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Personalized Recommendation of Domestic Tourism in the Post-Epidemic Era

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***Abstract*—** *In the era of big data, the tourism industry faces the problem of information explosion. How to quickly and accurately obtain valuable data from massive tourism information is a problem that needs to be solved. At the same time, the arrival of the new crown epidemic in recent years has seriously affected the development of tourism. In response to these problems, this paper analyzes the research schemes of personalized tourism recommendations at home and abroad in recent years and makes customized offers according to the needs of users, travel preferences, and information about the dynamic changes of the epidemic situation to meet the needs of local governments for epidemic prevention and control. It can recommend the most suitable tourist attractions for users to meet their personalized needs and let users fully experience the fun of travel*.

***Keywords*—** *Post-pandemic era; Domestic travel recommendation; Personalized recommendation*.

I. INTRODUCTION

The research and development of personalized recommendation systems have reached a particular stage, and many fields, including tourism recommendations [1], have begun to apply them. The domestic epidemic has been effectively controlled, and the tourism industry has started to recover. Better realization of people-oriented thinking is an essential direction for the future development of tourism enterprises. However, the application of recommender systems in the tourism industry is not perfect in the context of epidemics in China. It cannot meet the increasing needs of users for a personalized tourism experience. In view of this challenge, this paper proposes a personalized travel recommendation system model in the post-epidemic era.

II. THE THEORETICAL BASIS OF PERSONALIZED TOURISM RECOMMENDATION

A. *Collaborative Filtering Algorithm*

The essential part of recommender systems is the recommendation algorithm. It has a significant impact on the quality of recommendations. The collaborative filtering algorithm is a relatively successful algorithm at present, and it is also widely used. [2]. We mainly adopt two collaborative filtering algorithms in this system. One is a user-based collaborative filtering algorithm, and the other is a tourist-attraction-based collaborative filtering algorithm.

The user-based collaborative recommendation algorithm

This algorithm flow is as follows: (1) Constructing a two-dimensional matrix from the user's historical behavior information; (2) According to the two-dimensional matrix, then the similarity between users is calculated; (3) obtain neighbors of the target user according to the similarity; (4) recommend tourist attractions for the target user according to neighbors' preferences.

The conceptual diagram of the user-based collaborative recommendation algorithm is shown in Figure 1. It can be seen that both user A and user B like tourist attractions A and B, and user C like attraction B. User D has no favorite tourist attraction with other users, user D is an irrelevant user, and other users are related. Among related users, user B and user C both liked tourist attraction D, and user A did not act on the tourist attraction. Therefore, tourist attraction D is highly recommended to user A.

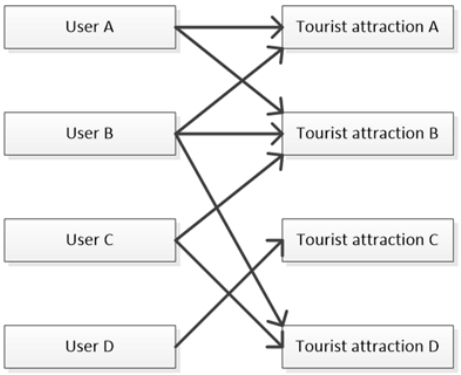

Fig. 1. The conceptual diagram of the user-based collaborative recommendation algorithm

The collaborative recommendation algorithm based on attractions

The collaborative recommendation algorithm based on attractions considers that the target user will also like the tourist attraction B, similar to A that the user selects, and then recommends the tourist attraction B to them [3]. The process of the collaborative recommendation algorithm is the same as that of the user-based collaborative recommendation algorithm. The only difference is that after constructing a two-dimensional matrix based on user behavior information, what is calculated is not the similarity between users but the similarity of tourist attractions.

A conceptual diagram of the tourist-attraction-based collaborative filtering algorithm is shown in Figure 2. Assuming that user A is the target user to be recommended, user B likes tourist attractions B, C, and D, user C likes tourist attractions B and C, and user B and user C both like attraction B and C, then attraction B and C are defined as similar attractions, which means that users who like attraction B also like attraction C with a high probability. As a result, because user A wants attraction B, we can recommend attraction C to user A.

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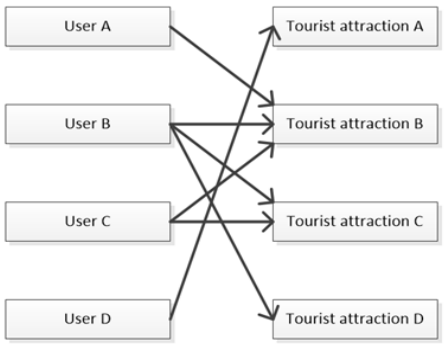

Fig. 2. Conceptual diagram of collaborative recommendation algorithm based on attractions

B. Similarity Calculation

Cosine similarity

There are two space vectors $A(a_1, a_2, \dots, a_i, \dots, a_n)$ and $B(b_1, b_2, \dots, b_i, \dots, b_n)$ .Then the cosine value of the included angle between them is

$$\cos < A, B >= \frac{\sum_{i=1}^{n} a_i * b_i}{\sqrt{\sum_{i=1}^{n} {a_i}^2} * \sqrt{\sum_{i=1}^{n} {b_i}^2}}.$$

Applied to the similarity calculation, A and B represent the two users/tourist attractions to be compared, a_i、b_i ,respectively represent the specific values of various features of the two users/tourist attractions, and the cosine value of the included angle is used to judge the difference of the two users/tourist attractions. The cosine value tends to be 1. The included angle between the two vectors is 0, and the two users/tourist attractions are almost in the same direction; that is, they are very similar. On the contrary, the cosine value tends to be 0. The included angle between the two vectors is 90°, indicating that the two users/tourist attractions are almost perpendicular; that is, they are entirely dissimilar [4]. The advantage of this algorithm is that the calculation has a simple process and high accuracy, and it is widely used in recommender systems.

Pearson correlation coefficient

Pearson correlation coefficient improves cosine similarity, which solves the problem of missing dimension value. The formula for calculating Pearson correlation coefficient is

$$\rho_{x,y} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i - \bar{y})^2}}.$$

The coefficients take values from -1 to 1. The absolute value is closer to 1, and the correlation between the two users/tourist attractions is more significant. In detail, if the correlation coefficients are estimated to be positive, they are also positively correlated. If the correlation coefficients are estimated to be negative, they are also negatively correlated. If the correlation coefficients are equal to 0, they have no linear correlation [4]. The advantage of this algorithm is that it can reasonably measure the correlation between two users/tourist attractions.

III. Detailed Design of Tourism Recommendation System in the Post-Epidemic Era

A. System Overall Structure Design

In the age of epidemic, to recommend tourist attractions for users, the structure of this system is divided into three parts: the presentation layer, the business layer, and the data layer. First of all, the presentation layer provides a login interface, tourist attraction recommendation interface, and epidemic data interface. Afterward, the business layer provides epidemic information management, user information management, tourist attraction information management, etc. Finally, the data layer includes epidemic information, user information, tourist attraction information, etc. The detailed structure diagram of the tourism recommendation system in the post-epidemic era is shown in Figure 3.

B. Detailed Design of System Function Modules

This system is developed for users. According to users' needs, it is mainly divided into the following four modules: user information management module, tourist attraction information management module, epidemic data management module, and personalized recommendation module. Each module and its basic functional structure are shown in Figure 4.

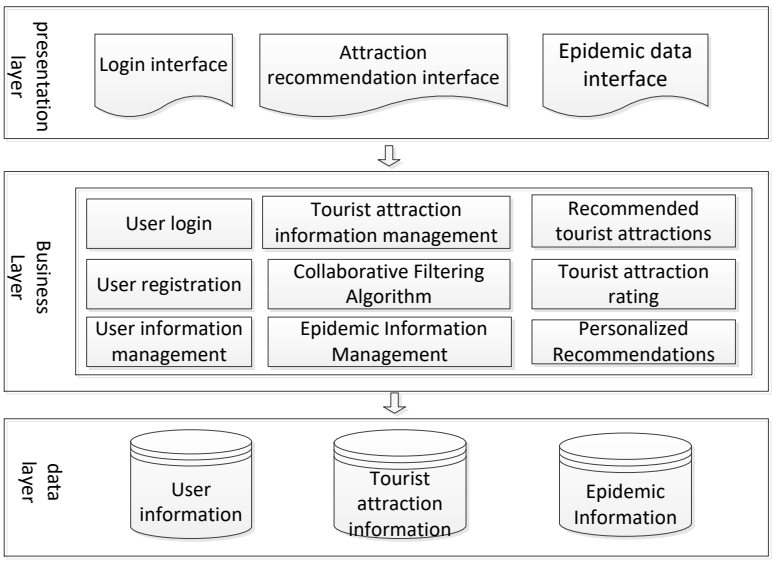

Fig. 3. Structure diagram of tourism recommendation system in the post-epidemic era

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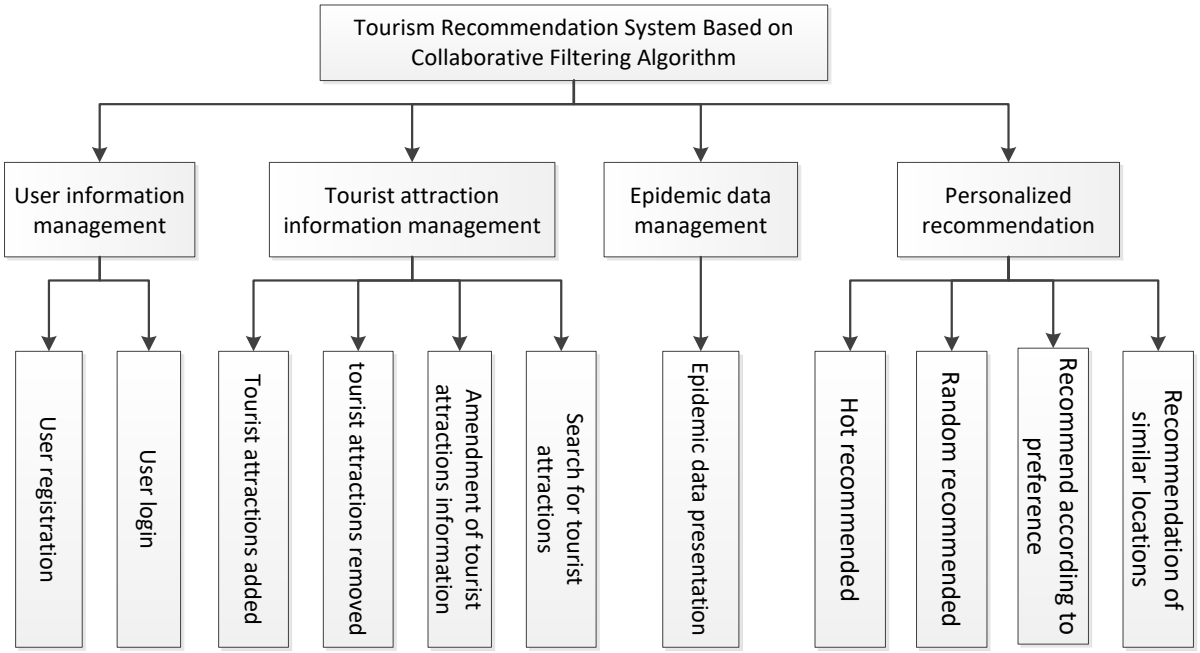

Fig. 4. System Organization Function Module Diagram

(1) User information management module

This module is designed for users, so the interface design is essential, which not only attracts users but also improves the user's actual user experience. This module is divided into two parts: user registration and user login. In this module, new users can complete user registration, and old users can directly log in to the system by filling in the correct information.

(2) Tourist attractions information management module

This module is the core data module, which collects relevant information about major tourist attractions, including route data, primary information data about tourist attractions, and users' rating data for tourist attractions.

(3) Epidemic data management module

The module is about the epidemic. It adds an electronic map function. The epidemic situation at home and abroad is displayed in the form of maps by crawling data. It has functions such as zooming and restoring the size. Local policies and the epidemic situation are prompted, and personalized travel plans are formulated for users in combination with user identities and changes in travel habits.

(4) Personalized recommendation module

This module is divided into four parts: popular recommendation, favorite recommendation, similar location recommendation, and random recommendation. Among them, a collaborative filtering algorithm is used for preference recommendation.

C. Interface design

Major scenic spot pictures as the main background, the interface is designed using Javascript technology. The main page of the website is shown in Figure 5.

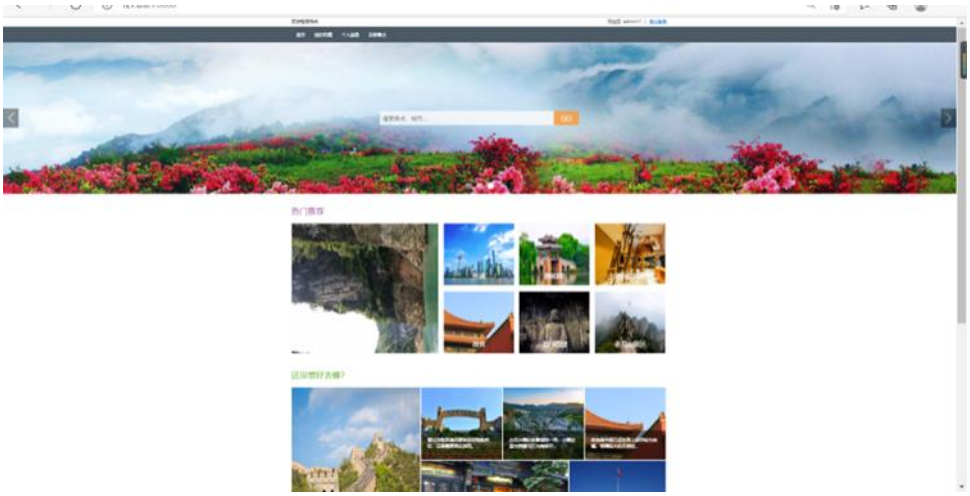
Fig. 5. Main interface display

IV. CONCLUSION

With the continuous increase in the number of tourists and the country's strong support for tourism, tourism has developed rapidly. Personalized travel recommendations are vital in the travel industry. However, with the arrival of the epidemic, we also need to meet the government's epidemic prevention and control needs and combine the dynamic information of the epidemic to improve the function of the recommendation system to provide tourists with the most suitable tourist attractions.

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