# Artificial Intelligence Inspired Computer-Aided Design of Library Service System

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**Abstract.** In modern society, as one of the important components of mobile design clients, "WeChat", with its high penetration rate among young people, not only occupies a vast media market, but also develops into a multi-functional integration in the continuous upgrade. a mobile platform. In particular, the "Official Account" function brings more convenient mobile information services to WeChat users. Under this background, university libraries actively respond to the changes of the times, so as to provide more convenient library information services for university students. Due to the late start, the service functions and contents provided by most libraries are still relatively simple, and the degree of secondary development is not enough, and the mobile information services of libraries are not provided under a unified framework. In the field of library services, through the application of intelligent technology, a complete intelligent system can be established according to the characteristics of various service work in the library, and the intelligent management and control of books, equipment and even various infrastructures can be realized. , which is of great help to the improvement of library service quality and work efficiency.

**Keywords:** Big Data; University Library; Personalized Information Service; Computer-Aided Technology.
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## 1 INTRODUCTION

With the development of Internet technology, the number of netizens in my country is increasing [1]. According to the 35th "Statistical Report on Internet Development in China" conducted by the China Internet Network Information Center, as of December 2014, the number of netizens in China has reached 649 million, and the number of mobile phone users has reached 649 million [2]. The number of netizens was 557 million, and the Internet penetration rate reached 47.9% [3]. At present, with the development of mobile Internet, social network, Internet of Things, digital office, etc., the speed of information release is more convenient and rapid, and the growth rate of information quantity is accelerated, which makes the data grow exponentially [4]. These data show the characteristics of large amount of data information, various types, high value density, and fast growth rate, which are also the main characteristics of big data, marking that human beings have entered the era of big data [5]. Mahmood et al. [6] believes that data has become an important competitive resource and a huge economic asset. People who master data resources will dominate the future. Therefore, Mehra [7] believes that it is the only way to develop information technology and the necessity of scientific decision-making to use big data mining and analysis technology to deeply mine potential information resources in data.

In the age of big data, Pauwels et al. [8] believes that users' awareness of information needs has increased. However, the user's information selectivity barriers make it difficult for users to find information that meets their needs in rich data resources. Therefore, Roux and Hendrikz [9] believes that libraries must provide users with targeted and accurate information. The research of Umme et al. [10] has promoted the emergence of personalized information services. In the information age, the library network service has changed from the traditional closed service to the open service. Yang and Chew [11] believes that the core of its service is people-oriented. The changes in network information services have also promoted the development of personalized information services. Changes in the information environment make users' needs, awareness, and service management mechanisms change accordingly. Under this influence, the emergence and development of personalized information services is inevitable. Only in this way can the contradiction between users' personalized information needs and rich information resources be resolved, improve the quality of library services, and promote the healthy development of university libraries on the road in the future.

In the era of big data, in addition to traditional paper documents, university libraries also have a large number of digital resources. For a long time, the library attaches great importance to the collection, arrangement and utilization of documents, but neglects the arrangement and mining of data. The existing digital resources, in addition to various electronic resources, literature databases, etc., also track and record a large number of user basic information, information behavior and service information and other data in its automated system. At the same time, the development of social networks, such as WeChat, Weibo, etc., generates a large amount of communication information, which is not only structured data, but also semi-structured and unstructured data. Direct or potential value information ⑤. For example, by mining and analyzing user behavior information, the real-time information needs of users can be obtained, and real-time or potential information with high accuracy can be provided for users.

Quickly obtaining real-time information needs of users is the key to personalized information services. The author combines the emerging big data mining and analysis technology with the personalized information services of university libraries. Big data is mined by using the existing user information resources of university libraries. Obtaining the user's real-time information demand model, the university library actively pushes information for users according to the data decision results, and provides users with personalized information services with real meaning and high satisfaction. Under this concept, the author conducts a sample survey of fifteen university library websites, analyzes and compares the current status of personalized information services, finds existing problems, and then borrows big data technology to propose strategies to solve the problems, and build a large-scale library based on this. The personalized information service model of university library under the data environment, this paper researches the personalized information service of university library under the condition of recognizing the characteristics of the current era, provides a theoretical basis for the development of personalized information service in the future, and also provides a theoretical basis for the development of university library. Therefore, this research has important theoretical and practical significance.

# 2 RELATED CONCEPTS AND THEORETICAL BASIS

## 2.1 Library Intelligent Service System Architecture

The application of intelligent technology in the field of library service usually needs to be realized with the help of library intelligent service system. Here, taking the intelligent service system of a university library as an example, the specific scheme design of library intelligent service is discussed. From the perspective of service functions, the university library has designed multiple subsystems such as access control system, book borrowing and returning system, and seat reservation system according to its own service needs, which are used to provide online borrowing and returning books and seat reservations for readers such as teachers and students. and other services. In terms of system architecture, the library intelligent service system can be divided into three parts: intelligent data collection layer, intelligent data analysis layer, and intelligent data application layer (as shown in Figure 1).

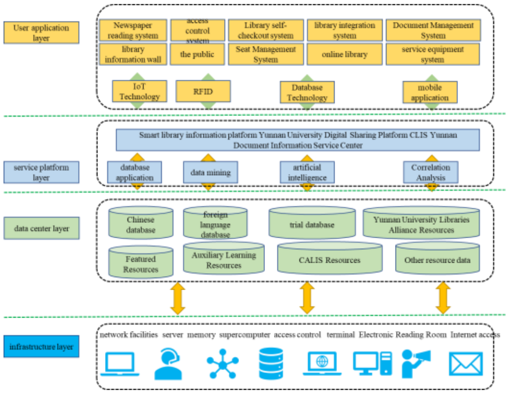


**Figure 1**: The overall architecture of the library intelligent service system.

The intelligent data application layer is mainly used for the analysis and processing of data information, specific management decisions, and service optimization. Intelligent management decisions are made based on library service conditions and user service needs and behaviors, and comprehensive management and control of various subsystems to achieve an overall improvement in service quality.

## 2.2 Library Service System

(1) Integrated wiring design

In order to reduce the management level, the library intelligent service system can meet the needs of library operation and readers' broadband communication, multimedia communication business, personal communication business, reliable and confidential communication, etc., based on computer data wiring and telephone voice wiring. A set of integrated wiring system, in which computer data wiring forms a set of integrated wiring system separately, and the two sets of wiring systems are physically separated. Each microcomputer room and electronic reading room are equipped with independent wiring cabinets, respectively laying a 4-core 10 Gigabit optical cable, and at the same time The external network is connected to the Internet, the internal network is connected to the school campus network, and the voice is connected to the local telephone network.

(2) Design of access control system

In order to realize intelligent circulation management, the library intelligent service system has established an access control subsystem. From the perspective of the internal structure of the system, the subsystem is mainly composed of network access control controller, access control card reader, electric lock, and computer control center. The reader presents a card (electronic label) when entering and exiting normally, and the access control card reader identifies the information in the electronic label of the access control card, and communicates it to the computer control center after confirming the authority. A lock that allows readers to enter the library.

(3) Book Retrieval and Borrowing and Returning System

The book borrowing and returning system mainly uses RFID technology to classify and catalogue the paper books in the library, and accurately locate the location of the books. When readers need to borrow books, they can enter the document name or keywords on a special retrieval device, and then the system automatically completes intelligent screening from the collection resources, recommends relevant document resources for readers, and indicates the location information of paper document resources, such as If the literature resource is electronic literature, it can provide services such as automatic download and online reading. You can place the book you want to borrow on the self-service borrowing and returning device, and the device scans the electronic label on the top of the book to identify and record the book information, and then define the book as a borrowing state, and add the borrower, borrowing time and other information. When the reader needs to return the book, the book is also placed on the self-service borrowing and returning device to scan the electronic label, and then the system defines the book as unborrowed according to the information in the label, and at the same time re-lists it into the list of books that can be borrowed.

## 2.3 Overview of Personalized Information Services

With the acceleration of the social informatization process, the demand for personalized information service has become increasingly prominent. The leading trend of today's service is service individuation, and its goal is to meet the specific information and services required by specific users at a specific time. In the era of big data, the contradiction between the growing information and the personalization of user information needs is becoming more and more prominent. The traditional service model of providing common information to all users can no longer meet the needs of current users, so the development of personalized information services has become a history. inevitable choice.

Due to the different disciplines and emphases of domestic and foreign researchers, the understanding and concepts of personalized information services will be different. Some focus on the content and quality requirements of information services, and some focus on cultivating users' personalized satisfaction and exploration, but the essence is to provide users with high-quality information services. IBM defines it from the process of personalized information service: Personalized information service is the process of collecting, storing and analyzing user information, and delivering the correct information at the right time to users based on the results of user information analysis. Some scholars believe that personalized information service refers to constructing a user-centered model based on the user's basic information, educational background, demand level, behavioral habits and inner thoughts, and actively matching and selecting the information required by the user. The resources are delivered to the user's terminal through the personalized service system.

To sum up, personalized information service is fundamentally that users customize collection resources through static and dynamic methods such as registration and online behavior. The library service system builds a user model based on user behavior information, and the personalized service system summarizes user information, Analyze user behavior and push personalized information resources for each user. The basic service process is shown in Figure 2.

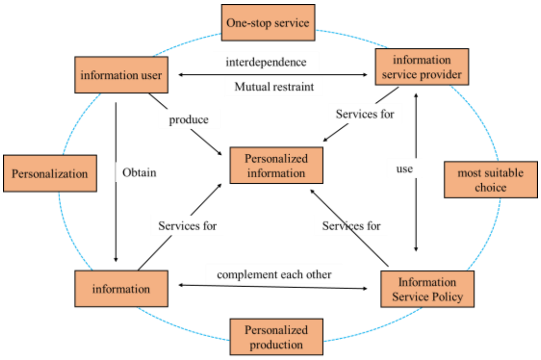


**Figure 2**: Process diagram of personalized information push service.

From the concept of personalized information service, the five basic characteristics of personalized information are obtained: user-centered, focusing on interaction with users, flexible and diverse service methods, active service, and real-time security information.

(1) Taking the user as the center, the personalized information service process reflects the service concept of "people-oriented". The ultimate purpose of personalized information service is to meet different information needs of users in different ways and provide users with targeted and active services. This is the most essential difference between personalized information services and traditional information services.

(2) Emphasis on interaction with users, which is the main difference between personalized information services and traditional information services. The service process is mainly based on the interaction between users and information providers. Users and information providers conduct real-time interactive exchanges, and update and share user feedback information in a timely manner.

(3) The service methods are flexible and diverse. With the development of modern network technology, people's access to information is no longer limited by geographical and time. Users can dynamically customize the type of service required, such as customizing characteristic information resources according to personal scientific research information needs. Customize service methods and types according to your own habits, so that personalized information services become information services that users "tailor-made" to meet their individual needs.

## 3 RELATED TECHNOLOGIES

### 3.1 VIRE Positioning Algorithm

The VIRE (Virtual Reference Elimination) virtual tag algorithm is an algorithm that is further improved by comparing the shortcomings of the LANDMARC algorithm.

The VIRE algorithm divides the positioning area into multiple identical grids, and at the same time places the reference labels in the divided grids on average, and then divides the grid more finely into the positioning area, which is divided into n*n virtual grids. grid and make each virtual grid include 4 virtual reference labels. The RSSI value of the virtual reference label can be based on the obtained physical reference label The sign's RSSI value and coordinate values are calculated using linear interpolation, as shown in Equations 1 and 2:

Signal strength of virtual labels in the horizontal direction:

$$S_k\left(T_{p,b}\right) = S_k\left(T_{a,b}\right) + p * \frac{S_k\left(T_{a+n,b}\right) - S_k\left(T_{a,b}\right)}{n+1} \tag{1}$$

Signal strength in vertical direction:

$$S_k\left(T_{p,b}\right) = S_k\left(T_{a,b}\right) + p^* \frac{S_k\left(T_{a+n,b}\right) - S_k\left(T_{a,b}\right)}{n+1} \tag{2}$$

In the formula, SK(Ti, j) represents the signal strength obtained by the virtual tag with coordinates (i, j) corresponding to the Kth reader, where a=[i/n], b=[j/n], 0⩽ p=i%n⩽n-1.

After obtaining the virtual reference label set closest to the target to be located, the target coordinates are obtained by using the weighted average sum. The VIRE algorithm uses two weights W1i and W2i for weighted calculation. W1i and W1i are set according to the signal strength value of the virtual tag to the distance weight of the reference tag in the virtual tag. The smaller the distance, the larger the W1i.

$$W_{1i} = 1 - \sum_{K=1}^{K} \frac{S_k\left(T_i\right) - S_k(R)}{K^* S_k\left(T_i\right)} \tag{3}$$

The weighting factor W2i is set according to the density of the virtual reference labels. The greater the density of the virtual reference labels, the greater the W2i.

$$W_{2i} = \frac{n_{ci}}{\sum_{i=1}^{na} n_{ci}} \tag{4}$$

where na represents the number of nearest virtual reference labels in the entire region, and nci represents the density of the ith nearest virtual label. According to the final weight factor Wi=W1i*W2i in the VIRE algorithm, the coordinates of the target to be located can be obtained from Equation 5.

$$(x, y) = \sum_{i=1}^{na} W_i * \left(x_i, y_i\right) \tag{5}$$

### 3.2 Algorithm Optimization

The relationship between the distance and the RSSI value of the actual reference label and the virtual reference label is not ideal, that is to say, their relationship is not linear. Since the attenuation of good faith in the library obeys the logarithmic normal distribution, the paper uses the logarithmic distance loss model. The "distance-loss" formula is shown in 6:

$$P = p_0 + 10n \lg\left(\frac{d_{ij}}{d_0}\right) + \zeta_{ij} \tag{6}$$

In formula 6: d0 represents the distance from the reader i to the electronic tag on the book; P0 represents the RSSI value when the electronic tag on the book is received by the reader i, that is, the distance is d0; P represents the virtual reference tag received by the reader i. RSSI value; n is the path loss index; d ij represents the distance from reader i to the jth virtual reference label; ζ represents the shadowing factor, as a random variable, the mean value of this random variable is 0 and has nothing to do with the distance of propagation.

Taking T13 and T14 as target book labels, and T8 and T9 as neighbor labels, the following formulas are used to calculate the distance-loss indices n1 and n2 of the two paths:

$$n = \frac{p - p_0}{10 \lg \frac{d}{d_0}} \tag{7}$$

After obtaining the path losses of the two paths close to the tag to be located, the angles between the TS and Tg paths and the straight line formed by the reader are θ1 and θ2 respectively, and the path loss index of the tag to be located can be obtained by the following formula:

$$n = n_1 \frac{\theta_1}{\theta_1 + \theta_2} + n_2 \frac{\theta_1}{\theta_1 + \theta_2} \tag{8}$$

By Equation 8, T is obtained. After the distance-loss model parameter of the position, the signal strength value of T} is obtained by formula 6 and the signal strength value of Ts.

### 3.3 K Proximity

After the reader receives the feedback signal of the target tag, it calculates the signal No. 1 strength value of all virtual reference tags, and selects K virtual reference tags close to the target tag according to the signal strength value. Finally, Then perform weighted summation on them. Its body description is: there are u target tags, m readers and n virtual reference tags, and the target tag and virtual tag are 1-a vector of signal strengths, which are 9 and 10 respectively:

$$\vec{S} = \left(S_{j,1}, S_{j,2}, \ldots\ldots, S_{j,m}\right) \tag{9}$$

$$\vec{\theta} = \left(\theta_{i,1} \theta_{i,2}, \ldots\ldots, \theta_{i,n}\right) \tag{10}$$

where j represents the signal strength value of the i-th target tag read by the j-th reader, ie[1, u], je[1, n]; Sij represents the i-th target tag read by the j-th reader The magnitude of the signal strength value of each virtual label, i∈[1,m], j∈[1,n]. We use the Euclidean distance to represent the distance between the target label p and each virtual reference label. definition:

$$\sum_i = \sqrt{\sum_{i=1}^{m} (\theta i - 5i)^2} \tag{11}$$

where Wi represents the weighting factor of the ith signal strength value among all virtual reference labels with a total number of K. When all virtual reference labels have the same weight, the resulting positioning error value will be higher, so the design of the weight factor is particularly important. The weight factor is a virtual reference label that is relatively close to the target label, because these virtual reference labels can well reflect the position of the target label. Therefore, the weight factor depends on the size of E, as shown in Equation 12:

$$wi = \frac{\frac{1}{E_i^2}}{\sum_{i=1}^{k} \frac{1}{E_i^2}} \tag{12}$$

Through 12, the virtual reference label closest to the target label is the weight factor with the largest distance. and satisfy 13.

$$w_1 + w_2 + \ldots\ldots + w_3 = 1 \tag{13}$$

To calculate the similarity between the above-mentioned books and the books in Zhang San's collection, it is necessary to rely on the calculation formula of the similarity, and it is only necessary to calculate the similarity between Zhang San's collection and the above-mentioned books. It is better to use the Euclidean distance to calculate the similarity. The Euclidean distance formula is:

$$D = \sqrt{\sum_{i=1}^{n} \left(p_i - q_i\right)^2} \tag{14}$$

where the variables represent:

$$\mathrm{p}\left(\mathrm{p}_1, \mathrm{p}_2, \mathrm{p}_3, \mathrm{p}_4 \cdots\right) \tag{15}$$

Represents a book in the Favorites leaderboard.

# 4 EXPERIMENTAL RESULTS AND ANALYSIS

## 4.1 Comparison of VIRE Positioning Algorithms

In this paper, after optimizing the VIRE positioning algorithm, some experimental measurements are made on the VIRE positioning algorithm and the VIRE optimized algorithm. The statistical histogram of the results of the experimental measurement is shown in Figure 3 as follows:

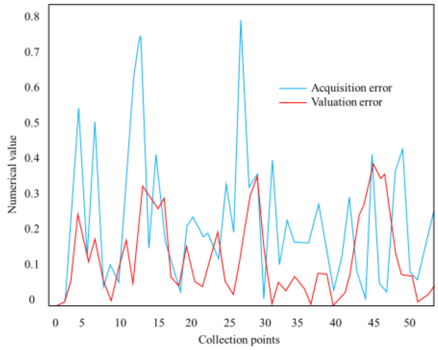


**Figure 3**: The average error of positioning of VIRE algorithm and VIRE optimization algorithm.

Figure 3 shows the error of the positioning accuracy of the two positioning algorithms. The abscissa represents the label number that needs to be measured experimentally, and the ordinate represents the number of labels within a certain distance. In the VIRE localization algorithm, the sum of all labels used in this experiment is between 700 and 1000. As can be seen from the above figure, the effect of the positioning algorithm after VIRE optimization is much better than that of the VIRE algorithm, and the improved positioning errors are 0.08 meters, 0.16 meters and 0.15 meters respectively.

It is generally believed that the accuracy of positioning within a library is proportional to the density of virtual reference labels. Therefore, it can be considered to add more virtual reference labels, and the number of virtual reference labels should be added to achieve the best effect of positioning. We use m*n to represent the sum of all reference labels. In the experimental measurement, the number of virtual reference labels separated from the actual reference labels is selected as 4, 6, 8, 10, 12, 13; the area is 12*14, 18*20, 24*26, 28*30, 32*34, 38*40.

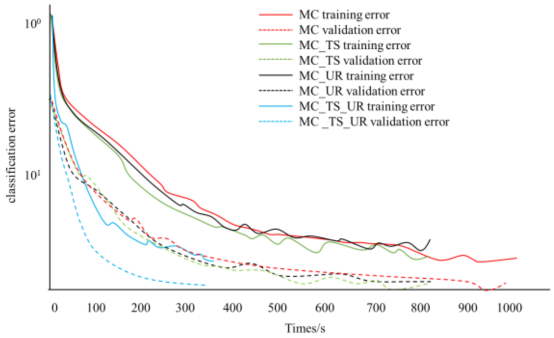


**Figure 4**: Influence of virtual reference label density on the errors of the two algorithms.

Figure 4 shows the experimental measurement results of the VIRE positioning algorithm of the virtual reference tag and the optimization of the VIRE algorithm. The positioning accuracy is affected by the number of intervals of the virtual reference tag, and the larger the number of intervals, the smaller the error. It is not difficult to find from the above figure that when the number of virtual reference labels reaches 10, that is to say, when the total number in the area reaches 28*30, the whole becomes stable, and when the number of intervals continues to increase, the results of the experiment will not be affected. great impact.

The VIRE algorithm needs to obtain the intersection of K reference labels from the entity reference label to obtain the proximity map, so as to obtain the location of the label to be located more accurately. The experiment tests the two algorithms from the value of K. The values of K for the quiz are 1, 2, 3, 4, 5, and 6. The result is shown in Figure 5:

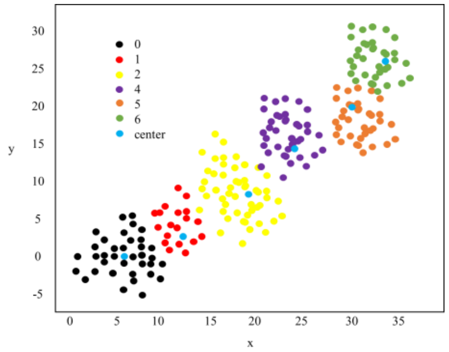


**Figure 5**: The influence of the value of K on the two algorithms.

It can be seen from Figure 5 that the value of K affects the positioning error of the VIRE algorithm and the VIRE optimized algorithm. The experimental results show that when the value of K is smaller, the error value is larger. But when the value of K is 6, the error will tend to increase.

## 4.2 Analysis of Results

On the whole, the overall support for optimistic multi-granularity decision-making is better. The cross-validation method is used to compare the rationality of its decision-making through the increase and decrease of the number of clustering coefficients. Through cluster analysis, the obtained digital library knowledge discovery data-driven multi-granularity rough set decision-making performance of user semantic retrieval in the field the reasonableness is shown in Figure 6.

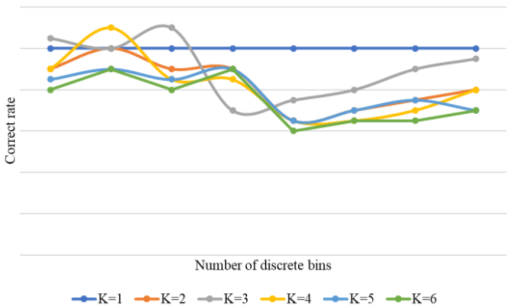


**Figure 6**: Construction decision performance optimization effect diagram.

As shown in Figure 6, the correctness prediction experiment test of the user semantic retrieval approach is carried out considering the number of clusters from 1 to 6 respectively. From the above analysis results, when K=2, 3, its driving performance is improved through optimistic decision-making It is more reasonable, the advantages of multi-granularity rough sets in performance optimization are obvious, and multi-granularity decision-making has a good effect on the knowledge discovery service of user semantic retrieval. When the number of discrete bins is 4, and the number of clusters is 3, the performance effect is the best. According to the retrieval needs of 7 users, when the knowledge discovery platform provides users with a retrieval decision-making channel that integrates keywords, titles, and abstracts, the knowledge information retrieved by the users is the best, and the retrieval performance of the platform is the best.

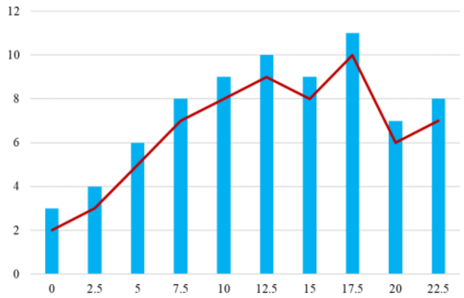


**Figure 7**: Evaluation of the experimental results of the title field.

Figure 7 shows the experimental result evaluation of the title field. Analysis of the above experimental results shows that the experimental results of the title field and the description field are quite different. The average FI value of the seven experiments in the title field is 92.58%, while the average FI value of the description field is only 66.90%. The automatic indexing for the purpose of the description can completely select the title field without selecting the description field, because the indexing performance of selecting the description field is far lower than the indexing performance of the title field, and in the Template? experiment of the title experiment the accuracy rate is 92.75%, the recall rate is 92.77%, and the F1 value is 82.86%.

## 5 CONCLUSION

The existing manual service mode of university libraries has a large workload, and the book inventory work is time-consuming and labor-intensive, and the book recommendation function for readers is not perfect. For these problems, this paper realizes the improvement of the precise positioning algorithm for books, and personalized the research and comparison of service recommendation methods realizes the information service of smart library in colleges and universities, and completes the upgrade of the automatic management system of the library service mode. The system achieves the expected goal, and there are still shortcomings that need to be improved. The work done in this paper includes: (1) Based on the VIRE algorithm, this paper proposes an improved algorithm. Through the re-division of the positioning area, nonlinear interpolation and optimization of K proximity, the density of the virtual reference tags in the positioning area is increased, the obtained signal strength is strengthened, and the position of the tag is more accurately obtained through the adjacent map. (2) In the personalized service of the system, by comparing the commonly used recommendation methods, the recommendation technology based on the collaborative filtering technology of associated content is selected. After researching the recommendation algorithm, a recommendation model for personalized service is constructed. The recommendation model is used to compare the recommendation information of the content-based collaborative filtering technology with the book information database, so as to recommend books with high relevance to readers. (3) On the basis of precise positioning of books, the functions of intelligent inventory and self-service borrowing and returning are realized. Through the precise positioning of each book, the system can accurately and timely display the location of each book and the number of books in each shelf, ensuring that the inventory work is completed in an orderly manner.

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