Design of music audio-visual archives resource management system based on random forest algorithm

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ABSTRACT

With the development of IT (Information technology), the frequency of digital management is increasing. For music audio-visual archives, the traditional management mode is no longer suitable for the development of the times. Realizing digital management can better improve the management efficiency of music audio-visual materials and improve the storage safety and utilization efficiency of music audio-visual materials. Therefore, on the basis of analyzing the structure and characteristics of the digital management system of audio-visual archives, this paper constructs a music audio-visual archives resource management system based on RF (Random forest) algorithm. RF algorithm is a statistical learning theory that includes multiple decision tree classifiers. It uses feature subspace to construct the model, which can better deal with noise and avoid over-fitting. Based on the construction process of decision forest, this paper puts forward an improved RF method. The results show that the error of the algorithm is low and the accuracy is high, which can reach 95.47%. At the same time, the proposed method can intelligently recommend relevant music audio-visual archives resources to users according to their needs, which further improves the management efficiency and utilization efficiency of music audio-visual materials.

Keywords: Random forest algorithm; Music; Archives resource management

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1. INTRODUCTION

Based on the gradual transformation of music audio-visual archives management in the IT era, the disadvantages of the traditional management mode gradually appear. The traditional management of audio-visual files is based on magnetic tape, which is often demagnetized to varying degrees by temperature, humidity, dust and various human factors [1]. Moreover, with the increase of preservation time, the signal and quality of audio-visual materials will be affected. To avoid this phenomenon, it is necessary to build a high-quality and large-space storage place for audio-visual archives, and monitor and maintain them regularly [2]. This will increase the management cost of the audio-visual archives management department and increase the consumption of time and talents. With the continuous development of archives, in all kinds of archives at all levels, the scale of audio-visual archives is getting bigger and bigger, the level is getting higher and higher, the quality is getting better and better, and the number is increasing [3]. In order to improve the management efficiency of music audio-visual archives resources, data technology should be applied to realize the information development of archives resources management [4]. The modernization of archives management is a necessary measure for social and cultural progress. The management of audio-visual archives is an important part that cannot be ignored, and it is also the key and difficult point in archives management [5]. More and more people pay attention to the modernization of audio-visual archives management, and at the same time they are interested in the measures to optimize their management. Audio-visual materials, also known as audio-visual materials, are dynamic materials that take electromagnetic film materials as carriers and electromagnetic waves as information symbols, record language sounds and text images, and store and play information through audio-visual equipment. Archival work in the IT era can manage all files such as words, pictures, music and videos in a new way, so that they can play a greater role [6]. Especially in the management of music audio-visual files, the use of data management can create greater social benefits in the storage, management and inquiry of audio-visual files [7]. The significance of the existence of archives is not only the preservation of itself, but also the application of the internal information of archives, but all of which need to be based on the premise of the integrity of archives. The preservation of audio-visual archives is a challenge for archives management measures, and it is also of great significance to rationalize its management [8]. In order to realize the sharing of archives information, in the specific implementation, the archives can be carved into CDs, music or voice can be added and played through the network to ensure the realization of resource sharing. Therefore, the relevant departments must strengthen the retrieval of relevant archival information, enrich the information resources of all kinds of stored archives, and deepen the content of archival information [9]. However, in the current management of music audio-visual files, even if computer technology is used, the file information is simply processed by computer, and the audio-visual materials are not catalogued further. As a result, the amount of work in file management, searching and borrowing will increase and the work efficiency will be low [10]. Based on the above, this paper analyzes the structure and characteristics of the digital management system of audio-visual archives, and constructs a music audio-visual archives resource management system based on RF algorithm. It further improves the management efficiency and utilization efficiency of music audio-visual materials.

2. METHODOLOGY

2.1 Relevant theoretical and technical basis

Audio-visual materials have the functions of preserving music cultural heritage, providing academic information and serving teaching and scientific research, and the ways of editing and editing audio-visual materials are extensive and flexible. The management of audio-visual archives is very important in the development of the whole project management, which contains a large number of precious audio-visual materials. By digitizing audio-visual archives, music audio-visual archives can be stored in the form of numbers 0 or 1, and a music audio-visual archives resource management system can be constructed [11]. Music audio-visual archives administrators can operate in this management system, which can reduce the workload of music audio-visual archives management and improve the management efficiency of audio-visual archives. At the same time, the quality of managers will have a direct impact on the management quality level in the management of music audio-visual archives resources. Therefore, the relevant departments should strengthen the training of managers, so as to improve their own quality level, help them master more management experience and skills, fully optimize the knowledge structure of managers and expand their knowledge. Strengthening the construction of music audio-visual archives resource management system aims to realize the complementary and sharing of audio-visual materials resources, improve the utilization rate of collections, and effectively alleviate the shortage of personnel, funds and storage space. It is conducive to the development of archives,

books, intelligence, information centers and other departments at all levels in a characteristic, professional and systematic direction to better meet the needs of all aspects of society. At the same time, the realization of digital management of music audio-visual archives is not only to improve management efficiency, but also to improve the efficiency of information search. By constructing the corresponding music audio-visual file resource management system, users can quickly search for information through the corresponding query system. After the user accurately finds the target data with the help of the data retrieval engine, he requests the system to call or download and output, and the storage management system quickly locates the required program according to the user's requirements. Users can find the information they need in time and make use of it, thus enhancing the practicability of their audio-visual files and avoiding the situation that audio-visual files are put on hold for a long time. It greatly reduces the management cost and improves the use efficiency of digital management of music audio-visual files.

The sampling frequency of audio has an important influence on the sound quality of audio. The higher the sampling frequency of audio, the better the sound quality. On the contrary, the lower the sampling frequency of audio, the worse the sound quality. However, the higher the sound quality, the greater the amount of audio data and the larger the storage space of audio data [12]. On the whole, in order to better ensure the sampling quality of audio, the frequency of 44.1kHz can be used when sampling audio. At the same time, in order to avoid the loss of audio-visual files, we should do a good job of backup, constantly improve the file preservation system, and regularly check the files to avoid related problems. Due to the high quality and high capacity requirements of audio and video data, it is difficult to control the construction cost of digital management system of audio and video archives. Therefore, when choosing a large-scale system with comprehensive functions, high performance and high efficiency, many archives have to face the reality that the initial investment cost is high. In this paper, on the premise of ensuring the system performance and equipment quality, through repeated testing and evaluation of equipment, the best cost-effective hardware equipment is selected to save the cost to the greatest extent. Although the retrieval technology of music audio-visual materials is very complicated, it should be simple and easy to operate. Even users who don't know anything about computers can operate by simulating buttons on the screen, so that people can get the information they need in an acceptable way. Hard disk storage is based on computer. Audio and video files are stored on hard disk, and can be read by computer when reading. Hard disk uses magnetic media to store data, and a hard disk has several disks. Hard disk can be used to store some important audio-visual archives. Moreover, the hard disk is used to store audio-visual archives, which can also avoid the influence or damage of audio-visual archives due to humidity and high temperature.

2.2 Design of music audio-visual archives resource management system

The storage safety of music audio-visual archives can be greatly improved by digitalization. The traditional storage form of audio-visual materials is in the form of magnetic tape. With repeated use, the quality of music audio-visual materials will become worse. By constructing a music audio-visual file resource management system to realize digital management, the damage of audio-visual materials can be avoided. Because music audio-visual materials are saved in the form of files, even if the music audio-visual materials are read many times, the quality of the audio-visual materials will not be damaged. The overall structure diagram of the music audio-visual file resource management system is shown below.As shown in Figure 1.

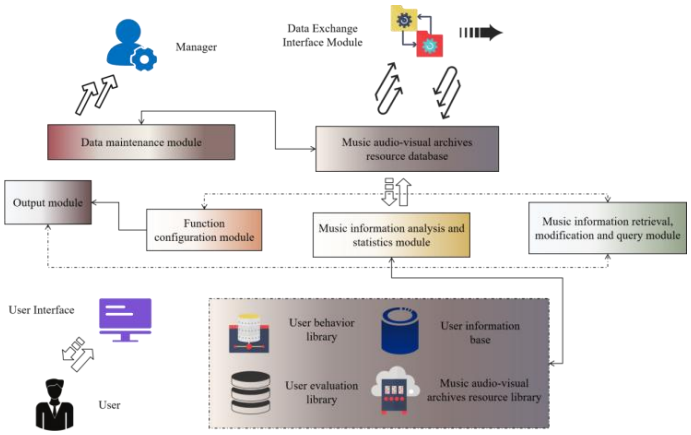

Figure 1. Overall structure diagram of music audio-visual archives resource management system.

RF is an algorithm based on classification tree. The algorithm selects n training subset samples from the training set without replacement. In particular, each sample subset is randomly selected from the original data set, so the training data set of each tree is different. Each training subset generates a decision tree. These n decision trees constitute RF. All decision trees are trained using the same learning algorithm. RF algorithm improves the prediction accuracy without significantly increasing the complexity, and is insensitive to multiple linearities, so it is more robust to missing data and unbalanced data. This paper uses multi-source information including audio information, music label, release year and singer identification information, and realizes multi-source information fusion through RF model. The model solves the cold start problem through two-stage architecture, and constructs a more complete feature system through multi-source information fusion. The cataloging system carries out unified, scientific and standardized cataloging indexing of the materials to be archived, and turns disorderly information into orderly resources. In this paper, the connotation of various materials is fully revealed and standardized indexing description is carried out, so as to provide necessary retrieval ways and as many retrieval points as possible for retrieval. After obtaining RF, when a new test sample enters RF, it is actually to let each decision tree vote separately, and finally choose the one with the most output categories among all decision trees as the classification result. Given the training sample set:

$$(x_i, y_i), i = 1,2,3,\ldots,l, x \in R^n, y \in \{\pm 1\} \tag{1}$$

The hyperplane is denoted as $(w \cdot x) + b = 0$. In order to correctly classify all samples and have the maximum distance interval, the following constraints must be met:

$$y_i[(w \cdot x) + b] \geq 1, i = 1,2,3,\ldots,l \tag{2}$$

It can be concluded that the geometric distance of classification is $\frac{2}{\|w\|}$. Therefore, the problem of constructing the optimal hyperplane is transformed into solving under the constraint conditions:

$$\min \phi(w) = \frac{1}{2}\|w\|^2 = \frac{1}{2}(w' \cdot w) \tag{3}$$

In order to solve this constrained optimization problem, Lagrange function is introduced:

$$L(w,b,a) = \frac{1}{2}\|w\| - a\{y[(w \cdot x) + b] - 1\} \tag{4}$$

Where $a_i > 0$ is Lagrange multiplier. The solution of constrained optimization problem is determined by Lagrange function, and the solution of optimization problem satisfies the partial derivative of w and b at point.

When calculating similarity, because the data is generally sparse, the number of users who have acted on products is relatively small, and the data without behavior will often have a certain impact on the results. Therefore, in order to calculate the accuracy of similarity, when calculating the similarity between users, only the vectors formed by products that they have had common behaviors are selected to calculate the similarity. Multi-source information fusion refers to the combination of multiple information sources according to specific standards, in order to get a consistent description or explanation of the tested object, so that the information system has better performance than its subsystems. In this paper, the audio information, release year, label information and singer identification information of music are extracted and deeply fused to get an effective model. However, because there are a lot of dirty data in the original data, it is necessary to preprocess the data before the subsequent analysis. In the data analysis, it is found that it has been praised many times and needs to be duplicated. For interactive records such as browsing and praise, these data need to be deleted. In addition, digital acquisition is used to realize the processing of traditional media and traditional signals by computer software and hardware to generate digital media data, and save it on digital media in an open file format and coding format. When constructing the music audio-visual archives resource management system, the storage format of music audio-visual materials has a very important influence on the preservation of audio-visual materials, and different storage formats have different data volumes. In this paper, when music audio is saved, different storage formats are selected according to different requirements. At the same time, on the premise of ensuring system performance and equipment quality, the hardware equipment with the best cost performance is selected through repeated testing and evaluation of

equipment; Through the practical work experience, the system structure is optimized to the greatest extent, and the cost investment is saved on the premise of meeting the system requirements.

3. RESULT ANALYSIS AND DISCUSSION

Under the background of the current era, it is a problem that relevant personnel must pay attention to that the management of music audio-visual archives resources should be managed in an all-round way, so that it can better cope with the impact of networking on archives work, better improve the efficiency of the use of audio-visual archives and better serve the society. The traditional management mode of music audio-visual archives resources consumes a lot of manpower and material resources. In this case, strengthening unified management of materials can save more money and material resources. At the same time, the archives are effectively integrated, which provides more convenience for the search of subsequent materials. Based on the analysis of the structure and characteristics of the digital management system of audio-visual archives, this paper constructs a music audio-visual archives resource management system based on RF algorithm. In order to verify the effectiveness of the proposed method, this section carries out experimental analysis.

The experimental platform in this section is Canopy, which is an integrated development environment of Python. More than 450 Python packages for scientific calculation are integrated on it, and Scikit-Learning package is used in the experiment. There are many tool functions of machine learning, which can effectively reduce the difficulty of experiment realization. The system adopts Windows. In addition, in order to reduce the complexity of audio data learning, this paper converts WAV format audio data into Mel spectrum through short-time Fourier transform and Mel filter bank, and uses Mel spectrum as the input of the model. Firstly, the improved RF algorithm and classical RF algorithm are compared and analyzed respectively. The result shown in Figure 2 is obtain.

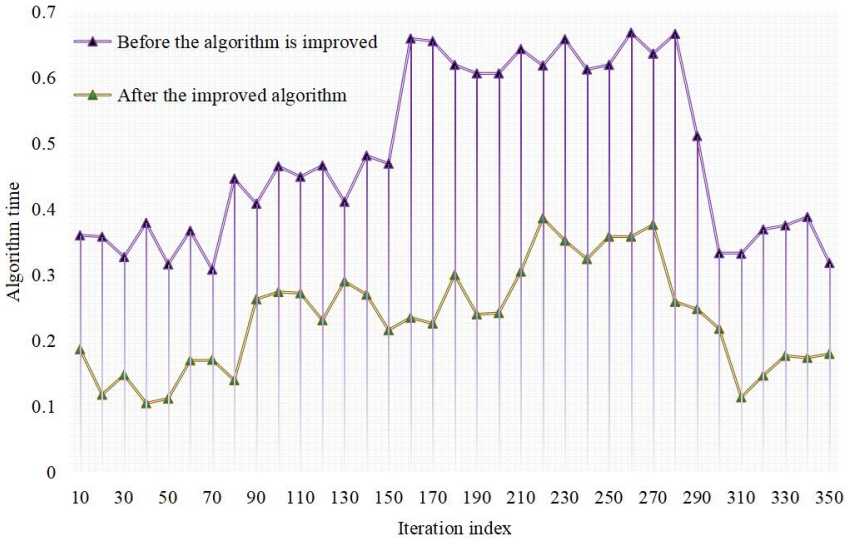

Figure 2. Comparison before and after algorithm improvement

Video sampling format refers to the way to obtain brightness and color information when digitizing video materials. Different sampling formats have different ways to obtain brightness and color information. Because people's sensitivity to chroma is obviously lower than that of brightness, when sampling video, this paper reduces the sampling chroma relatively, which can effectively reduce the video capacity and storage space. Cataloging is mainly to describe all kinds of video and audio programs and materials, and its process is equivalent to creating a text description index for the stored data for future reuse. Because the cataloging work is mainly carried out manually by catalogers, the efficiency and quality of cataloging will have a direct impact on the provision and utilization of system data.

Due to the limitation of computing resources and time cost, this paper chooses to extract a random 3s WAV format audio data of one channel in the experiment and divide the audio data into a unified format. The construction of decision tree in RF is the core of model building. The number of decision trees directly affects the operation speed and classification effect of RF classification algorithm, so the number of decision trees is very important for modeling. Considering the decision tree contained in RF and the speed of modeling, it is ideal to select 11 decision trees in RF classification algorithm, which makes the system get accurate results quickly and meet the needs of the system for the time limit of recommendation. Figure 3 shows the error results of different recommendation algorithms. The recommendation accuracy results of different algorithms are shown in Figure 4.

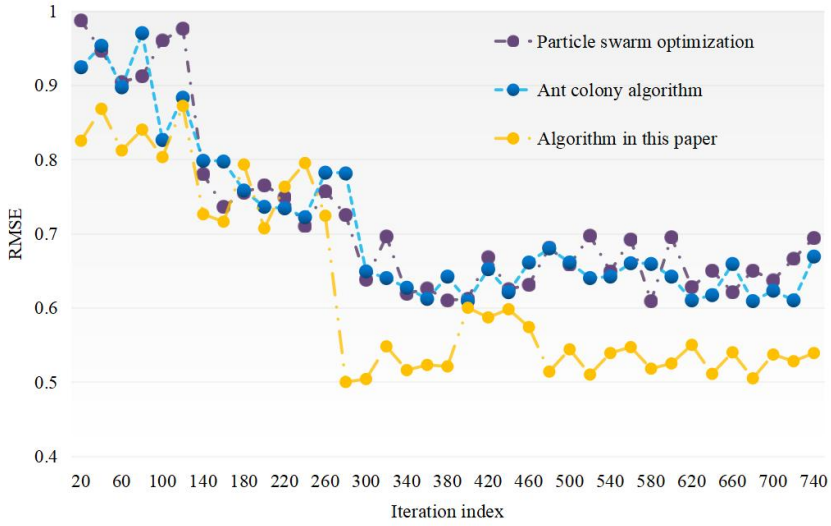

Figure 3. Algorithm error result

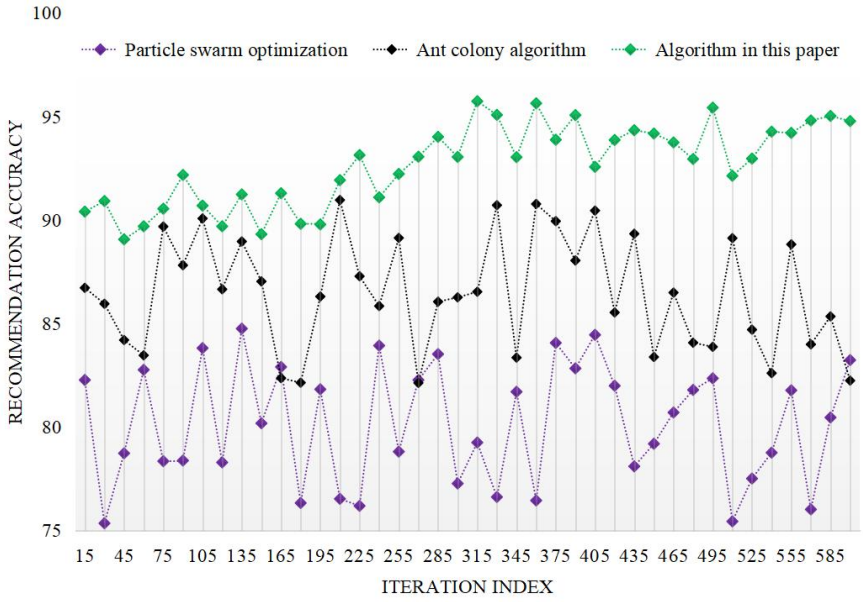

Figure 4. Algorithm recommends precision results

The experimental results in Figure 3 and Figure 4 show that the error of the algorithm is low and the accuracy is high, which can reach 95.47%. The proposed method can intelligently recommend related music audio-visual file resources to users according to their needs.

Users can use data retrieval, fill in the relevant query conditions, and easily find the required video and audio data. Once the user determines the data information he needs, he can send a download request or a review request of high-quality data through the retrieval system. On the basis of recognizing the characteristics of data, this paper extracts possible useful features according to factors such as browsing, interaction and time. The so-called feature extraction is to transform the original features into a set of features with obvious physical or statistical significance, so as to find more meaningful potential variables and help people to have a deeper understanding of the data. Different methods are used to recommend music audio-visual archives resources, and the comparison of user satisfaction is shown in Figure 5.

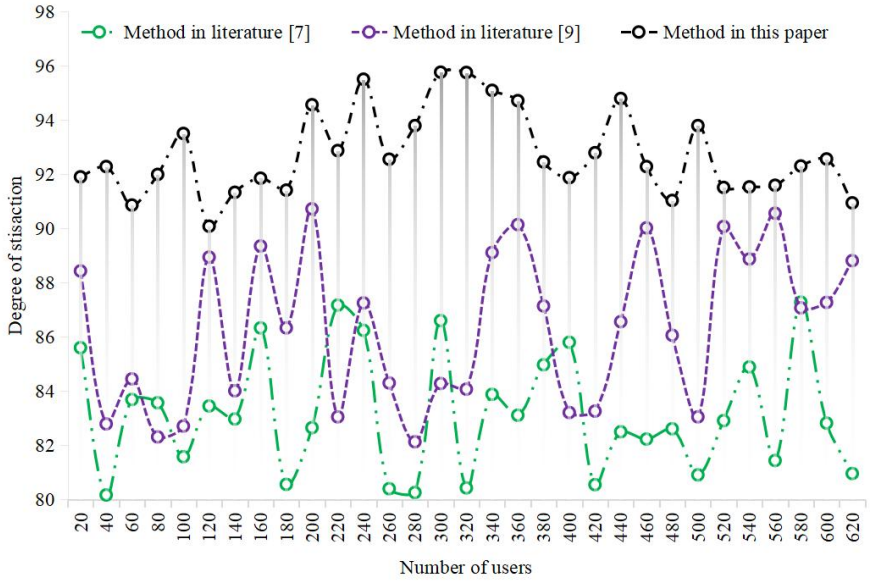

Figure 5. Comparison of users' satisfaction

Through experimental analysis, it is found that the recommendation accuracy of music audio-visual file resources based on RF algorithm proposed in this paper is high, reaching 95.47%, and the error is low. In addition, the highest user satisfaction can reach about 95.4%. This shows that the music audio-visual file resource management system constructed in this paper is scientific and reliable, and has excellent expansion ability. It can quickly, accurately and comprehensively find the music audio-visual archive resources that users want, and can provide comprehensive services to meet users' needs after users find the needed information.

4. CONCLUSIONS

With the passage of time, many precious historical materials and music audio-visual archives need to be copied and protected urgently. The modern development of audio-visual archives resources management is a necessary measure for social and cultural progress. Realizing the digitalization of music audio-visual archives can effectively manage music audio-visual archives as a whole, facilitate the preservation, search, addition and deletion of music audio-visual archives, and greatly improve the management efficiency of music audio-visual archives. Based on the analysis of the structure and characteristics of the digital management system of audio-visual archives, this paper constructs a music audio-visual archives resource management system based on RF algorithm. The simulation results show that the algorithm has low error and high accuracy, which can reach 95.47%. At the same time, the proposed method transforms practical problems into classification models, and realizes data processing, feature extraction and parameter adjustment, which can intelligently recommend relevant music audio-visual archives resources to users according to their needs, further improving the management efficiency and utilization efficiency of music audio-visual materials. Audio-visual archives can be said to be historical records. In these records, there are not only records of words and graphics, but also comprehensive information storage combined with elements such as sound and image, so as to truly play the significance

of the development of archives. Follow-up discussions will continue to lay an important foundation for the management of music audio-visual archives.

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REFERENCES

[1] Wang, C. Y., Wang, Y. C., Chou, S., A Context and Emotion Aware System for Personalized Music Recommendation[J]. Journal of Internet Technology, 19(3):765-779 (2018).
[2] Behera, S., Choudhury, N. D., A systematic review of energy management system based on various adaptive controllers with optimization algorithm on a smart microgrid[J]. International Transactions on Electrical Energy Systems, 2021(12):31 (2021).
[3] Wang, X., Personalized recommendation framework design for online tourism: know you better than yourself[J]. Industrial Management & Data Systems, 120(11):2067-2079 (2020).
[4] Garner, S., Fenton, T., et al., Effect of Personalized Diet and Exercise Recommendations in Early Inflammatory Arthritis: A Randomized Trial[J]. The Journal of rheumatology, 44(6):891-891 (2017).
[5] Danaf, M., Becker, F., Song, X., et al., Online discrete choice models: Applications in personalized recommendations[J]. Decision Support Systems, 119(4):35-45 (2019).
[6] Díez, J., Pérez-Núez, P., Luaces, O., et al., Towards explainable personalized recommendations by learning from users' photos - ScienceDirect[J]. Information Sciences, 520:416-430 (2020).
[7] Xw, A., Qt, A., Lz, B., A deep neural network of multi-form alliances for personalized recommendations[J]. Information Sciences, 531:68-86 (2020).
[8] Pierce, M., Emsley, R., Estimating and evaluating personalized treatment recommendations from randomized trials with ptr:[J]. Stata Journal, 21(2):348-359 (2021).
[9] Zhou, W., Han, W., Personalized recommendation via user preference matching[J]. Information Processing & Management, 55(3):955-968 (2019).
[10] Garner, S., Fenton, T., et al., Effect of Personalized Diet and Exercise Recommendations in Early Inflammatory Arthritis: A Randomized Trial[J]. The Journal of rheumatology, 44(6):891-891 (2017).
[11] Lee, D. H., Brusilovsky, P., Improving personalized recommendations using community membership information[J]. Information Processing & Management, 53(5):1201-1214 (2017).
[12] Ge, C., Personalized travel route recommendation using collaborative filtering based on GPS trajectories[J]. international journal of digital earth, 11(12):1-24 (2018).