

The Application of RFID Technology in the Management of Art Books

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ABSTRACT: Art education is an important measure for moral education among college students. Due to the characteristics of art books such as a wide variety of categories and significant differences in geometric dimensions, it is difficult for libraries to manage the shelves. At present, the shelving methods of art books are generally divided into two categories: classified shelving and book type shelving. This paper discusses RFID technology and its role in the construction of the smart library of China Three Gorges University. Through RFID technology, the management of book tags, status reading and writing, and precise positioning have been achieved. Through the integration with Internet and Internet of Things technologies, the autonomous search, location and borrowing of WeChat mini-programs on mobile phones have been further realized. Based on the above technical support, it is possible to display art books in offline special counters and zones, and promote them online through WeChat official accounts. The results show that the smart library system based on RFID technology, on the one hand, shortens the distance between teachers and students and art books, enhances the reading experience and improves the user experience. On the other hand, it also innovates the form of art education, changing passive education to active promotion and experience, providing a good reference for improving the efficiency and quality of art education in universities.

KEYWORDS: RFID, Smart Library, Art category, Library Management.

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I. INTRODUCTION

Art books are a very important type of books in university libraries. They not only provide services for teachers and students of art majors, but also undertake the important responsibility of moral and aesthetic education for all teachers and students in the university. However, due to the wide variety of art categories, the different printing specifications of books and the large borrowing volume of readers, how to manage art books scientifically and efficiently has always troubled the library management work. From the perspective of facilitating book storage, libraries are constantly exploring scientific shelving management methods for art books in order to improve the utilization rate of books and reduce the workload of librarians^[1]. The "double shelving method" was proposed in the early days, which classified and arranged books by size. This was beneficial for storage but not conducive to the classified storage and retrieval of books^[2]. From the perspective of facilitating readers' borrowing, how to quickly search, locate books, recommend similar ones, and enable self-service borrowing has always been a difficult "last mile" to break through.

With the continuous introduction of Internet and Internet of Things technologies into library systems, they provide innovative ideas for the management of art books. Zheng Qiaoying et al. introduced the nearly 40-year development history of the library of Shanghai Jiao Tong University in the research and application of library integrated management systems, from single systems to integrated management systems, and from the introduction of commercial systems to the independent research and development of a new generation of library information system architecture that is open and shared^[3]. In 2021, the Library of the Central Academy of Fine Arts proposed the shelf coordinate method for book and document resources. This method mainly uses the shelf position numbers of the shelf coordinates and is supplemented by traditional classification numbers, and achieves precise positioning through the public retrieval system OPAC^[4]. Shi Xiaohua et al. analyzed the characteristics of the new generation of smart libraries. A prominent transformation is the shift from focusing on library management functions to meeting the needs and experiences of readers^[5].

RFID (Radio Frequency Identification, radio frequency identification) technology was born in the last century. Due to its technical advantage of non-contact two-way data communication, it has become an automatic identification technology that is widely used in this century. At the beginning of this century, RFID was gradually introduced into libraries^[6,7]. When it was first applied in domestic libraries, it was found that RFID technology had problems such as non-uniform standards, high cost and difficult integration^[8-12]. With the continuous improvement of RFID technology, many university libraries in China have gradually adopted this

technology and carried out integrated innovation. 78% of the readers in the library of Jimei University, China, think that this system has a good user experience^[13]; The "RFID Intelligent Library Management System" of Wuhan University Library has reduced the workload of management staff and improved service efficiency^[14]; After the Shenzhen Library adopted RFID technology, the number of readers visiting the library increased by 6 to 9 times compared with before, and the number of borrowed items increased by 5 to 7 times^[15]. In the past decade, the application of RFID technology in libraries has gradually become a hot research focus^[16-19]. With the continuous innovation and improvement of technology, RFID technology provides a good method for book positioning and management^[20], and on this basis, smart libraries are constructed^[21-23].

This article takes the library of China Three Gorges University as an example to introduce the application of RFID technology in the management of art books. It realizes self-service retrieval, location and borrowing of books, and actively pushes popular books and picture albums among teachers and students through the offline open display cabinets. It also pushes art appreciation books and lectures through the online WeChat official account, enhancing the reading experience of teachers and students. The utilization efficiency of art books has been improved.

II. ART LIBRARY MANAGEMENT

2.1 Large variation of book size

The standard Chinese paper size format is 787×1092mm and the larger Chinese paper size format is 889×1194mm. The formats of art books range from 4-page to 64-page. The size of the 4-page standard Chinese paper is 390mm×543mm, and the size of the 8-page paper is 271mm×390mm. The size of large-sized paper in 4K format is 422mm×581mm, and that in 8K format is 290mm×422mm. By these paper editions in a binder of art books in the plane geometry size present a very big difference, part of the collection of art books geometry size and thickness are shown in Table 1. It can be seen that even if the paper format is the same, the planar geometric dimensions of the books bound into volumes may still differ by 20 to 30mm. The thickness of books also varies greatly. "Two Kinds of Shen Yinmo's Calligraphy Works" is only 10 pages long, while "100 Years of Singing" has as many as 618 pages.

Table 1: A list of geometric dimensions of some art books in the collection

No.	Book title	Book format (mm)	Book size (mm)		Pages	Publisher
			H	W		
1	Selected Works of Yan Guobin's Meticulous Boneless Flower-and-bird painting	787×1092 1/4	53	38.5	28	Tianjin Yangliuqing Painting Society
2	Modern meticulous animal painting techniques	787×1092 1/4	53	38.8	28	Tianjin Yangliuqing Painting Society
3	Teaching Vision Grand Edition - Che Yufeng's Sketching Head Shape Training	787×1092 1/4	33.5	50	38	China Youth Press
4	Fan-shaped technique, green and blue landscape	787×1092 1/6	35	35	30	Jiangxi Fine Arts Publishing House
5	A classic model of Song Dynasty sketches, Flower and Bird (III)	787×1092 1/6	2.3	35	46	Tianjin People's Fine Arts Publishing House
6	Gothic Art	787×1092 1/8	40	30	567	Beijing Fine Arts and Photography Publishing House
7	Appreciation of Li Tongxin's Works	787×1092 1/8	8.1	26	116	Tianjin Yangliuqing Painting Society
8	Volume Four of Landscape Painting, Illustrated Guide to the History of Chinese Painting	787×1092 1/8	38	26	80	Shandong Fine Arts Publishing House
9	A Comprehensive View of Calligraphy Fan Paintings in the Ming and Qing Dynasties (Volume I)	787×1092 1/8	38	26	78	Tianjin People's Fine Arts Publishing House
10	Chinese traditional calligraphy	787×1092 1/8	7.5	27	291	Xiyuan Publishing House
11	Grand spectacles and minor tunes	889×1194 1/8	39	28.5	268	China Bookstore
12	Xun Zhi's calligraphy and Painting Collection	889×1194 1/8	43	30	303	Shanghai Painting and Calligraphy Publishing House
13	Shen Yinmo's calligraphy works fall into two categories	889×1194 1/16	33	21	10	Shanghai Painting and Calligraphy Publishing House
14	Singing 100: A Collection of Selected Choruses Celebrating the 100th Anniversary of the Founding of the Communist Party of China	787×1092 1/8	31.2	23.3	618	Hunan Literature and Art Publishing House

2.2 Diversity of paper type and book binding

The library of China Three Gorges University houses 3,893 volumes of Chinese paintings classified as J22, among which 644 volumes have a spine height greater than 32cm, accounting for 16.5%. Among the 644 books, 245 have a thickness of less than 30 pages, accounting for 38.0%, and 444 have a thickness of less than

50 pages, accounting for 68.9% as shown in Figure 1. It can be seen from this that nearly 70% of the books with larger planar geometric dimensions are relatively thin, and it is rather inconvenient to use vertical shelves.

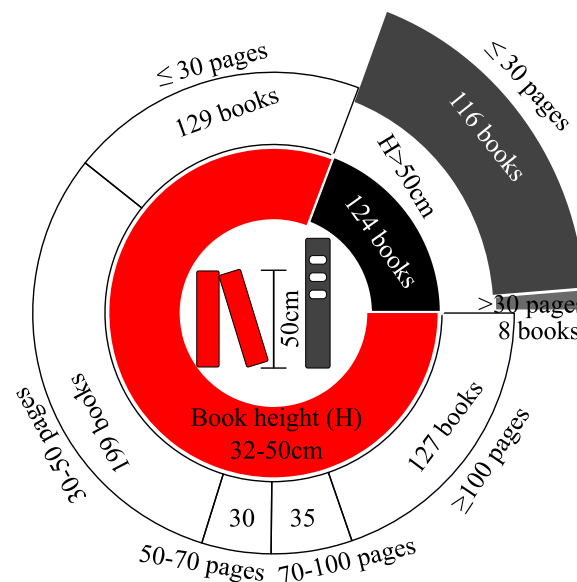


Figure 1: Statistics of 644 books in J22 Chinese paintings category

The printing paper for art books includes offset paper, pure paper, coated paper, lightweight paper, micro-drawing paper, etc. The binding methods include paperback, hardcover and box binding, etc. The binding directions include horizontal binding and vertical binding. The binding methods include saddle stitching, wireless adhesive stitching, sewn adhesive binding, sewn hardcover binding, antique sewn binding, loose-leaf binding, etc. In Table 1, the formats of "Teaching Vision Grand Copy - Che Yufeng's Sketching Head Shape Training" and "Selected Fine Brushwork Boneless Flower-and-Bird Works by Yan Guobin" are the same, with similar dimensions. One is bound horizontally and the other vertically, and the height difference of the spine is nearly 20cm. "Grand View of Ming and Qing Dynasty Calligraphy Fan Paintings (Volume I)" is a traditional-style bound book, while "Xun Zhi's Calligraphy and Painting Collection" is bound in a box.

2.3 Management status

The arrangement of book shelves is generally based on call numbers, which are arranged according to the classification numbers and species numbers stipulated in the "Chinese Library Classification". Therefore, the arrangement of book shelves is mainly based on classification numbers. Due to the particularity of art books, the shelving of art books is generally divided into two categories: classified shelving and book type shelving^[1]

The classification and shelving method is the conventional way of arranging books. The advantage is that books are classified by subject, and books of the same category are placed in adjacent areas, which makes it convenient for readers to search by call number and also facilitates librarians to categorize and shelving books. The disadvantage is that the characteristics of art books have not been taken into account. Art books in 16-page or larger format can be arranged on the shelves normally. 4-page, 6-page and 8-page books cannot be arranged vertically on regular bookshelves, while some 8-page books can be arranged horizontally. For 4-page and 6-page books, the single-sided width of a regular bookshelf cannot meet the space requirements for lying flat shelves, thus occupying the opposite bookshelves. For instance, the format of "Selected Fine Brushwork Boneless Flower-and-Bird Works by Yan Guobin" is 787×1092mm 1/4, with a spine height of 53cm and a width of 38.5cm, totaling 28 pages. On a regular bookshelf, it can only be placed flat or stacked, and it also occupies the opposite bookshelf.

The book-type shelving method is a way to arrange art books based on their characteristics. It can be divided into shelving by format, classification by format, dedicated bookshelves, clipboard shelving, box shelving, flat shelving, and drawer-type shelving, etc.

The general practice of the format classification method is to first classify books according to their format, theme content or drawing style, and then use the classification number and book number as the sub-classification. This classification method breaks through the conventional classification and shelving methods, and to a certain extent, achieves neat and beautiful shelving. Zhou Tianhao^[2] believes that this method causes inconvenience to the work of librarians in terms of shelving and sorting, and also makes it inconvenient for readers to systematically search and utilize art books from the disciplinary system.

Wei Jin^[1] proposed adding a three-level coded call number arranged according to the size of the format after the classification number and the book number to distinguish large-format books, and designed an inclined shelf device for storing large-format books.

Lie low shelving method does not need to adjust the height of the bookshelf can solve the problem of large-type books can't landscape, is simple and feasible method of shelving, but different books stacked together, increased the difficulty of books and to frame. Moreover, when books of different formats are stacked on top of each other, it is also very difficult to arrange them neatly. The drawer-type shelving method uses drawer-type bookcases with many layers and shallow layers to store relatively thin large-format art books.

All these methods aim to achieve or have already achieved neat shelving and beautiful arrangement, making it convenient for readers to find and retrieve books, and for librarians to organize and arrange the shelves. However, after classifying and shelving books of different formats, due to the discontinuous call numbers, it has caused certain difficulties for readers to find books by call numbers.

2.4 Reader's demand

The traditional library management mode is centered on the management objects (such as books), while the new generation of smart libraries is "user-centered" [3, 5]. The essence of "user-centeredness" is to meet the needs of readers and enhance their experience. Take China Three Gorges University as an example. The teachers and students of the School of Art have professional demands for art books and are the main borrowers, while the vast majority of teachers and students in science and engineering, medicine and management are more likely to browse through them in the library. Readers can hold and flip through 16-page books. However, if they are 8-page, 6-page or other art books, they are not suitable for reading on the shelves. Readers need a reading platform of approximately 50cm×80cm. In addition, although non-art students have the need to improve their art appreciation ability, they often do not actively search for the desired materials in unfamiliar art categories such as J22. This also reflects from another aspect that the user experience of libraries when looking up materials is not friendly enough. How to bring high-quality art resources to readers as soon as possible? This "last mile" needs to be bridged through technological innovation and management innovation.

III. RFID TECHNOLOGY AND LIBRARY MANAGEMENT

3.1 RFID and smart library

The RFID tags attached inside the books are passive RFID tags, which are composed of RFID chips, resonant capacitors and antennas. The RFID chip has the function of reading and writing. The library first writes the information of the book into the chip and then places it inside the book. In this way, the book acquires its own attributes, just like a student has attributes such as name, student number, gender, class, grade and school.

RFID tags can be read one-to-one. When the card reader or active detection device approaches the passive RFID tag, the resonant capacitor charges by induction. The chip then responds to the command sent by the detection device and sends relevant information through the antenna. Just like when the teacher asks "Zhang SAN" to ask a question, if "Zhang SAN" is in the classroom, he will answer the teacher's question. If he is not, there will be no response.

RFID tags can also be read one-to-many. When the probing device sends out reading commands in a group based on certain attribute characteristics, all RFID devices within the probing range receive the information number. They first determine through the chip whether they meet the command requirements. If so, they send relevant information; if not, they do not respond. Just like when the school broadcast informs the students of "Class One" to gather on the playground, the students of "Class One" who hear the notice will rush to the playground, while those who are not at school or are at school but have not heard the notice will not rush to the playground.

In conclusion, RFID technology enables the setting of object attributes and short-range (typically within 10 meters) wireless communication. To further realize intelligent libraries, it is necessary to introduce Internet and Internet of Things (IOT) technologies. By integrating objects such as books, bookshelves, floors, and floor divisions into the network database and associating the book objects with their location-related attributes, such as floors, divisions, and bookshelves, information retrieval and positioning can be achieved. The smart library system of China Three Gorges University has realized functions such as visual book navigation, self-service book borrowing and returning, and WeChat book borrowing. The library of China Three Gorges University manages books by classification and shelving in accordance with the "Chinese Library Classification". After applying RFID technology, books are located through RFID tags, and the specific storage locations of books can be visually displayed on the map. For instance, through the library's collection resource system, the call number for "Grand View and Small Plot" was found to be J215/K776/2. The book is located on the second floor of the 58th shelf in Block B on the fourth floor, with 6 columns on the A side, as shown in Figure 2.

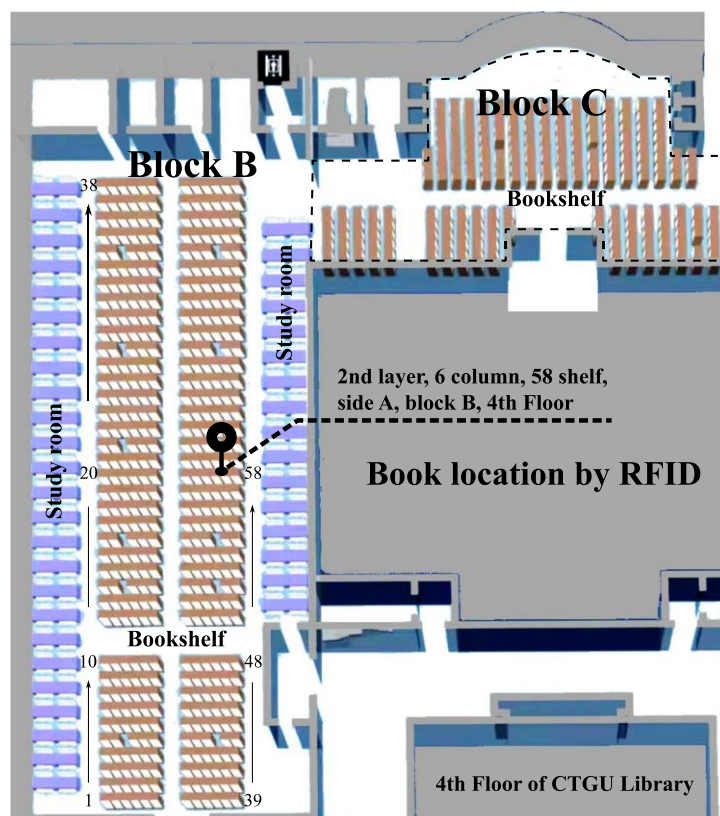


Figure 2: Book location by RFID at CTGU Library

3.2 Smart book service based on RFID location

In September 2023, the RFID smart library construction of China Three Gorges University Library was completed. It has established six business systems, namely the security subsystem, circulation subsystem, management subsystem, display subsystem, condition support system, system connection and labor service. It has realized functions such as the circulation, anti-theft, inventory, retrieval, navigation and mobile phone borrowing of books and periodicals, and improved management efficiency.

If RFID+ Internet and Internet of Things technologies have enhanced the security of books, enabled query and location, and improved the efficiency of borrowing and returning, this merely optimizes the traditional management model of libraries and cannot yet be called a "smart library". Wisdom library should "user centered" [5]. To realize the above design concept, it is necessary to fully understand the user's needs, user usage habits, etc. The construction of smart libraries can, on the one hand, quantitatively analyze the usage of library resources systematically, grasp the reading situations of teachers and students for paper and electronic books, and analyze the different demands of students of different disciplines for book resources, thereby improving the construction and guarantee of book resources in a targeted manner. On the other hand, it can proactively connect with colleges, teachers and students, investigate user needs, and explore the construction of a characteristic book database. Overall, a smart library should not only have an interconnected smart platform, but also possess the concepts of smart construction, management and innovative service measures.

In terms of smart construction, the library of China Three Gorges University has developed a search and location program for the collection list on mobile phones and web pages, enabling autonomous borrowing and renewal of books through WeChat mini-programs. It provides the "Enjoy Book Stack" service for book reservation and new book recommendation. RFID tags were placed on 3,785 reading seats from the first floor to the fifth floor of the library, enabling autonomous reservation services both online and offline. Among them, there were 38 seats on the first floor, 648 on the second floor, 596 on the third floor, 1,387 on the fourth floor and 1,116 on the fifth floor. Six multi-functional meeting rooms have been opened for online reservation, accommodating 12 to 50 people for discussions and studies.

In terms of service innovation, the library of China Three Gorges University, based on the university's educational feature of "water conservancy and power", has established the "Three Gorges Hydropower Characteristic Literature Resource Center". It has built six characteristic resource libraries, including the Three Gorges University Library, the Water Conservancy and Hydropower Literature Resource Library, and the Engineering Resettlement Database, and has collected a large number of documents and materials related to the construction of large and medium-sized water conservancy and power projects such as the Three Gorges Project.

In addition, the library holds the "Sailing and Sourcing" Reading Culture Festival every year. On the one hand, it invites experts and scholars to give cultural lectures. On the other hand, it releases an annual reading report based on the library's big data analysis to honor the "Scholarly College" and the "Borrowing Star".

3.3 Art book service

Based on the RFID smart library system, the author proposes a new method for classifying and managing art books. According to the collection situation, art books are divided into two major categories: The first category consists of books no larger than 16 pages, which are arranged by the traditional classification and shelving method, based on the call number, and positioned by the RFID smart library system in the order of shelving. The second category includes large-format art books such as 4-page, 6-page and 8-page, which are classified by size, geometric dimensions and thickness through counter shelving. A book reading area is set up in the art book section of the open-shelf library. Different customized bookcases are applied to store and display art books, and the RFID smart library system is used to locate books, providing readers with a better reading and borrowing experience.

By analyzing the format and size of art books, three types of special bookcases were customized: double-layer low cabinets, drawer-type high cabinets and triangular display cabinets. Double-layer low cabinets, drawer-type high cabinets and triangular display cabinets are all equipped with RFID tags in layers and columns. Double short ark height of 110 cm, 70 cm wide, single layer height 50 cm, the height is adjustable, double-sided, single-sided 35 cm width, the ark set reading board. Draw-out type tall ark height of 150 cm, 40 cm wide, points and 15 layers, each layer of 10 cm, drawer set mobile partition in the middle. Triangle reveals ark height of 150 cm, width 20 cm, 3 layers, each layer of 50 cm, with combining draw-out type tall ark, the formation of the joint bookcase 60 cm wide, wide with double short ark, can be placed side by side.

According to the survey, more than 80% of university teachers and students have followed the WeChat official account of the library of China Three Gorges University and browsed the cultural services pushed by the official account. The library uses the WeChat official account that is popular among teachers and students to recommend good books every week, and holds online classes and book fairs, as well as offline lectures and training sessions. For more effective to promote college students' art education, art institute of library active docking, we use WeChat public push art books, training on art appreciation.

IV. CONCLUSION

This article analyzes the characteristics and difficulties of art book management, as well as the contradiction between readers' demands for art books and the unfriendly user experience of book consultation. The advantages of RFID technology and its application in the autonomous query and intelligent positioning of the library of China Three Gorges University are introduced. Based on the RFID smart library system, this paper proposes to manage art books in two categories. The first category is books no larger than 16 pages, which adopt the traditional classification and shelving method. They are shelving according to the call number of the Chinese Library and positioned by the RFID smart library system in the shelving order. The second category involves large-format art books larger than 16K, which are displayed in dedicated counters. In order to further enhance the effect of art education, the library has innovated the ways of displaying and promoting art books. It has set up a special reading area for art books offline and carried out WeChat official account promotion and art appreciation training activities online. Transforming passive education into active promotion and experience has effectively enhanced the interest and appreciation level of teachers and students in art, providing a good reference for bridging the "last mile" between art books and readers.

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