Information and Knowledge Management (2025)
Clausius Scientific Press, Canada

DOI: 10.23977/infkm.2025.060115
ISSN 2523-5893 Vol. 6 Num. 1

Individuation of campus library service based on intelligent recommendation algorithm

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Keywords: Intelligent Recommendation Algorithm; Campus Library; Individualized Service

Abstract: This article focuses on the individualized service of campus library, the aim is to improve service quality and maximize resource utilization by employing intelligent recommendation algorithms. Based on the theory of individualized service and intelligent recommendation algorithm of campus library, this article designs an individualized service system covering system architecture, functional modules and algorithm models. Taking 500 students in a university as the object, the experiment was carried out, they were split into two groups: the test group and the comparison group. Individualized service system based on intelligent recommendation algorithm and traditional library recommendation service were adopted respectively. Through rigorous experimental verification, the findings indicate that the experimental group achieved a recommendation accuracy of 76% and a recall rate of 63.33%, both of which are considerably higher than the control group's results (45% and 38.57%). These results demonstrate that the campus library's personalized service system, powered by the intelligent recommendation algorithm, is both practical and effective. It better aligns with user needs and offers viable solutions for the development of personalized services in campus libraries.

1. Introduction

As information technology advances rapidly, the campus library has become a key hub for knowledge sharing, is facing the challenges and opportunities of service model transformation [1]. The traditional campus library service mode often adopts the universal resource recommendation method, which is difficult to meet the diverse and individualized needs of different students and teachers [2]. The use of advanced technology to achieve personalized campus library services has become a key focus in library research [3].

As one of the key technologies in the era of big data, intelligent recommendation algorithm can accurately push resources that meet users' needs according to their behavior data and preference information [4]. Introducing intelligent recommendation algorithm into campus library services is expected to break the limitations of traditional services and improve resource utilization and user satisfaction [5]. By analyzing users' borrowing history, search records and other data, intelligent recommendation algorithm can deeply understand users' interests and knowledge needs, thus providing more targeted book recommendation services [6].

At present, some studies have explored the use of intelligent recommendation algorithms in

campus libraries, but there are still some areas to be improved [7]. Part of the research focuses on the theoretical discussion of the algorithm, lacking effective verification in practical application scenarios; Some applications are not reasonable enough in the selection and optimization of algorithm models, which leads to unsatisfactory recommendation results. Based on this background, this article conducts in-depth research, aiming at exploring a set of individualized service system suitable for campus libraries. By constructing a scientific and reasonable intelligent recommendation algorithm model and carrying out strict experimental verification, it provides practical solutions for improving the service quality of campus libraries.

2. Related theoretical and technical basis

Individualized service in campus libraries involves tailoring and offering specialized resources and services based on the specific information needs, behavioral patterns, and interests of teachers and students [8]. It is characterized by pertinence and initiative, aiming at satisfying the differentiated demands of teachers and students for knowledge acquisition and improving the utilization efficiency and service quality of library resources. The goal of this service is to help teachers and students acquire knowledge more efficiently and promote campus knowledge exchange and academic development by deeply understanding the needs of teachers and students and providing accurate book recommendation and information consultation.

Intelligent recommendation algorithm is a kind of technology based on data analysis to predict user preferences, so as to realize individualized recommendation [9]. Two commonly used algorithms are collaborative filtering and content-based recommendation. Collaborative filtering depends on the similarity of user behaviors. By analyzing the historical behavior data of users, such as borrowing records, it finds a user group whose behavior is similar to that of the target user, and recommends the books preferred by this group to the target user. A key benefit of this algorithm is that it does not rely on the content information of the book, and it can discover the potential interests of users. Content recommendation algorithm focuses on the characteristics of book content. By extracting the characteristics of books, such as subject, author and category, and matching them with the characteristics of users' interests, books that meet users' interests are recommended [10]. The algorithm can make recommendations for users' specific interests, and the recommendation results are highly interpretable. These algorithms provide technical support for individualized service of campus library, and through reasonable application, the accuracy and individuation of recommendation can be effectively improved.

3. Individualized service design of campus library based on intelligent recommendation algorithm

3.1. System architecture design

The campus library's personalized service system, driven by an intelligent recommendation algorithm, utilizes a layered architecture that primarily consists of the data layer, algorithm level and application level.

The data layer is responsible for gathering, storing, and managing different kinds of data, such as users' basic information (name, student ID, major, etc.), borrowing history, book resource information (title, author, publishing house, classification, etc.) and user search behavior data on the library platform. These data are the basis of individualized recommendation. The algorithm layer serves as the system's foundation, and various intelligent recommendation algorithm models are deployed. This layer receives the data from the data layer, uses collaborative filtering algorithm, content recommendation algorithm and so on to analyze and process it, mines users' interest

preferences and potential needs, and generates individualized recommendation results. At the same time, the algorithm layer should also have the function of model training and optimization, and modify the algorithm model based on continuously updated data to enhance the precision and efficiency of recommendations. The application layer presents the recommendation results generated by the algorithm layer to users in an intuitive and friendly way. For example, on the official website of the library, mobile applications and other platforms, information such as individualized recommended books list and recommendation reasons are displayed for users, which is convenient for users to quickly obtain book resources that meet their own needs.

3.2. Functional module design

User information management module: handles the entry, modification, and removal of user data. It also performs in-depth analysis of the information, generating characteristic tags for each user, such as professional direction and reading preference, are extracted to provide data support for individualized recommendation.

Book resource management module: comprehensively manage all kinds of book resources in the library, including book editing, shelves, shelves and other operations. Each book is annotated with detailed information, so that the algorithm layer can accurately extract the book features and achieve accurate recommendation.

Recommendation module: according to the recommendation results generated by the algorithm layer, combined with the user's current operating scenarios and needs, display individualized book recommendation content to users. The recommendation methods are diversified, such as popular recommendation, recommendation based on users' historical behavior, recommendation based on similar users, etc., to accommodate the diverse needs of various users.

Feedback module: collect users' feedback information about the recommended results, such as whether they are interested or not, whether to borrow or not, etc. These feedback data will flow back to the data layer to further optimize the algorithm model and form a closed-loop optimization mechanism to continuously improve the quality of recommendation services.

3.3. Algorithm model construction

Combined with the characteristics of campus library, a hybrid recommendation algorithm model combining collaborative filtering algorithm and content recommendation algorithm is constructed. Firstly, the collaborative filtering algorithm is used to analyze user behavior similarities, find a user group with similar interests to the target user, and obtain books borrowed by this group but not borrowed by the target user as candidate recommendation sets. At the same time, the content recommendation algorithm is used to match the content characteristics of books with the interest tags of target users, and the books that meet the interests of users are selected to join the candidate recommendation set. Then, the books in the candidate recommendation set are comprehensively sorted. In the process of sorting, many factors are considered, such as the preference of users for different types of books, the popularity of books, the confidence of recommendation algorithms and so on.

By analyzing the user's feature vectors of scored books, the user's interest model is constructed. A straightforward approach is to obtain the user's interest vector y_u by weighted average of the book feature vectors scored by users. Suppose the user u scored the book $d_1, d_2, d_3, \ldots, d_m$, and the scores are as follows:

$$r_{u1}, r_{u2}, r_{u3}, \ldots, r_{um} \tag{1}$$

Then:

$$y_u = \frac{\sum_{k=1}^{m} r_{uk} \times x_{dk}}{\sum_{k=1}^{m} r_{uk}} \tag{2}$$

Recommendation prediction: calculate the similarity between user interest vector y_u and feature vector x_j of books to be recommended, such as cosine similarity;

$$Sim(y_u, x_j) = \frac{y_u, x_j}{\|y_u\| \times \|x_j\|} \tag{3}$$

Sort books according to similarity and recommend books with higher similarity to users.

In the actual hybrid algorithm model, the recommendation results of collaborative filtering algorithm and content recommendation algorithm are integrated. By setting different weights α and $(1-\alpha)$ to fuse the predicted scores of the two algorithms, the final predicted score P_{final} is obtained:

$$P_{final} = \alpha \times P_{CF} + (1-\alpha) \times P_{CB} \tag{4}$$

Where: P_{CF} is the score predicted by collaborative filtering algorithm; P_{CB} represents the score forecasted by the content recommendation algorithm, and the recommendation effect can be optimized by adjusting the value of α. By setting the weights reasonably, this approach guarantees that the recommendations not only cater to users' individual preferences but also consider popular and high-quality book suggestions.

In order to make the algorithm model adapt to the needs of campus library users and the dynamic changes of book resources, the model is updated and trained regularly. Using the newly generated user behavior data and the newly added book resource information, the model parameters are fine-tuned to enhance recommendation precision and responsiveness, ensuring more personalized and efficient services for campus library users.

4. Experimental verification and analysis

4.1. Experimental design and process

This experiment aims to evaluate the efficacy of the campus library's personalized service system utilizing an intelligent recommendation algorithm. The experiment selected 500 students from different majors and grades in a university as the experimental objects. The experiment set the recommendation accuracy and recall rate as the main evaluation indexes. The students were randomly assigned to one of two groups, experimental or control, with each group comprising 250 participants. The experimental group utilized a personalized service system powered by an intelligent recommendation algorithm, while the control group used traditional library recommendation service.

Before the experiment began, we collected the borrowing records of all the subjects in the past semester and their search behavior in the library system as the basic data of users' interests. During the experiment, students in the experimental group obtained recommended books through individualized service system, while students in the control group obtained recommended books through traditional library recommendation channels. The experimental period is one month, and

the behavior data of two groups of students such as clicking and borrowing recommended books during the experiment are recorded.

4.2. Analysis of experimental results

Following the experiment, the gathered data is organized and analyzed, as shown in Tables 1 and 2:

Table 1: Comparison of recommendation accuracy between experimental group and control group

Group	Total number of recommended books	Number of books in line with users' interests	Recommendation accuracy
Experimental group	1250	950	76%
Control group	1200	540	45%

As presented in Table 1, the experimental group achieved a recommendation accuracy of 76%, significantly higher than the control group’s 45%. This indicates that the system utilizing an intelligent recommendation algorithm can more precisely identify books that align with users' interests. The experimental group relies on intelligent algorithm to deeply analyze user behavior data and book characteristics, which can more accurately match recommended books with user interests. In contrast, the traditional recommendation service lacks sufficient mining of users' individualized information, resulting in a low proportion of recommended books that meet users' interests.

See Table 2 for specific data on recall rate:

Table 2: Comparison of recall rates between experimental group and control group

Group	Total number of books that users are actually interested in.	Number of books in the recommendation list that meet the interest	Recall rate
Experimental group	1500	950	63.33%
Control group	1400	540	38.57%

As shown in Table 2, the experimental group achieved a recall rate of 63.33%, while that of the control group is only 38.57%. This means that the experimental group's system based on intelligent recommendation algorithm can cover the books that users are actually interested in more comprehensively. Through the comprehensive analysis of massive data, intelligent recommendation algorithm can not only recommend similar books according to users' existing behaviors, but also tap users' potential interests, so as to include more books that users may be interested in in in the recommendation list.

By integrating the experimental findings on recommendation accuracy and recall, the campus library's individualized service system, powered by an intelligent recommendation algorithm, demonstrates a clear advantage over traditional recommendation services. It more effectively fulfills students' personalized book needs while also confirming the system and algorithm model's effectiveness and practical value.

5. Conclusions

This article focuses on the individualized service of campus library based on intelligent

recommendation algorithm. By building a hierarchical system, the design includes user information management, book resource management and other functional modules, by integrating collaborative filtering with content-based recommendation algorithms, a hybrid recommendation model was developed, which provides a complete solution for individualized service of campus libraries. The experimental results show that the experimental group using the individualized service system has obvious advantages in recommendation accuracy and recall compared with the control group using the traditional recommendation service, with the recommendation accuracy increased by 31% and the recall increased by 24.76%. This shows that the intelligent recommendation algorithm can effectively tap users' interests, accurately push the book resources that meet the needs, and significantly enhance the personalization and precision of campus library services.

However, the study also has certain limitations, including a relatively brief experimental period, which may not fully reflect the long-term use effect; And only one college student is taken as the sample, so there is room for improvement in representativeness. In the future, the experiment period can be extended, the sample range can be expanded, the algorithm can be progressively refined to enhance the recommendation system's performance, offering stronger support for the advancement of personalized services in campus libraries, and promote the spread of campus knowledge and academic exchanges.

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