Personalized Recommendation Technology of Network Teaching Resources Based on Ant Colony Algorithm

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Abstract. In order to solve the problem of low recall rate in traditional network teaching resources personalized recommendation technology, an ant colony algorithm-based network teaching resources personalized recommendation technology was designed. By describing the user's online teaching resource interest, the user's online teaching resource interest is acquired, and the ant colony algorithm is used to dynamically adjust the user's online teaching resource interest to obtain information that the user is interested in, that is, the user's personalized characteristics, and to generate a synthesis User interest models, including individual user models, group user interest models, and integrated user interest models, build a personalized recommendation model for online teaching resources, including the application layer, business logic layer, and data layer, to achieve personalized recommendation for online teaching resources. In order to prove the high recall rate of the personalized recommendation technology of network teaching resources based on ant colony algorithm, the traditional personalized recommendation technology of network teaching resources was compared with this technology. The experimental results show that the recall rate of this technique is higher than that of the traditional personalized recommendation technique.

Keywords: Ant colony algorithm · Network teaching resources · Personalized recommendation of resources

1 Introduction

At present, online teaching has become an important way to cultivate talents and promote the development of scientific research and education. However, the network is only the carrier of information transmission, the acquisition and sharing of teaching resources is the purpose of people using the network. In order to make the network and information technology truly serve for teaching and realize the optimization of teaching process and teaching resources, it is necessary to have abundant teaching resources to support [1]. The prerequisite for the development of online teaching is to build a complete and

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substantial system of online teaching resources. The construction of teaching resource base is the core content of educational informatization. In the development of online teaching, countries all over the world have realized that the sharing of teaching resources and the interoperability of systems are decisive to the practicability and economy of online education. At present, the teaching resource database system is mainly used for the management of teaching resources such as materials, courseware, integrated parts, online supplementary materials and teaching plans that have been developed and made, and for the uploading of teaching resources, searching of teaching resources and downloading of teaching resources [2]. It mainly focuses on "objects" and fails to reflect the idea of "people-oriented". In particular, the existing teaching resources are not personalized and intelligent, which makes it difficult to manage and inconvenient to use teaching resources. Due to the individual differences in users' learning starting point, learning style, learning desire and learning pace, there is a general contradiction between massive teaching resources and users' personalized needs. Because of the existence of this contradiction, on the one hand, caused a huge waste of teaching resources, on the other hand, for users to find and use the teaching resources caused great difficulties [3]. All these problems hinder the play of teaching resources in teaching, resulting in a great waste of teaching resources.

In the teaching resource database system to add personalized services, so that the user network teaching resources personalized recommendation will fundamentally solve this contradiction. The essence of personalized recommendation is to respect users, study their habits and interests, and provide better services for users to choose the teaching resources they need. Based on this, a personalized recommendation technology of network teaching resources based on ant colony algorithm is designed.

2 A Personalized Recommendation Technology of Network Teaching Resources Based on Ant Colony Algorithm Is Designed

2.1 User Interest Extraction and Adjustment

Firstly, the user's interest in network teaching resources is described, then the user's interest in network teaching resources is acquired, and finally the user's interest in network teaching resources is dynamically adjusted based on ant colony algorithm [4]. Interest to the user's network teaching resources is described first need to grasp the user's interest, user's interests is the user's personalized features, it is determined by the human individual characteristics in its demand for teaching resources of the combination of characteristic information, and is determined by the particular user demand for the teaching resources of relations and produce a series of useful information for the individual. After the teaching resource is characterized by keywords, the user's interest in a teaching resource can be equated with his interest in the teaching resource keywords. If users have a great interest in a teaching resource, they will spend their energy to acquire it. As the basic way for Web users to acquire teaching resources is to browse, the user's previous browsing of teaching resources contains the user's personalized characteristics. The more times the user visits the teaching resources and the closer the recent access time is, the more interested the user is in the teaching resources. That is, the intensity of

interest should include the number of visits and the last visit date, the two actual interest indicators [5].

Then, there are two ways to acquire users' interest in network teaching resources and obtain personalized information reflecting users' information: The first method is to record the user's access characteristics by the teaching resource library system into a log file, and then summarize the user's interest model by analyzing the log file or the log file generated by the browser. The second way is for users to provide their own personalized feature information by filling in the form. The second method is used to collect the initial personalized characteristics of users, and the first method is used to timely track the personalized characteristics of registered users. The basic information base of users is used to save the static information of users. A user personality library is used to store the dynamic information of the user, that is, the user personalized access characteristics. The formal definition of their structure is as follows:

Definition l: user static information *US*, Namely, the basic information base of users, which is a database:

$$US = \{UID, NAME, SPECIALIZED, GRADE\} \tag{1}$$

Where, *UID* represents the user number; When the user registers, the system automatically generates; *NAME* represents the description of *US*, that is, the user name; *SPECIALIZED* represents the constraint of *US*, the user's specialty; *GRADE* represents the constraint of *US*, the user's grade [6].

Definition 2: user dynamic information *UD*, that is, the database of user personality characteristics is a database:

$$UD = \left\{ \begin{array}{l} UID, KEY\_WORD, COUNT, \\ LAST\_DATE, UNITE\_INDEX \end{array} \right\} \tag{2}$$

Where, *UID* represents the user number; When the user registers, the system automatically generates; *KEY_WORD* represents key words; *COUNT* represents the cumulative visits of users to keyword *KEY_WORD*; *LAST_DATE* represents the last access date for saving the user to keyword *KEY_WORD*; *UNITE_INDEX* is a distribution function of *KEY_WORD* to [0, 1], Indicates the degree of user interest in *KEY_WORD*. Is the comprehensive interest index of users on keyword *KEY_WORD*, which is obtained according to *COUNT* and *LAST_DATE*. While *KEY_WORD* belongs to *KEYS*, as shown in formula (3):

$$KEY\_WORD \in KEYS \tag{3}$$

Where, *KEYS* represents the keyword set.

User personality traits in the library all the words from the users are most interested in teaching resources of keywords selected, weights of each entry in the library reflects the word and the relevance of the user interests, because in a specific time, the user's interest is relatively stable, the user's interest is approximated by a finite number of keywords can express. When the user is successfully registered, the teaching resource database system will ask the user to fill in a demand information form for teaching resources, the demand information is the initial characteristics of the user's interest, and will establish a user

personality characteristics database for the user to record these initial characteristics of interest [7].

Finally, based on ant colony algorithm, the user's interest in network teaching resources is dynamically adjusted, and the user's browsing and related feedback on teaching resources are timely adjusted and updated. That is, extract all keyword names, cumulative visits and recent access dates of teaching resources of interest to users, and add the user's personality library according to the following algorithm:

Algorithm: adjustment of the user's personality feature library: according to the user's browsing of teaching resources or related feedback, the corresponding keyword *key* is added to the user's personality feature library.

Input: teaching resource keyword *key*, current date *D*, user personality library *UD*.
Output: a library of user characteristics.
Methods
if the user's personality characteristics database capacity is full {the response ratio of each keyword is calculated systematically S_i; Eliminate the keywords corresponding to the maximum value;}
else
{add a record:
$KEY\_WORD =$ user keyword k;
$LAST\_DATE =$ current date D:
$COUNT = 1$;}
Calculate the comprehensive interest index $UNITE\_INDEX$ of keyword *key*.

In the adjustment algorithm of user personality characteristic library, response ratio is defined as:

$$S_i = \frac{D_t - D_i}{C_i} \tag{4}$$

Where, S_i represents the response ratio of each keyword; D_t represents the current date; D_i represents the most recent visit date of the keyword; C_i represents the cumulative visit times of the keyword. The algorithm flow of personalized recommendation technology for network teaching resources based on ant colony algorithm is shown in Fig. 1.

As can be seen from Fig. 1, it can be seen that: if the keyword's recent access time is the same, the access frequency is less to be eliminated; If the keyword access times are the same, the most recent access time far from the current time is eliminated. This adjustment strategy considers the time and times of users' interest, which is a better method.

2.2 Building a User Model

Personalized service of teaching resources is not a pointer to a user, but to provide the information that the user really needs, that is, the problem of accurate filtering. A user model is a representation of a user's information needs or interests. There are two steps to get a user model. First, the information that the user is interested in, that is, the

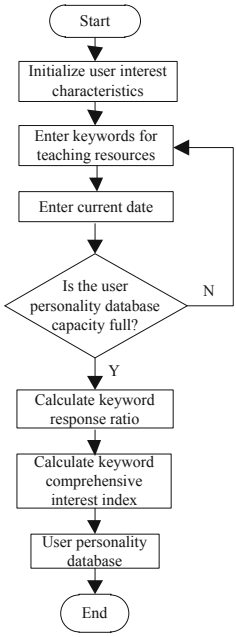


Fig. 1. Algorithm flow of personalized recommendation technology for network teaching resources based on ant colony algorithm

personalized characteristics of the user, and then the user model is constructed according to these characteristics. Design a library of user characteristics for each user to obtain and track the user's personalized access characteristics; Individual user model was adopted to realize individual filtering, group user model to realize collaborative filtering, and comprehensive user model to realize comprehensive filtering.

Firstly, the individual user model is constructed, which is the description of individual user's personalized interest in teaching resources. The vector space model is used to represent the user's interest, which is regarded as a vector of multi-dimensional space, and is closer to the user's demand than the keyword matching. Therefore, a keyword-based user model U can represent the user vector by a pair (character item, weight) according to the traditional vector representation [8].

Then build the group user interest model, the group user interest, can have a more important effect on the individual user interest. Therefore, the group user interest model is generated according to the individual user interest clustering, and the comprehensive user model is formed through the individual's inheritance of the group user interest, so as to realize the conceptual expansion of the process of teaching resource filtering, and the user model has the ability of keyword expansion and self-adaptation [9]. First, the 20 users whose interest is closest to that of the individual user are found, and these 20 users and the designated user jointly form a group. The first 100 keywords of the group's common interest are extracted, and the group user model centered on the designated individual user is obtained. Compared with the individual user model of the specified

user, the group user model contains a broader range of interests, which can effectively extend the interest characteristics of the specified user.

From the previously generated individual user interest vector and group user interest vector, 100 keywords with high comprehensive interest index and corresponding comprehensive interest index are selected to construct the comprehensive user interest vector I (if there is repetition, remove one item with small comprehensive interest index). Then this comprehensive user interest vector not only reflects the individual user's personalized interest characteristics, but also contains the group interest characteristics of multiple users with similar interests. The steps for generating a comprehensive user interest model are shown in Table 1.

Table 1. Steps for generating a comprehensive user interest modelserial number

	Step	Content
1	Create individual user interest vector	According to the individual filtering technology, the first 100 high weight keywords in the user's personality database are selected to create the individual user's interest vector U
2	Select users to form user groups	According to the collaborative filtering technology, multiple users closest to the specified user's interests are selected to form a user group
3	Build group user interest vector	According to the interest characteristics of the user group, the first 100 keywords with the largest comprehensive interest index value are selected to construct the group user interest vector G
4	Building a comprehensive user interest vector	From the individual user interest vector and group user interest vector generated previously, 100 keywords with high comprehensive interest index and corresponding comprehensive interest index are selected to build the comprehensive user interest vector I (if there is repetition, remove the one with small comprehensive interest index)

2.3 To Achieve Personalized Recommendation of Network Teaching Resources

The construction of personalized recommendation model of network teaching resources includes application layer, business logic layer and data layer. Through the construction of network teaching resources personalized recommendation model to achieve personalized recommendation of network teaching resources. Of application layer is the view layer of the model, to provide users with services, the main features are: resources

construction and sharing of learning resources (including upload and download, update and delete uploaded a resource, resource information search and preview), user management functions, including user registration, users' personal information preview, update, and delete), grade management functions (including learning resources for grading and evaluation in words).

Data layer is deposited personalized recommendation model all the data needed for the network teaching resources information, mainly including user basic information, learning resource information, various recommended number display Settings information, user history grading and evaluation information, etc., these data are from the model of interactive activities [10].

The business logic layer is the recommendation algorithm part of the model, which is also the difficulty and key part of the model. It is responsible for recommending learning resources that meet learners' interests and preferences and their own needs. The work of this layer includes the construction of user project rating matrix, the calculation of similarity between projects, the generation of pseudo-rating matrix, the calculation of similarity between users, the assessment of resource prediction and the generation of recommendation list.

The input part of the personalized recommendation model of network teaching resources includes the basic information of users and the score information of resources, and the output part is the personalized recommendation list of learning resources, which is presented to the target users in the form of a list. The recommendation based on the user's basic attributes and the recommendation of ATCF shall go through three steps of data processing, recommendation algorithm calculation, and prediction resource score to generate the recommendation data set, as shown in Table 2.

3 Experimental Research and Analysis

3.1 Comparative Experimental Study

Five categories with relatively uniform sample distribution and obvious category characteristics were selected, including computer science and technology, literature, mathematics, history, sports and so on. Among them, 60 articles in each category, a total of 300 texts, were used as experimental data. The configuration required for program operation in the experiment is shown in Table 3.

The personalized recommendation experiment of network teaching resources was carried out by using experimental data. In order to ensure the comparability of the experimental data, the traditional network teaching resource personalized recommendation technology is compared with the ant colony algorithm-based network teaching resource personalized recommendation technology designed in this paper. The traditional network teaching resource personalized recommendation technology includes the network teaching resource personalized recommendation technology based on the coordination and filtering technology and the network teaching resource personalized recommendation technology based on the personalized service model. Compare the recall rate of each technology. Recall rate refers to whether the number of relevant resources recommended to users can cover all qualified resource records. It is generally used to describe the ability of personalized recommendation of relevant resources.

Table 2. Recommended steps

Serial number	Step	Content
1	Data processing	It is mainly responsible for preprocessing and calculating the data information in the system to provide a data basis for personalized recommendation technology
2	Recommended algorithm calculation	The recommendation algorithm is a key part of the entire recommendation model. Adopt user basic attribute recommendation technology, repeat the calculation according to the similarity formula, find out the most similar K users among the target users, and establish similar user data sets
3	Generate recommendation data set	The recommendation result uses the target user's similar user set to obtain the target user's predicted score for unscored items. and according to the score level to get the final top-N resources for recommendation, so as to realize the recommendation of the target user

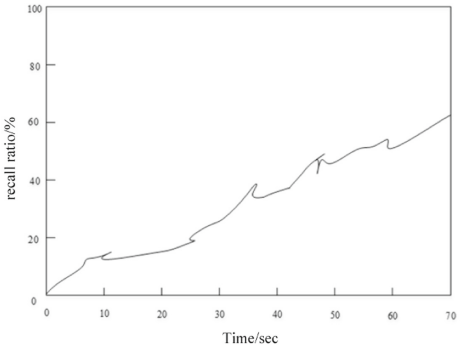
Table 3. Configuration required for program operation in the experiment

Serial number	To configure	Content
1	Hardware configuration	CPU: Intel Pentium 4-m 2. 00 GHz, memory: 1 GB, hard disk: 80 g
2	Software configuration	Operating system: Windows XP, database system: SQL Server 2005, client: IE6. 0 or above

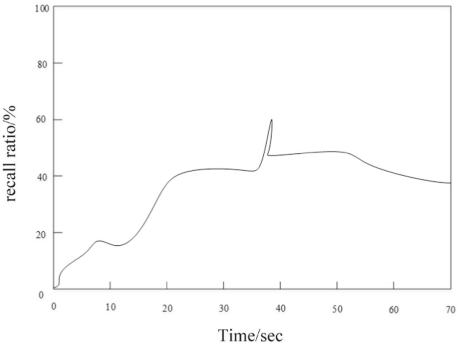
3.2 Research and Analysis of Experimental Results

The experimental results of recall comparison between the traditional personalized recommendation technology of network teaching resources and the personalized recommendation technology of network teaching resources based on ant colony algorithm are shown in Fig. 2.

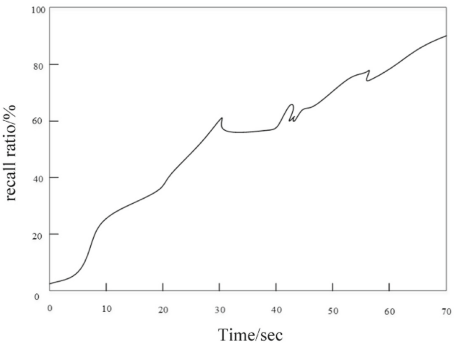
According to the comparison experiment results of recall in Fig. 2, the recall rate of personalized recommendation technology of network teaching resources based on ant colony algorithm is higher than that of personalized recommendation technology based on coordination filtering technology and personalized service model.



(a)Recommendation technology based on coordination filtering technology



(b)Recommendation technology based on personalized service model



（c）Recommendation model based on ant colony algorithm

Fig. 2. comparison of recall results

4 Conclusion

The personalized recommendation technology of network teaching resources based on ant colony algorithm can solve the problems of users' difficulty in finding the needed teaching resources and low utilization rate of teaching resources to some extent, and realize personalized active recommendation.

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