Design of Resource Recommendation System for Social Work Service Object Based on Collaborative Filtering

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Abstract. With the continuous development of social work, improving the matching degree between service objects and resources, and enhancing service efficiency and quality, has become an urgent problem to be solved. This paper designs a resource recommendation system for social work service objects based on collaborative filtering. The system adopts a B/S (Browser/Server) architecture and is developed using the SSH framework and MVC (Model-View-Controller) technology, ensuring the security, simplicity, and scalability of the system. In terms of functionality, the resource recommendation system includes key modules such as user management, resource management, recommendation algorithm implementation, and a feedback mechanism, providing comprehensive related services. Utilizing project-based collaborative filtering technology, the system recommends the most relevant resources to service objects by calculating the similarity between resources. This system can offer more accurate and personalized resource recommendations for social work service objects, thereby improving the overall effectiveness of social work services and promoting the healthy development of the social work industry.

Keywords: Resource Recommendation System, Social Work, Service Object, Collaborative Filtering.

1 Introduction

Social work refers to the activities of helping others under the guidance of altruism, based on scientific knowledge and using scientific methods. As a service to help people cope with social problems and improve their living conditions, the essence of social work is the interaction between people and the effective allocation of resources. In this process, the rational allocation of resources is particularly important, which is directly related to the effectiveness and quality of social services [1]. Nonetheless, conventional approaches to recommending resources frequently fall short in terms of relevance and customization, which poses challenges in addressing the varied requirements of those receiving social work services. Collaborative filtering, an established AI technique, is extensively employed in sectors such as online shopping and film suggestion systems to evaluate similarities [2]. By integrating collaborative filtering into the resource recommendation systems designed for social work clients, it becomes feasible to tackle

M. Zhang et al. (eds.), *Proceedings of the 2025 5th International Conference on Informatization Economic Development and Management (IEDM 2025)*, Advances in Economics, Business and Management Research 330,
https://doi.org/10.2991/978-94-6463-724-3_29

issues like sparse data and the cold start scenario commonly encountered in standard recommendation frameworks, thereby enhancing both the precision and effectiveness of the recommendations provided.

2 Collaborative Filtering Algorithm

Initially introduced by Goldberg and colleagues, the concept of a collaborative filtering recommendation algorithm has gained prominence. These algorithms facilitate suggestions grounded in various factors such as data and content. They are capable of categorizing users' interests and preferences, subsequently offering products and information that align with these specific tastes. The realm of collaborative filtering encompasses two primary types of algorithms: one that relies on user similarities and another that focuses on item similarities [3]. The present study concentrates on exploring the item-based collaborative filtering methodology.

The basic principle of project-based collaborative filtering is to calculate the similarity of projects, sort them according to the similarity, and then select the top items from the sort to form the latest project set, filter the candidate set according to the information of target users, calculate the project score through the interest degree, and take the top items as the recommended projects. The operation flow is shown in Fig. 1.

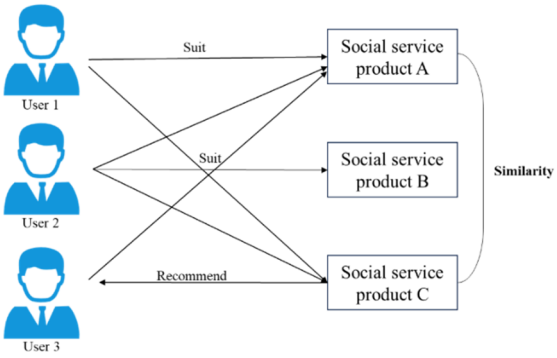

Fig. 1. Recommended example diagram of project-based collaborative filtering

It can be concluded from Fig. 1 that the basic idea and principle of this filtering recommendation is: assume that the social service products that social work service object 1 and social work service object 2 like are A, B and C respectively, and the social service product that social work service object 3 likes is A. Through the analysis of the user's historical information, it is concluded that when the user purchases product A, the user also clicks and browses product C. Therefore, it is believed that there are many similarities between social service product A and social service product C. Meanwhile, through further analysis of the user history records and history information, it is found that most of the users who like the social service product A like the social service product C. Therefore, based on the above analysis, it can be found that the user 3 also likes the product C. Therefore, the product C is recommended to the user 3 when the product is recommended to the user 3.

3 Requirements and Design of Recommendation System

3.1 System Requirements

In terms of functionality, the recommender system should at least include functions for user management, resource management, recommendation management, and feedback management [4]. In terms of performance, the system should have security, simplicity and scalability. Only by ensuring the security of the system can we ensure that the system can give full play to its functions and meet the various operations of users. The system is oriented to all social work service objects, the number of users is large, and the general educational level of vulnerable groups in society is not high [5]. The system shall ensure the simplicity of the operation interface as far as possible to facilitate the user's operation and ensure that all users can operate the system skillfully. In order to ensure that the system can better serve the vulnerable groups, it puts forward higher requirements for the scalability of the system and updates it in time, which is conducive to capturing the changes in the needs of social service objects.

3.2 System Architecture

The social work service object recommendation system must include a front-end inquiry system (primarily serving regular users) and a backend management system. B/S architecture is a widely used, versatile, easy to manage, simple structure, in line with the design requirements. Therefore, this paper will use this as the system architecture. Fig. 2 shows the overall architecture of the system. The system is based on SSH framework, using MVC technology to develop, fully considering the characteristics of low coupling and clear classification between modules. Based on multi-layer architecture, the system is developed by B/S access mode and Java language, which can meet the requirements of cross-platform use.

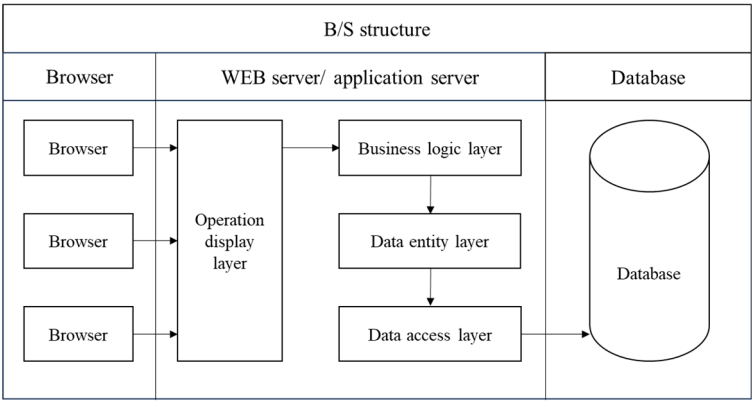

Fig. 2. Overall architecture diagram of the system

3.3 Function Design

User management module is responsible for handling the user's registration, login, information maintenance and other basic operations. Through this module, the system can collect the basic information of users, such as age, gender, occupation, interests and hobbies, and provide data support for subsequent personalized recommendation.

Resource management module involves the upload, classification, retrieval and other functions of resources. Social work clients may need various types of resources, such as training materials, policies and regulations, case studies, etc. This module ensures the effective management and efficient utilization of resources.

Recommendation algorithm implementation module is the core part of the system, which recommends the most appropriate resources for users through collaborative filtering algorithm according to the user's historical behavior, preference settings and the characteristics of resources. In this process, the algorithm will take into account the similarity between users and other users, as well as user's ratings and feedback on resources, so as to achieve personalized recommendation.

The feedback mechanism module allows users to evaluate the recommendation results, including likes, comments and other forms. User feedback will be recorded by the system and used to optimize the recommendation algorithm, forming a virtuous circle to continuously improve the accuracy of recommendation and user satisfaction.

4 Algorithm Implementation Process of Collaborative Filtering Recommendation Technology

4.1 Collection of Information Sources

When designing a resource recommendation system for social work service objects, the first step is to collect information sources. These information sources cover the personal data of service objects, service needs, historical service records and evaluation feedback of resources. The service objects are divided into children, adolescents, the elderly, the disabled, patients with major diseases, low-income families, patients with psychological problems, etc. Social workers are responsible for entering and updating the basic information of clients, including but not limited to age, gender, family status and health status [7]. At the same time, the service needs of the clients, that is, social service products, include psychological counseling, legal aid or employment guidance. This content should also be collected on the server. Historical service records, including service type, service time and service effect, are also captured by the system. In addition, the evaluation of used resources by service objects, whether through ratings, comments or other forms of feedback, provides valuable data for recommendation algorithms. We transform the important information of service objects, such as personal data, service requirements, historical service records and evaluation feedback of resources, into data tables, which lays the foundation for the subsequent calculation of collaborative filtering recommendation algorithm.

4.2 Calculate the Similarity of Product Recommendation

Computing similarity is the core step of collaborative filtering technology. Calculate that similarity between products is to jointly rate all resource set of the product j by the user i, namely obtaining a user-resource rating matrix table. Then the similarity of social service products is calculated by using the cosine similarity measure method. We plot the vectors in vector space based on their coordinate values. Determine the angle separating the vectors and calculate the cosine of that angle; this value serves as a measure of how similar the two vectors are. A smaller angle results in a cosine value nearer to 1, indicating that the vectors are more aligned and, consequently, more similar. We extend the cosine calculation to handle multi-dimensional data:

$$cos\theta = \frac{\sum_1^n (A_i \times B_i)}{\sqrt{\sum_1^n A_i^2} \times \sqrt{\sum_1^n B_i^2}} \tag{1}$$

Where A_n and B_n stand for the ratings of resources i and j on the nth dimension, respectively, and n is the total number of dimensions rated. The smaller the angle is, the closer the cosine value is to 1, indicating that the two resources are more similar in the evaluation of the service object.

4.3 System Recommendation

By calculating the resource-resource similarity table, we can further filter out the resource pairs with higher similarity [8]. This step involves filtering out items from the similarity table that have a similarity below a certain threshold, resulting in a condensed, high-similarity list of resource pairs. The high similarity resource pair list is associated with the original resource-service object rating matrix to generate a personalized recommendation for the service object. If the social service object has a high evaluation of a resource (social service product), the system will recommend other resources with high similarity. This recommendation process not only takes into account the personal preferences of service objects, but also makes use of the similarity between resources in order to achieve more accurate recommendation results. Recommender system can provide more personalized and relevant resources for clients, thus improving the quality and efficiency of social work services. Suppose we have three service objects (A, B, C) and four resources (Social service product 1, Social service product 2, Social service product 3, Social service product 4), and we have calculated the cosine similarity between resources and the evaluation of these resources by service objects. Examples of recommended results and reasons are shown in Table 1.

Table 1. Examples of recommended results and reasons.

Service object	Recommend resources	Reason for recommendation
User 1	Product 2	High similarity to Product 1 (0.8), User 1 rated Product 1 highly
User 1	Product 4	High similarity to Product 3 (0.5), User 1 rated Product 3 as medium
User 2	Product 1	High similarity to Product 3 (0.4), User 2 rated Product 3 highly
User 3	Product 1	High similarity to Product 2 (0.8), User 3 rated Product 2 highly

5 Conclusions

The recommender system based on collaborative filtering is applied in social work, which is of great significance to the socially vulnerable groups. By accurately matching the needs of service recipients with social work resources, the system significantly enhances the efficiency of resource allocation and service quality. At present, there are relatively few applications of recommendation systems in social work in China. In view of the fact that the design of the system fully considers the convenience of the user's operation and the security of the system, it is suggested to be popularized in the process of practice. At the same time, the recommender system has good scalability. In the future, the system will be constantly adjusted according to the changes of social work services in order to better serve the social work service objects.

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