Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9890239, 1 page
https://doi.org/10.1155/2023/9890239

Retraction

Retracted: Intelligent Sports Auxiliary Training Method Based on Collaborative Filtering Recommendation Algorithm

Wireless Communications and Mobile Computing

Received 29 August 2023; Accepted 29 August 2023; Published 30 August 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] Y. Sun and L. She, "Intelligent Sports Auxiliary Training Method Based on Collaborative Filtering Recommendation Algorithm," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 8703707, 8 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2022, Article ID 8703707, 8 pages
https://doi.org/10.1155/2022/8703707

Research Article

Intelligent Sports Auxiliary Training Method Based on Collaborative Filtering Recommendation Algorithm

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Received 10 May 2022; Revised 7 July 2022; Accepted 12 July 2022; Published 2 August 2022

Academic Editor: Kalidoss Rajakani

In recent years, people's living standards are rising, and the demand for health is also rising. National physical exercise has become the current trend. Using personalized recommendation technology to screen appropriate information and assist people in sports training can improve the efficiency of users to obtain relevant information and improve users' physical quality. Therefore, the collaborative filtering recommendation algorithm is optimized by combining bisection, and the intelligent recommendation model of sports training resources is constructed based on the algorithm. This paper uses the improved algorithm to calculate the similarity between users. Compared with other traditional algorithms, the user algorithm in this paper has higher accuracy and certain reference value. To sum up, the intelligent recommendation model of sports training resources proposed in the research can more accurately recommend suitable sports training resources for users, so as to assist users in correct sports training and improve users' physical quality, which plays an improvement of the physical quality of the whole people in China.

1. Introduction

Embodiment of vitality school education should establish the guiding ideology of 'health first' and strengthen physical education. Enable students to master basic sports skills and form a good habit of persisting in physical exercise. According to the curriculum objectives, the curriculum is divided into five dimensions: sports participation, sports skills, physical development, mental health, and social adaptation. Therefore, how to effectively achieve the goal of mental health in physical education teaching is an important issue faced by physical education educators at this stage. Physical exercise plays a prominent role in the promotion process. Physical exercise can adjust psychology and affect behavior. Be able to personally experience and feel the sports load that must be borne and the sports injury that must be borne and prevented. Must feel the victory and failure, and must struggle alone or collectively. In addition, the closed or open environment, the changing competitive situation at any time, and the need to timely and accurately process various changing information to obtain the winner, all of which have a positive effect on mental health and social adaptability.

People's quality of life is improving with the development of the times, but work pressure, family pressure, and learning pressure are also increasing. Many people's physical and mental health also have different degrees of problems. National fitness has become popular, and more and more people begin to pay attention to physical health. Physical exercise can effectively enhance the physical quality of athletes, release pressure, regulate emotion, and then regulate mental health. It is an effective way to regulate physical and mental health. Because of the constraints of time cost and economic cost, the general way for people to obtain sports auxiliary training is to query on the Internet. With the rapid development of computer, the whole society has quickly entered the development cycle of the combination of Internet and economy. The daily life of Chinese people has been inseparable from the development and application of the Internet, such as learning, entertainment, and economy. It is also difficult for the Internet to choose information resources. In this context, the research and application of personalized recommendation technology has gradually attracted people's attention [1]. Personalized recommendation technology can recommend resources for users based

on user data [2]. Therefore, the research constructs an intelligent recommendation model of sports training resources, which intelligently recommends sports auxiliary training resources for users based on users' interest preferences and physical quality level, so that users can train correctly and improve their physical quality.

The amount of information resources of sports training is huge, and there are many types, such as text, video, and pictures. Therefore, the construction of Intelligent Model of sports training resources. In addition, accurate sports auxiliary training resources, the research analyzes the user characteristics, establishes, and constructs the information resource characteristic model and user characteristic model. The algorithm needs to analyze the user's characteristic data and establish the similarity of user's body characteristics, so as to better recommend appropriate information resources for users. Therefore, Pearson correlation similarity algorithm and modified cosine similarity algorithm are used to calculate the similarity of project resources and user characteristics.

There are two main innovations in the research. The first is to introduce personalized recommendation technology into sports training, recommend the most suitable sports training information resources for users, assist users in scientific and reasonable sports training, and improve their physical quality. Second, in order to avoid the situation that the recommendation list is empty. This algorithm combines the project with the actual user experience in the system. The algorithm results verify the high accuracy and stability of the algorithm.

The second part mainly summarizes and discusses the research results of scholars in various countries on personalized recommendation technology and physical training in recent years. The third part is to build an intelligent recommendation model of sports training resources sports training resources and assist users in scientific exercise. The fourth part tests and analyzes the intelligent model of sports training resources of the intelligent model of sports training resources. The last part is to sort out and summarize the research.

2. Related Works

People's life and work are accelerating, but their physical quality is gradually declining. Appropriate and scientific physical training will help to strengthen physical quality, better work and study, and promote social progress. At present, the most commonly used sports auxiliary training method for users is to find resources on the Internet, but the amount of information resources on the Internet is relatively large, so it is necessary to screen them by using personalized recommendation technology. At present, a lot of research results on personalized recommendation technology and sports training. Zhang using Apriori algorithm to mine the correlation between customers from sales data and help businesses formulate sales strategies [3]. Yang et al. proposed a new model structure and then proposed a personalized API recommendation method [4]. Wang creates a user feature model based on behavioral data aggregation and then uses personalized recommendation technology to build an online tourism personalized recommendation framework [5]. Ghosh et al. studied the music recognition system. Based on the personalized recommendation technology, a personalized music recognition system is constructed for the user's personal data, music preference, emotional characteristics, and other data [6]. Ohtomo et al. use based on preference aware multimodal feature graph convolution network and verified the effectiveness of this method by using real data sets [7]. Li et al. designed an intelligent learning system through the content recommendation and realized the personalized recommendation of network teaching resources [8]. Arik et al. combined model and proposed a round recommendation system to intelligently recommend courses for students [9]. Bin et al. put forward a multimodel tourism learning framework, then analyze the data characteristics of tourists under this condition, and modeled them through models tkg2vec and traj2vec, so as to personalized recommend scenic spots for tourists [10].

Park and Lee studied the effects of appropriate physical exercise on self-efficacy and stair climbing ability of patients with chronic stroke [11]. Lima et al. recruited 20 community elderly subjects to study the impact of daily life exercise program for the elderly over 875 years old in some communities [12]. Aseev takes the students of the professional training institute of the educational institution of the Russian Ministry of the interior as the research object. Based on the complexity and modeling methods of various exercises, Aseev has developed physical education technology [13]. According to Boroujeni et al., the different traceability characteristics of multiple brain nerves were studied, the pathological imaging was analyzed, and the influence characteristics of multiple factors of brain function and patients' memory function were summarized. Research shows that the analysis and rehabilitation can be well carried out through various studies of brain nerves [14]. According to Ullmann et al., physical exercise can help the mental health of the elderly to perform their functions [15].

From the above research results, it can be seen that there are many research results on sports training and personalized recommendation technology, but few studies combine sports training and personalized recommendation. Therefore, the research uses the collaborative filtering recommendation algorithm to build an intelligent recommendation model of sports training resources. Based on the user's interest preference and physical quality level, it intelligently recommends sports auxiliary training resources for users, so that users can train correctly and improve their physical quality effectively.

3. Construction of Intelligent Recommendation Model of Sports Training Resources

3.1. Calculation of User Similarity and Project Resource Similarity. Real time push information data is provided to users through personalized recommendation to meet users' real-time needs. This category is mainly for daily active users to complete recommendations and formulate satisfactory recommendation data for users through the historical

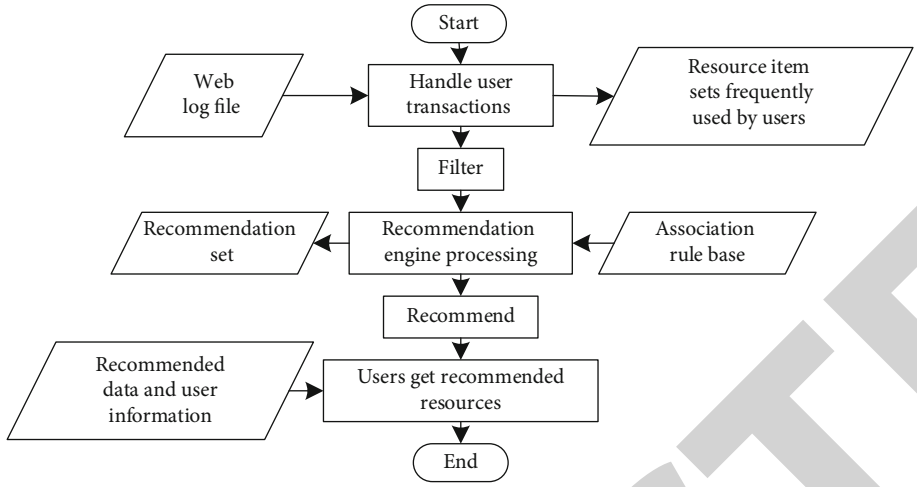

Figure 1: Personalized recommendation process.

preference information and behavior of active users. In personalized recommendation technology, the performance often affects the recommendation effect of personalized recommendation technology [16]. Therefore, the selection of recommendation algorithm is very important. At present, the commonly used is personalized recommendation algorithms. Algorithms based on the correlation of different research factors usually need routine verification analysis. The algorithm in this paper establishes a database of user's feature history, which can help the user according to their own conditions. The database contains the relationship between users buying different kinds of products and then reflects the user's behavior pattern. The recommendation process of association rule-based recommendation algorithm is shown in Figure 1.

However, the recommendation algorithm needs a large amount of data to ensure the accuracy of recommendation and has the defect that it is difficult to generate association rules. It is not practical in the recommendation of physical training auxiliary teaching resources. Classification accuracy is defined as the proportion of whether a product user likes to be judged correctly by the recommendation algorithm. Therefore, when users only have binary choice, it is more appropriate to use classification accuracy for evaluation. Therefore, if you want to evaluate the recommendation algorithm with accuracy and recall, you must divide the score into two parts. If it is higher than a certain score, it means you like it, and if it is lower than this score, it means you do not like it. This algorithm can be used to analyze the similarity of users' different features and then recommend interesting resources of similar users for users [17]. The preconditions of collaborative filtering algorithm are similar users have the same resources of interest; as well as similar resources in which users are interested [18]. The low dependence on the amount of data can also explore the potential interested resources of users, which is suitable for the personalized recommendation of sports training auxiliary method resources. The basic flow is shown in Figure 2.

The user's interest model is constructed based on data, gender, sports training image, sports training preference, etc., and then the user item scoring matrix is established by using the model, as shown in the following formula.

$$R(m,n) = \begin{bmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ r_{m1} & r_{m2} & \cdots & r_{mn} \end{bmatrix}. \quad (1)$$

In formula (1), the user set can be represented by the following formula.

$$U = \{U_1, U_2, \cdots, U_n\}. \quad (2)$$

The item set can be represented by the following formula.

$$P = \{P_1, P_2 \cdots, P_m\}. \quad (3)$$

The higher the similarity, the more similar the preference for sports training auxiliary resources between the two users [19]. There are two ways to calculate the similarity. One is Pearson correlation similarity algorithm, as shown in the following formula.

$$\mathrm{Sim}(i,j) = \frac{\sum_{k \in r_{ij}} \left(R_{j,k} - \bar{R}_j\right)\left(R_{j,k} - \bar{R}_i\right)}{\sqrt{\sum_{k \in r_{ij}} \left(R_{j,k} - \bar{R}_j\right)^2} \cdot \sqrt{\sum_{k \in r_{ij}} \left(R_{j,k} - \bar{R}_i\right)^2}}. \quad (4)$$

In formula (4), $R_{j,k}$ represents sports training resource k, and $\bar{R}_i$ and $\bar{R}_j$ are the average scores of user FF and user GG on a sports training resource. In addition to Pearson correlation similarity algorithm, cosine similarity algorithm can also users and projects, as shown in the following formula.

$$\mathrm{sim}(i,j) = \cos\,(i,j) = \frac{\vec{i} \cdot \vec{j}}{\left\|\vec{i}\right\| \cdot \left\|\vec{j}\right\|}. \quad (5)$$

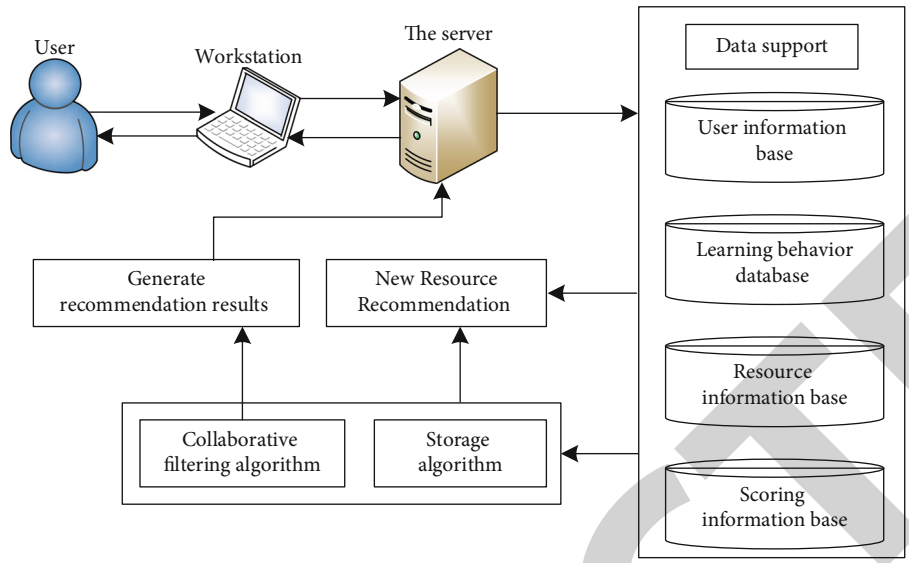

Figure 2: Basic flow of collaborative filtering.

In formula (5), $\bar{i}$ and $\bar{j}$ are the vectors of user $\bar{j}$ and user j scoring sports training resources. However, the user's score of project resources has strong subjectivity, and there is no unified standard for the score of project resources, resulting in large error in the result of similarity calculation. Therefore, the algorithm is used to correct the difference of each dimension [20], as shown in the following formula.

$$\operatorname{sim}(i,j) = \frac{\sum_{s\in r_{ij}} \left(R_{i,s} - \bar{R}_i\right)\left(R_{j,s} - \bar{R}_j\right)}{\sqrt{\sum_{s\in r_{ij}} \left(R_{i,s} - \bar{R}_i\right)^2} \sqrt{\sum_{s\in r_{ij}} \left(R_{j,s} - \bar{R}_j\right)}}. \quad (6)$$

Pearson correlation similarity can be used preferred project resources, while the modified cosine similarity algorithm.

3.2. Improved Algorithm. Collaborative filtering algorithm can accurately recommend sports training information resources for users, but it still has the defects. Cold start means that new users cannot score sports resources and have no corresponding browsing records [21]. Therefore, collaborative filtering recommendation algorithm cannot recommend sports training resources that users may be interested in. Data sparsity means that when users score less on project resources, and the user project scoring matrix will become sparse. Therefore, in order to recommend sports training learning resources more accurately and effectively for users and assist users to exercise scientifically, it is also improve the algorithm, which uses Euclidean formula to calculate the distance between the preset initial clustering center and a point, see the following formula for Euclidean formula.

$$E(x,y) = \sqrt{\sum_{i=1}^{n} (r_{ui} - r_{vi})^2}. \quad (7)$$

In formula (7), x and y represent the scores of users u and v on project resources; r_{ui} and r_{vi} represent the resource i, and n represents the number of project resources. After obtaining the average value of all category data points, the data point closest to the average value point can be used as the new clustering center, as shown in the following formula.

$$c_i = \frac{1}{m} \sum_{x\in C_i} x. \quad (8)$$

In formula (8), C_i is the data of category i, c_i is the average value point of category i, and m_i is data points of category i. According to the change of clustering center, the algorithm can converge. The binary k-means algorithm is mainly used to solve some problems that need to be solved in the previous traditional algorithms. For example, problems arising from the distance of the affected centroid need to be analyzed.

Bisection, also known as halving, is a search algorithm for finding specific elements in an ordered array. The idea of binary search is as follows: (1) first, search from the middle element of. If this element happens to be the target element, the search process ends. Otherwise, execute the next step. (2) If the target element is greater than/less than the intermediate element, search in the half area of the array that is greater than/less than the intermediate element, and then repeat the operation in step (1). (3) If a step array is empty, the target element cannot be found. The core idea of bisection k-means algorithm is to treat all data points as a cluster and divide the clusters according to the (SSE) in the cluster until the number of clusters reaches the preset value.

$$\mathrm{SSE} = \sum_{i=1}^{k} \sum_{x\in C_i} \operatorname{dist}(c_i, x)^2. \quad (9)$$

In formula (9), dist represents the Euclidean distance between two vectors. Combined with K-means, the collaborative filtering recommendation algorithm can be optimized

and improved. First, the data set is clustered, and the K value with the best clustering effect is obtained by contour coefficient ($S(i)$). The calculation method of $S(i)$ is shown in formula (9).

$$S(i) = \frac{b(i) - a(i)}{\max\{a(i), b(i)\}}. \tag{10}$$

In formula (10), $b(i)$ is the average cluster of sample point i and all data points in the nearest cluster, and $a(i)$ is between sample data points in the same cluster. After the most ideal K value is obtained, the binary k-means algorithm is for secondary clustering. According to the clustering results, the project resources that users have not scored and similar users have scored are predicted and scored. The calculation method of prediction score $\hat{r}_{ui}$ is shown in the following formula.

$$\hat{r}_{ui} = \bar{r}_u + \frac{\sum_{v \in N_m} \mathrm{sim}(u, v)(r_{vi} - \bar{r}_v)}{\sum_{v \in N_m} |\mathrm{sim}(u, v)|}. \tag{11}$$

In formula (10), N_m is the first m users with the highest similarity with users. The calculation of similarity is a comparison result combining the results of multiple feature calculations, as shown in the following formula.

$$\mathrm{sim}(u, v) = \mathrm{sim}_{\mathrm{Jaccard}}(u, v) \cdot \mathrm{sim}_{\mathrm{Pearson}}(u, v). \tag{12}$$

Optimized recommendation algorithm, an intelligent recommendation model of sports training resources, can be constructed to intelligently recommend sports auxiliary training resources for users. Figure 3 shows the basic process.

The average (MAE), accuracy, and recall average the performance of the model, see the following formula for the calculation method of MAE.

$$\mathrm{MAE} = \frac{\sum_{i=1}^{N} |\hat{r}_i - r_i|}{N}. \tag{13}$$

In formula (12), r_i is the actual score, and N is the number of scoring items. The calculation method of accuracy is shown in the following formula.

$$\mathrm{Precision} = \frac{\sum_{u \in U} |R(u) \cap T(u)|}{\sum_{u \in U} |R(u)|}. \tag{14}$$

In formula (13), $R(u)$ represents the list of project resources recommended by the model for user u; $T(u)$ indicates user u's behavior records, such as browsing and searching sports training resources, or training materials uploaded by users.

$$\mathrm{Recall} = \frac{\sum_{u \in U} |R(u) \cap T(u)|}{\sum_{u \in U} |T(u)|}. \tag{15}$$

$$F_1 = \frac{2 \times \mathrm{Precision} \times \mathrm{Recall}}{\mathrm{Precision} + \mathrm{Recall}}. \tag{16}$$

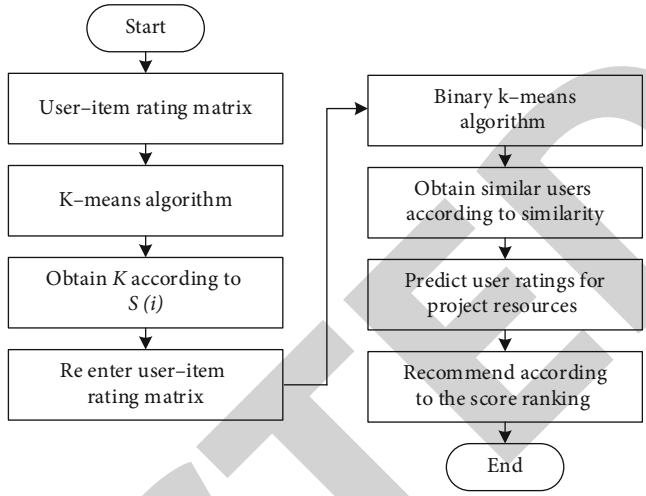

Figure 3: Basic process of intelligent recommendation model of sports training resources.

According to the above indicators, the performance of the model can be verified.

4. Performance Verification of Intelligent Recommendation Model for Sports Training Resources

This paper uses algorithm and bisection algorithm to improve and optimize and constructs an intelligent recommendation model of sports training resources based on the improved algorithm. So as to verify the performance of the intelligent recommendation model of physical training resources, the keep data set is used, which contains 96521 scores of 2512 physical education teaching project resources by 1000 users. The intelligent recommendation model of sports training resources is trained and tested. Based on the optimized algorithm proposed in the research, the intelligent recommendation model of sports training resources (model 1), the algorithm optimized based on K-means algorithm (model 2), the algorithm optimized based on binary k-means algorithm (model 3), and the general algorithm (model 4) are constructed, respectively. The above four models are trained with 70% data until the model reaches the expected accuracy. The training process is shown in Figure 4.

As can be seen in Figure 4, model 1 only needs 162 to achieve, 2 needs 298 iterations to achieve the target accuracy, and 136 times more than model 1; model 3 needs 367, 205 times more than model 1; model 4 needs 462 iterations, 200 times more than model 1. The above combined with bisection k-means algorithm has better optimization effect and higher training efficiency on collaborative filtering recommendation algorithm. After training, the performance of the above four models is tested with 30% data. The average absolute error of the four models is shown in Figure 5.

It can be seen from the figure that the project results of each model change with the number of resources. When the number of models is about 350, the results are at the

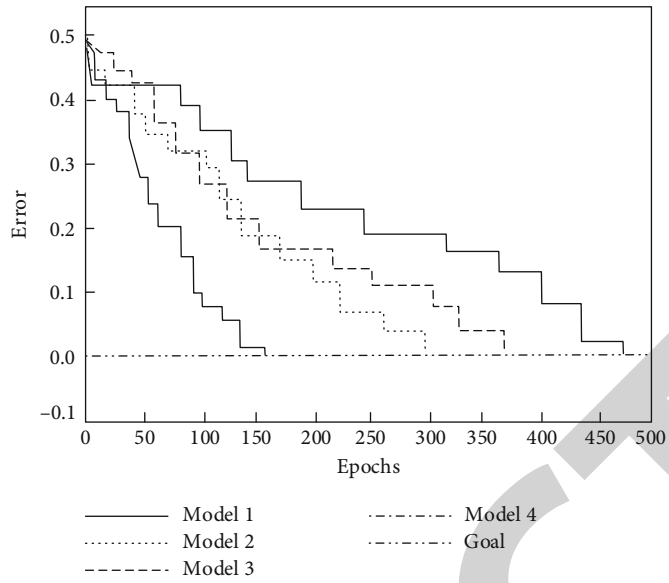

Figure 4: Training process of four models.

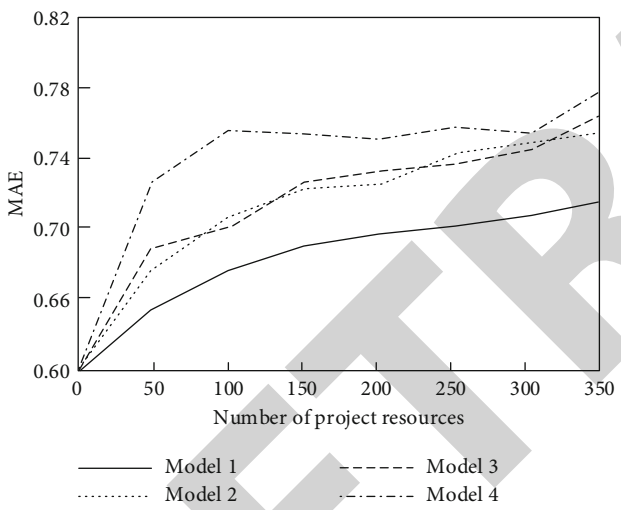

Figure 5: Mean absolute error of four models.

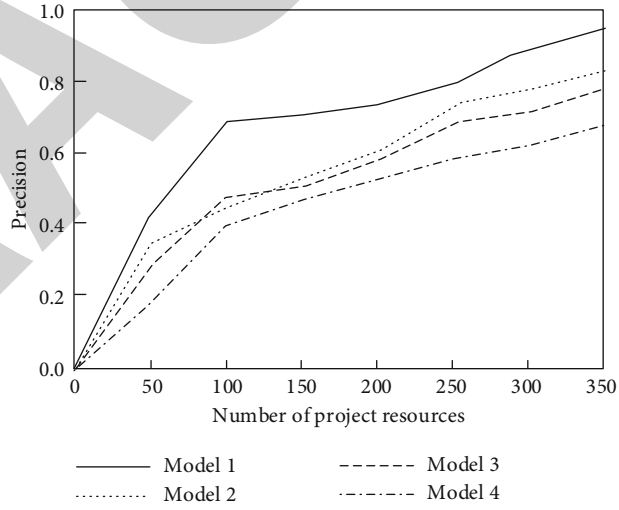

Figure 6: Accuracy of four models.

lowest. At this time, it is obvious that all model results are in a low state. When the model ratio is high, the model has some innovative reference value. Figure 6 shows the accuracy results.

It is easy to see in Figure 6 that project resources, the recommendation accuracy of the four models is also improving. Project resources reach 350, the accuracy of model 1 is the highest, reaching 95.4%; 2 was 80.1%, which was 15.3%; the accuracy of the model is low, so it is necessary to analyze and judge the accuracy of the model. The above results need to be optimized to determine the synergy. Filtering algorithm can improve the recommendation accuracy, better recommend sports training resources for users, and assist users in scientific sports training. The recall rates of the four models are shown in Figure 7.

In Figure 7, with the rapid increase of resource projects, the recall probability of each model has been greatly increased. The reference ratio of each resource item is at a high position. After comparison, only model 1 has the highest recall rate among all models. The recall rate of model 3 is 0.40, which is 0.25 lower than that of model 1. $F1$ values of the four models are shown in Figure 8.

Figure 8 shows the model values for all project resources. After comparing the results of different groups, the model has a good ratio effect when the $F1$ value in model 1 reaches the highest horizontal position. Other models are not as good as model 1 as a whole. Based on the above contents, it can be seen that the value of the sports training resources intelligent recommendation model proposed in the study is higher than the other three models, and the MSE value is lower than the other three models, which shows that the sports training resources intelligent recommendation mode. The four models are tested with keep data set. The number of test project resources reached 350, and the MAE value

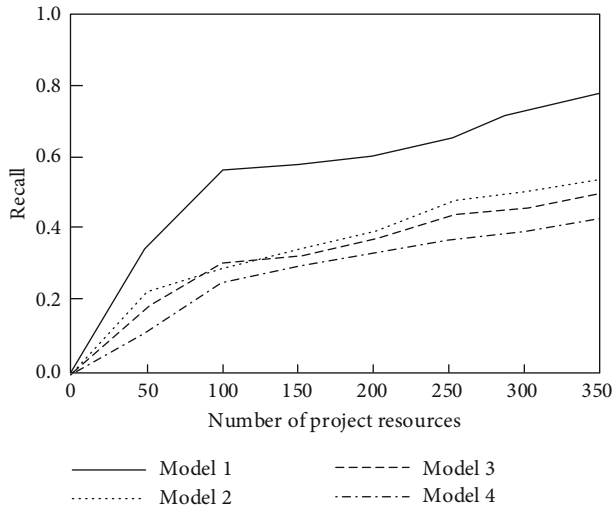

Figure 7: Recall rate of four models.

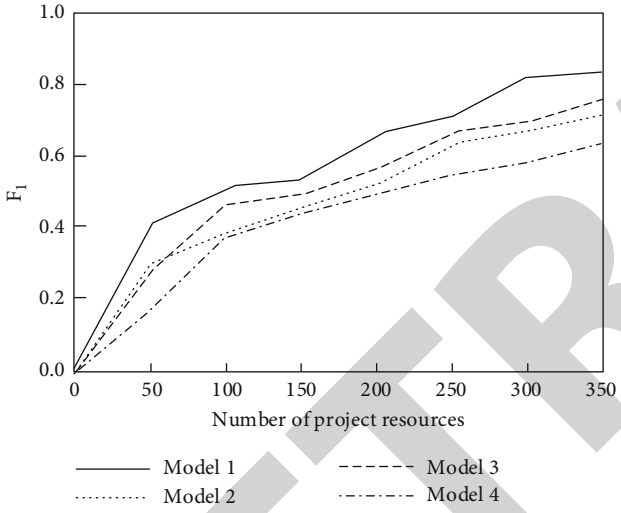

Figure 8: F_1 values of 4 models.

of the intelligent recommendation model of sports training resources was 0.71, lower than the other three models. The above results show that the optimized collaborative filtering algorithm proposed in this paper has good performance.

5. Conclusion

In this paper, the collaborative filtering algorithm is combined and optimized, and an intelligent recommendation model of sports training resources is built based on the optimized collaborative filtering algorithm to help users carry out sports training scientifically. The four models are tested with keep data set. The number of test project resources reached 350, and the MAE value of the intelligent recommendation model of sports training resources was 0.71, lower than the other three models. The above results show that the optimized collaborative filtering algorithm proposed in this paper has good performance. To avoid empty recommendation list, the intelligent recommendation model of sports training resources based on this algorithm has high recommendation accuracy and can better help users carry out scientific sports training and improve their physical fitness. The algorithm combines the project with the actual user experience in the system. The algorithm results verify the high accuracy and stability of the algorithm. This article has certain significance to improve the national health level in our country. However, this study has not tested and verified a large number of data sets, and further research is needed in the future.

Data Availability

The figures used to support the findings of this study are included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

The authors would like to show sincere thanks to those techniques who have contributed to this research.

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