Intelligent Library System Based on RFID Technology

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Abstract. Radio Frequency Identification (RFID) is a kind of automatic identification technology. It uses radio frequency to communicate two-way non-contact data, and uses radio frequency to read and write recording media (electronic tags or radio frequency cards) so as to achieve identification objectives and data transfer. It is considered as one of the most promising information technologies in the 21st century. In the field of Library management, it can improve the overall efficiency of libraries and reduce the cost of library management of mass books. In this way, libraries can put more funds and manpower into improving the quality of Library services.

1. Introduction
Radio Frequency Identification (RFID) is the abbreviation of Radio Frequency Identification. The principle of this method is non-contact data communication between reader and label to achieve the goal of target recognition. At present, the typical applications of RFID are animal wafer, automobile wafer anti-theft device, access control, parking lot control, production line automation, material management.[1]

2. RFID technology
Radio Frequency Identification (RFID) is a kind of non-contact radio frequency identification technology. It is a high and new technology for collecting and processing information quickly and in real time, and is listed as one of the top ten technologies in this century.

2.1. RFID development process
Today, the technology theory of RFID has been further enriched and developed. People have developed single chip electronic tags, multi-tag reading, wireless readable and writable RFID technology to adapt to high-speed mobile objects, and related products have entered our lives and started to be widely used. Its development process is shown in table 1.

| Year     | RFID DEVELOPMENT PROCESS                                                                 |
|----------|------------------------------------------------------------------------------------------|
| 1940-1950| Because of the development and progress of radar technology, the technology of RFID was derived, and the theoretical basis of RFID was born in 1948. |
| 1950-1960| People began to explore the technology of RFID, but not without laboratory research.       |
| 1960-1970| Relevant theories continue to evolve and the system has been applied in practice.         |
RFID technology is constantly updated, product research is gradually in-depth, and the testing of RFID has begun to accelerate further. And it realizes the application of the related system.

1980-1990 RFID technology and related products have been developed and applied in the market, and a variety of applications have emerged.

1990-2000 People began to pay attention to the standardization of RFID, and in many areas of life can see the image of RFID system.

After 2000 The importance of standardization has been widely recognized. The types of RFID products have been further enriched and developed. Both active, passive and semi-active tags have begun to develop. The related production costs have further decreased and the application fields have gradually increased.

2.2. Composition of RFID system
The basic RFID system consists of three parts: Radio Tag, Reader & Writer and Antenna. One is Reader & Writer: a device that reads or writes radio frequency tag information, which is used to write or read information on the tag. It is generally divided into hand-held reader and fixed reader. Second, Radio Tag: it consists of a coupling element and a main control chip attached to the identified object, each radio frequency (RF) tag has a unique electronic coding. Third, antenna (ANT): transmitting/receiving radio frequency signals, transmitting radio frequency signals between tags and readers. In recognition system, the reading, writing and communication of electronic tags are realized by electromagnetic wave. The communication between RFID tag and reader is through radio frequency or microwave. Wave-guides of different frequency bands cause different reading and writing distances. Among them, the RFID tag and reader have antenna, which is a radio frequency signal coupling element, which can realize the spatial coupling between tag and reader. Coupling will form a communication channel, in which energy and data are transmitted and exchanged according to the time sequence.[2]

2.3. RFID working principle
A complete set of RFID system is composed of reader and electronic tag, which is also called transponder and application software system. Its working principle is that reader transmits a specific frequency of radio wave energy to drive the circuit to send out the internal data. Reader receives the interpreted data sequentially. Send it to the application program for processing. The reader emits electromagnetic waves with a certain radiation range, and the place where the electromagnetic waves can be received is the working range of the reader. When the RFID tag enters the working range of the reader, its antenna can convert the energy of the electromagnetic wave emitted by the reader into the electric energy needed by the chip circuit. According to the reader's instructions, the identification data stored in the tag can be automatically sent out in the form of electromagnetic wave, and the reader receives the electricity returned by the tag. The magnetic wave is used to obtain the identification data, and then the confirmation and follow-up work are carried out. In practical application, the functions of collecting, processing and remote transmission of object recognition information can be further realized through Ethernet or WLAN. RFID working principle is shown in table 2.
Table 2. RFID working principle

2.4 Technical characteristics of RFID
Radio Frequency Identification (RFID) technology is an automatic identification technology. Contactless communication is based on radio frequency identification technology. Radio frequency signals are processed by upper computer through specific identification and different data exchange objects.[3] Radio Frequency Identification (RFID) technology has the following characteristics:

- **Uniqueness**: Each RFID tag is unique. Through the one-to-one correspondence between RFID tags and products, the follow-up circulation of each product can be clearly tracked;
- **Efficiency**: The reading and writing speed of the RFID system is very fast. A typical RFID transmission process usually takes less than 100 milliseconds. The high frequency RFID reader can recognize and read the contents of multiple tags at the same time, which greatly improves the efficiency of information transmission;
- **Applicability**: RFID technology relies on electromagnetic waves and does not require physical contact between the two sides. This enables it to establish connections without regard to dust, fog, plastics, paper, wood and various obstacles, and directly complete communications;
- **Simplicity**: The RFID tag has simple structure, high recognition rate and simple reading equipment. Especially with the gradual popularization of NFC technology on smart phones, every user's mobile phone will become the simplest RFID reader;

2.5 Advantages and disadvantages of RFID technology
Radio Frequency Identification (RFID) technology can be widely used in many industries and fields. There must be some "excellence" and some shortcomings.[4]

2.5.1 Advantages
- Waterproof, magnetic proof and high temperature resistance;
- Data real-time updating;
• It can store large amount of information and ensure the smooth progress of work;
• Radio frequency identification technology has a long service life;

2.5.2 Disadvantages
• The technology maturity is not enough;
• High cost;
• Technical standards are not uniform;
• The security is not strong enough;

3. Application of RFID technology in library management

3.1 Current situation of RFID technology at home and abroad
At present, China has made some progress in the research of RFID technology, especially in the automatic identification system of railway harmony number, which is a fully independent long-distance automatic identification system of intellectual property rights. At the same time, radio frequency card has been used in many cities as a card, electronic ticket or meal card. The application of RFID technology in libraries differs greatly at home and abroad. At present, more than 400 libraries around the world have used RFID technology, and about 150 libraries in North America have used RFID technology.[5]

3.2 Application of book management
With the continuous progress of the times, the consulting culture has become more and more developed, and the phenomenon of knowledge economy has become increasingly prominent. Libraries have become an important place for consulting services. According to the characteristics of University libraries, a self-service lending device suitable for readers is designed. The self-service lending device including RFID mid-distance reader is placed within the scope to be identified, connected to the server through the network line and exchanged data. This device has a computer host and touch screen display, which can be designed according to the needs of their respective libraries, and try to design an adult human interface, so that readers can complete this function quickly and conveniently. Its topological graph is shown in table 3.

Table 3. RFID topological graph of book management
- Book cataloguing;
- Counter Service;
- The whole shelf of books;
- Safety access control;
- Self-help loan and repayment;
- Query Service;
- Label identification;

3.3 The book lending system based on RFID technology

RFID technology is an automatic and efficient identification technology. Self-help lending system simplifies the circulation process, changes manual lending to self-help lending, improves the quality of readers' borrowing service, and provides book circulation rate.[6]

- RFID technology reduces the workload of librarians, librarians can spend more time on the location information maintenance of books and services for readers;
- Convenient self-service in borrowing and returning books;
- Safety, Bar code is a naked-eye automatic recognition technology, which can use fewer data security means;
- RFID technology makes the process of borrowing and returning books much simpler, supporting the operation of borrowing and returning more than one book at a time;
- Effective administrator efficiency, Perfect presentation of the overall service level of the library;
- To improve the process of borrowing and returning books, RFID technology can provide penetrating and simultaneous identification functions, providing humanized services for Readers;
- As mentioned in the first point, using the RFID system will free the administrator from the heavy and complicated work;
- Strong data statistics, integrated design of borrowing and returning;

4. Conclusion

With the formulation of standards, the widespread application fields, the increasing number of applications, the continuous improvement of technology and the rapid progress of technology, the RFID technology usage cost will be lower, the identification distance will be further, the components and parts shape will also be smaller. The application of RFID technology makes it possible for an unmanned library to be fully open for 24 hours in a real sense. The research and application of this technology are gradually carried out in libraries to meet the requirements of the times. Continuously meet the needs of readers, and truly realize the functions of the library entrusted by the times.

References
[1] Lou, Z.J. (2019) Development and application analysis of RFID library management system. Chinese and foreign entrepreneurs, J,17:97-100.
[2] Meng D.S. (2018) Application of RFID technology in university library management system, Intelligence, J,27:56-61.
[3] Li, L.L. (2018) Application of RFID technology in library management system, China's high and new technology. J, 18:77-80.
[4] Wang, Y.Q. (2017) Probe into the book positioning and shelving mode in RFID library management system, Research on modern state-owned enterprises.J,24:85-89.
[5] Wang, Y.Y. (2018) Application of Radio Frequency Identification Technology in Library Management System of Higher Vocational Colleges, Science and Technology Wind. J. 10 :123-125.
[6] Xiao, L.T. (2018) Application of RFID in Intelligent Library Management, China Science and Technology Information,J,19:155-158.