborative Network, to provide online reference services to the public. Eleven member units, including Hunan Library, Hunan University Library, and Hunan Science and Technology Information Institute benefit from the rich literature resources, information technology, and human resources of the network, and all sites work together to provide free online reference advice and remote delivery of literature to a wide range of patrons, as well as advisory and tutorial services to guide patrons on how to use the library's physical and digital resources.<sup>28</sup>

### ***Smart services without personal interactions***

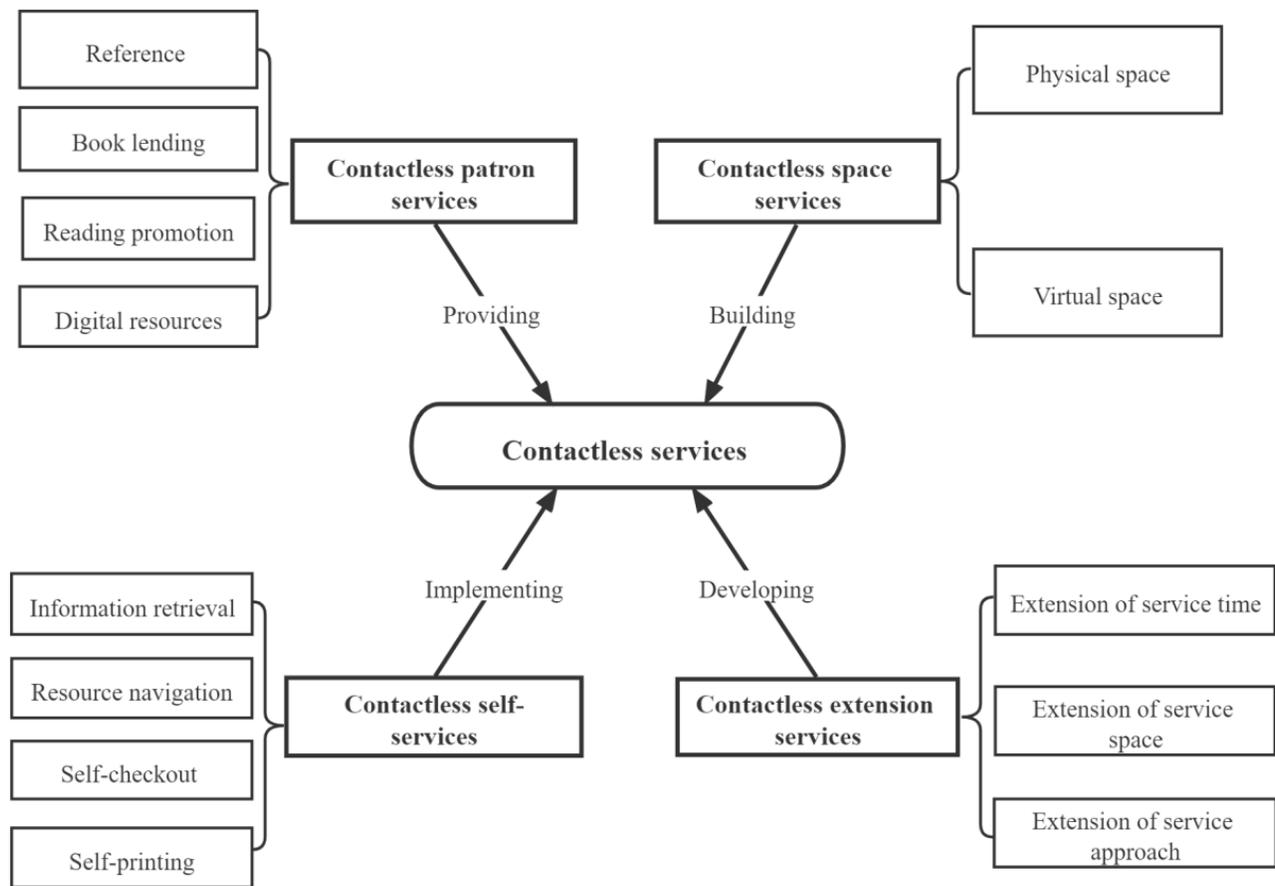
Driven by artificial intelligence, blockchain, cloud computing, and other technologies, libraries are evolving from physical and digital libraries to smart libraries. Smart services without personal interactions are a fundamental capability of smart libraries. This survey found that the coverage of

smart services was 52%, with virtual reality coverage at 21%, face recognition coverage at 20%, and swipe face to borrow books at 9%. Face recognition can be used in library resources services, face gates, security monitoring, self-checkout, and other online and offline real-name identity verification instances, which can improve the efficiency of identity verification. The biggest advantage of face recognition is that it is contactless and easy to use, avoiding the health and safety risks associated with contact identification such as fingerprints. Swipe face to borrow books is one of the applications included in face recognition technology that allows patrons to quickly borrow and return books by swiping faces, even if they have forgotten their reader's card. This technology also tracks the interests of patrons based on their borrowing habits and history records, providing them with corresponding reading recommendation services.

It is worth noting that Chinese public libraries have a rich variety of smart service methods. In terms of VR technology applications, the National Library of China launched the National Library Virtual Reality System in 2008, the first service in China to bring VR technology to the public eye. The virtual reality system provides patrons with the option to explore virtual scenes and interact with virtual resources available in the library. The virtual scenes are distributed by using computer systems to build realistic architectural structures and reading rooms, so that patrons can learn about the library in the library lobby with the help of VR equipment. Virtual resources are digital resources presented in virtual form. The technology combines Flash and human gesture recognition systems, allowing patrons to flip through books touch-free at virtual reality reading stations, enhancing the reading style and interactive experience. In addition, the Fuzhou Library is concerned with the characteristics of different groups of people and has made virtual experiences a focus of its services, using VR technology to innovate reading methods, such as presenting animal images in 3D form on a computer screen, which has been welcomed by a large number of readers, especially children. Shanghai Library, Tianjin Library, Shenzhen Library, Chongqing Library, and Jinan Library have introduced VR technology into their patron services as to attract more users. In terms of blockchain applications, the National Digital Library of China makes use of the special features of blockchain technology in terms of distributed storage, traceable transmission, and high-grade encryption to provide full-time, full-domain, and full-scene copyright protection for massive digital resources and promotes the construction of intelligent library services. Related to big data technology, the Shanghai Library provides personalized recommendation services for e-books based on the characteristics of the books borrowed by readers. Patrons using a mobile phone can scan a code on borrowed books and click on the recommended book's cover for immediate reading.<sup>29</sup>

## CONCLUSION & RECOMMENDATIONS

An in-depth analysis of the contactless service strategy will help to steadily improve the smart library development process in public libraries and to support their transition to smart libraries. This report provides a systematic framework for contactless services for public libraries based on a survey and assessment of the contactless service status of large public libraries in China. Contactless patron services, contactless space services, contactless self-services, and contactless extension services are the four key components of the framework (see fig. 13).



**Figure 13.** A systematic framework of contactless services for public libraries.

***Providing contactless patron services***

Patron services are the heart and soul of each public library. The library’s services providing no personal physical contact or touch-free connection with patrons are referred to as contactless patron services. This includes book lending, online reference, digital resources and network reading promotion.

At present, most Chinese public libraries have few contactless lending options, making it difficult to meet the needs of patrons who cannot access the library due to COVID-19 or transportation difficulties for various reasons. Therefore, public libraries can enrich their existing book lending methods by providing patrons with contactless services, such as book delivery and online lending, to create a convenient reading environment.

A focus on digital resources is fundamental to achieving contactless patron services. At present, some public libraries in China neglect the management of digital resources due to the emphasis on paper resources, and digital resources are not updated and maintained in a timely manner, which leads to the inability of patrons to use them smoothly; therefore, the effective management of digital resources in libraries is crucial. In addition, public libraries can carry out activities such as network reading promotion and reader education to effectively improve the utilization of library resources.

***Building contactless space services***

Contactless space services refer to the touch-free interaction between physical space and virtual space. Physical space services mainly include self-reservation of study rooms, discussion rooms, meeting rooms, as well as providing venues for public lectures or exhibitions, etc., to fulfill the space demands arising from patrons' access to information. Virtual space services mainly include building spaces for collaboration and communication, creative spaces, information sharing spaces, and cultural spaces, providing a virtual integrated environment for patrons' needs for information exchange and acquisition in the online environment.

Public libraries can develop their activities through different channels according to the characteristics and elements of physical and virtual spaces, so that libraries can evolve from "library as a place" to "library as a platform." The combination of an offline library space and an online library platform provides a more convenient and accessible library experience for patrons.

***Implementing no-touch interaction self-services***

No-touch interactive self-service plays a pivotal role as one of the service forms of the contactless service strategy. It mainly includes no-touch interaction self-services such as information retrieval, resources navigation, self-checkout, and self-printing.

Public libraries can set up no-touch interaction self-service sections on their official websites or social media accounts to help patrons quickly access up-to-date information from anywhere and at any time.

***Developing contactless extension services***

In the three dimensions of time, space, and approach, contactless extension services refer to the mutual extension of the library. Public libraries can be open year round on a 24/7 basis or during holidays without librarians, allowing patrons to swipe their own cards to gain access. The traditional collection of paper books should not only be available in offline libraries but can extend to individual self-service libraries or city bookshops. Libraries can approach patrons with a more individualized service strategy. For example, some public libraries provide a service called Build a Book Bag, where librarians select books according to the patron's personal interests and reading preferences and deliver them to a designated location.

***Limitations and prospects***

After analyzing the current status of contactless services in large public libraries in China, this paper finds that contactless services such as reference and access to digital resources are well established in Chinese public libraries. On the other hand, the availability of contactless applications such as no-touch interaction self-services, network services, and smart services without personal interaction are less well-developed. Despite the rapid development of touch-free services and their variety, public libraries in China have not yet implemented a system of contactless services.

This paper proposes a systematic framework to improve the development and practice of contactless services in public libraries and interrupt the spread of COVID-19. The framework includes four core modules: contactless patron services, contactless space services, contactless self-help services, and contactless extension services. It is foreseeable that contactless services will become the mainstream of public library services in the future.

## ENDNOTES

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