Analysis of the Smart Library Construction in Colleges Based on Big Data and Artificial Intelligence

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Abstract. With the rapid development of artificial intelligence in recent years, colleges and universities committed to information construction are seeking to transform from digital to intelligent. Among them, the smart library is an important part of university information construction. However, setting up smart libraries face such problems as low rate of library entry and poor sense of experience. This paper analyses the status and difficulties of research and practices in smart libraries by crawler technology and questionnaire, and puts forward a smart library information construction scheme. The results show setting up a smart campus is in line with the new trend of education.

1. Introduction
As an indispensable and important department in colleges, the library not only provides learning and environment, but also the task of auxiliary teaching and scientific research [1]. The traditional digital library eclipsed in the era of information explosion and the rise of artificial intelligence. Users find it difficult to obtain the resources they want, and are satisfied with environmental services of the library [2][3]. Figure 1 shows the dissatisfaction of college students in their own colleges and universities through crawler technology. Based on dissatisfaction and complaints of university students about the library’s problems, schools are more firm in transformation and upgrading of library. Especially with the rise of artificial intelligence, and other emerging technologies, many university workers or other scientific researchers have gradually carried out research on smart libraries [4].

Figure 1. Complain about the libraries.

Figure 2. Smart library research trends.

Research on smart libraries has increased in recent years. The number of relevant papers searched by the keyword "smart library*" in SCI and CSSCI can prove the above conclusion, the results are
shown in figure 2. The research focuses mainly on the definition and application of smart libraries. Few research from the perspective of technology set up smart libraries. This paper mainly discusses the feasibility and demands of smart libraries from a technical perspective, and puts forward some possible problems.

2. Requirements analysis

AI technology has had a profound impact in many fields. In order to realize intelligence, the library should consider the demands and technologies comprehensively. Through the questionnaire survey to understand the needs of college students to the library. The design of the questionnaire is shown in Table 1. After statistical analysis of the questionnaires, it found that among the 386 valid questionnaires, the frequency of visiting the library is mainly several times a month. The purpose of using the library is mainly to borrow books. More people feel that adding face recognition and personalized recommendation will make them more pleased. Most people hope the library is a place where they can borrow books for leisure learning. The results of statistics are shown in Figure 3.

| Question                  | Option                                      |
|---------------------------|---------------------------------------------|
| sex                       | 1 male, 2 female                            |
| education                 | 1 undergraduate, 2 graduate                 |
| frequency of library visit| 1 never, 2 several times altogether, 3 several times a month, 4 several times a week, 5 every day |
| purpose of visit library  | 1 self-study, 2 reading, 3 borrow books, 4 relax, 5 other |
| reason you haven’t been to library | 1 wanted but have no time, 2 bad library environment, 3 borrowed books but studied elsewhere, 4 not rich in resources, 5 other |
| satisfaction of library service | 1 added seats, 2 face recognition into library, 3 personalized recommended books, 4 24h library, 5 screen displays daily newsletter, 6 library sleeping cabin |
| wanted space              | 1 a place to search for resources, 2 a place for relax and study, 3 workshop space, 4 a place for self-study, 5 other |
| get services on your mobile device | 1 willingness, 2 unwillingness, 3 don’t care |
| wanted services through the mobile phone | 1 overdue remind, 2 mobile reading, 3 reader interaction, 4 other |

How to use AI technology to meet the needs of college students? We should have a comprehensive understanding of AI technology. Statistics show that many students think the library is a place for leisure and relaxation. They prefer to use the convenient way of face recognition to enter the library and personalized recommendation services. Besides, intelligent navigation needs to quickly find locating books to ensure the books on shelves are in their suitable positions, including RFID scanning detection. Using mobile intelligent retrieval, we can use natural language processing to realize robots. Large screen display needs big data visualization. The friendly library environment can apply to IOT. Each technology corresponds to the research hot spot in the wave of artificial intelligence.
3. Application of AI technology in smart library

3.1. face recognition

The application of face recognition in the smart library is not only limited to the needs of students who use face recognition to enter the library, but also can be used to borrow or return books and reserve other services. Besides, face recognition is also of great benefit to the overall campus information. For example, it can be used in scenarios such as faculty and staff face clocking, meeting sign-in, test identity confirmation, student dormitory access control. While many scenes can use face recognition on campus, the first crux is bind the face data with the information of students, faculty and staff to verify their identity. Photos quality should be strictly inspected within a limited range. User uploads face photos by himself or herself, and the terminal extracts the feature value of the photos and stores it in the data center. Storing characteristic values can lessen the risk of personal privacy leakage. When face recognition in a certain scene, the feature value should be mapped and calculated. When the matching degree exceeds a certain threshold, the recognition result judges correctly, if not, the recognition is wrong.
It is worth noting that face recognition technology needs to be cautious when using it to perform a certain intimate authority of the user\cite{5}. For instance, because of the algorithm defect, the possibility that A’s face becomes B when borrowing books. A successfully enters B’s account and borrows books at will, which infringe B’s rights and interests. This paper proposes that multiple identification measures should be adopted to address the issue of permission confusion caused by such mismatches. This article proposes two ways: First, after face recognition, add a layer of password or fingerprint recognition to achieve double protection. Second, while collecting face data, collect eye iris images too. Both eye iris and fingerprints can uniquely identify individual. Therefore, while collecting face photos, collect iris of the eye images. Reducing the acquisition cost, extracting photo features simultaneously, and achieving double guarantees. As shown in Figure 4.

3.2. Automatic book inventory and navigation system
A crux of the library is to organize books\cite{6}. Each book has its own location, but the book on the bookshelf may not be placed in the correct location. It was found in the investigation that a certain percentage of students complain that the books on the shelves could not be found, which is a typical book misplaced problem. The popular means for traditional libraries to solve such problems was normally to check one by one with the naked eye. However, this manual checking method is inefficient, and easy to make mistakes.

With the pervasive of RFID, the RFID tags embedded in books with data of the book itself. Workers use RFID device scan books to confirm they are in the correct place. If the location is wrong, the administrator or robot will put the book back in the correct position. The book inventory equipment has two types: hand-held and automatic mobile robot. Mobility is more convenient and needs no human intervention, but it is also more technically complex. The automatic mobile inventory can be designed as a robot in shape. Besides having a mechanical arm that can access books, it also needs high precision indoor navigation. The navigation allows the robot to move between the tighter bookshelves. Besides, an accurate sensor or image detection system is required to pick up the correct book within a small margin of error.

Table 2. Details of the methods of books misplaced

| shelving book method               | Technical protocols                                                                 | fund demand |
|-----------------------------------|--------------------------------------------------------------------------------------|-------------|
| manual inventory                  | check one by one with the naked eye. Replace all bookshelves and deploy              | very low    |
| intelligent bookshelf             | smart bookshelves. Built-in RFID tags, books and bookshelves corresponding.          | very high   |
| handheld RFID device              | Handheld RFID devices scan bookshelves one by one.                                  | low         |
| intelligent book inventory robot  | The robot can move freely under the indoor navigation system and scan automatically  | a little bit high |
|                                   | without human intervention.                                                        |

As for indoor navigation technology, the current mainstream technology includes indoor navigation based on MEMS sensor, indoor navigation based on WIFI, indoor navigation based on machine vision and other technologies\cite{7}. For the indoor navigation of smart library, WIFI-based indoor navigation is worth considering, because the construction of smart library needs a good wireless network environment. WIFI, as one of the hardware of smart libraries, does not need extra deployment of other facilities. The automated inventory robot can move freely under a WIFI-based indoor navigation system. In addition, users can also quickly find the book area and shelf location under the indoor navigation system based on WIFI, which of course requires the development of a mobile application to be deployed on the user’s phone. Table 2 lists in detail the methods and technical solutions of the current book inventory, as well as the capital requirements for the deployment.
4. Intelligent recommendation and question answering system

Students’ dissatisfaction report with the library shows that some students think the service attitude of the library staff is poor and the consultation channel is single. Besides, according to the information obtained from the questionnaire, adding personalized book recommendations will make people more satisfied with the library. To solve these problems, the intelligent recommendation and question answering system can be realized by natural language processing technology. The core of intelligent recommendation system is the design of algorithms. At present, the mainstream recommendation algorithms are based on collaborative filtering, based on interest points, based on knowledge graph and based on context awareness. Zhang Fang, a scholar, surveyed 42 double-first-class universities in China, and the results showed that only 35.7% of the university libraries have deployed personalized recommendation systems[8]. Dual first-class universities mean top universities in China. It is not hard to imagine that other universities will face greater difficulties in applying intelligent recommendation systems in the construction of smart libraries. The first crux is data storage without considering the algorithm condition. To realize the recommendation with high accuracy for each user needs historical data and a higher dimension of user data. Only when as much data as possible, can the recommendation information be mined as accurately as possible. Therefore, some requirements are put forward for the storage conditions in colleges and universities. Second, the requirement of data governance ability is higher. Without a unified data management scheme, all departments and systems of colleges and universities are just like information islands. If the multi-dimensional data of each user cannot be unified and combined, the recommendation information cannot be provided to the algorithm for mining.

At present, the two main methods of intelligent question answering system are expert system and natural language processing[7]. By presenting various situations in advance, the expert system matches in the expert system library and returns the corresponding reply to the user when the user asks a certain question. The whole system is like an omniscient expert, but it is obvious that experts also have their own knowledge of blind spots, and no one can predict the user's questions. Therefore, the intelligent question answering system based on deep learning natural language processing technology is more intelligent. After several training sessions with the existing data, it can answer the user's questions on its own. However, such a system usually needs to be online for a period of time. During its operation, it also needs to collect the data asked by users and carry out incremental iterative updates, so that the whole system evolves more intelligently.

5. Information architecture of smart library

Constructs smart libraries must build a good information channel to provide infrastructure for the application of big data and artificial intelligence[9]. This paper proposes an information architecture of a smart library, as shown in Figure 5. First, a data center is established to connect and manage the data of all major systems and platforms of the school, realize data governance, delete redundant fields, and update the latest data. The face data collected by the access control system of the library is extracted from the off-line terminal and matched with the local face feature database to determine the legal identity. AI is deployed inside the library to welcome the robots, provide basic inquiry and reminder services, and realize free and real-time communication based on deep learning technology[10]. Large visual screens are set up in places where the library is easy to observe, showing the statistical information of the library in a certain period of time. Automated inventory robots are deployed inside the library, which can move freely between shelves based on the indoor navigation system under a good WIFI network and take inventory of books in error[11]. Readers can quickly locate the area based on the indoor navigation system and obtain personalized information under the intelligent recommendation system. Operations related to user rights, such as book borrowing and returning functions, require dual identification of face recognition and eye iris recognition to safeguard user privacy[12].
In addition, the construction of smart libraries also requires the deployment of other spaces and facilities. Table 3 lists in detail the applications and functions obtained based on demand analysis, and describes the application scenarios and information measures.

Table 3. Demand for smart library

| product or application | scenarios | informatization means |
|------------------------|-----------|-----------------------|
| face recognition       | library, dormitory, office access control, conference hall sign-in; | face data information is only bound to staff and students, system should be safe and reliable, some scenes should double judgment. |
| RFID related applications | automatic book sorting; security check | procurement automatic sorting system, security door system. |
| intelligent recommendation system | library website book recommendation; | system can carry out incremental learning; record the content of the recommendation, and a label for the user to feedback whether the recommendation is satisfactory or not. |
| intelligent question answering system | answer frequently asked questions instead of human customer service | two solutions: 1. build an expert system; 2. build an intelligent customer service system based on natural language processing. |
| indoor navigation system | places where the indoor environment is complex | build a good wireless network, purchase indoor navigation system; broadcast and remote interaction across the campus, check in, projection and other functions, record panorama and close-up, and form course resources. |
| seminar room           | library                                            | real-time monitoring system, warm reminder, in case of long time study brought sudden death and other security risks. |
| 24H study area          | near the library or dormitory                       | develop a unified equipment rental platform on which students can reserve the equipment to be rented. |
| rental equipment        | library or laboratory                                | develop the reservation system and connect the existing student accounts and passwords. |
| seat reservation        | library                                             | self-service should be done in a limited way, only for staff or students on campus to print. |
| self-service printing/photocopying | the library self-service area | use mobile phone scanning code to achieve access to items. |
| smart lockers           | library store personal belongings                   | greeting robot built-in natural language processing system, book inventory robot need cooperate with indoor navigation. |
| robot                   | lobby greeting robot, book inventory robot;         | |


6. Conclusion
This paper mainly holds the opinion data of students on the library through the form of questionnaire, and combines the current hot technology of artificial intelligence to comprehensively analyse the application in the intelligent library. An intelligent library information architecture is put forward, and the application difficulties and problems to be solved are analysed. It provides a reference for the construction of an intelligent library. Finally, it lists the products and functions available for the implementation of the smart library, and describes the application scenarios and information measures in detail, to provide reference for the construction of the smart library in other universities. The vigorous development of artificial intelligence is integrated with the development trend of the education industry, and the application of emerging technologies such as big data, Internet of Things and artificial intelligence in libraries or universities is the current research direction of building intelligent libraries, which also provides strong support for smart campuses and smart cities.

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