Research on Contextual Recommendation System of Agricultural Science and Technology Resource Based on User Portrait

Hui Zhang, Xiaojing Qin*, Huaiguo Zheng

Institute of Agricultural Information and Economics, Beijing Academy of Agriculture and Forestry Sciences, Beijing 100097, China
zhanghui@agri.ac.cn

Abstract. Under the new situation of rapid development of information technology and increasingly diversified demands of farmers, agricultural information service is also faced with many problems, such as the traditional information service system is difficult to quickly and accurately find the information required by users in the mass information, and the universal information service form cannot meet the growing personalized needs of users. In view of the above problems, this paper explores the application of user portrait technology in agriculture. Through in-depth analysis of the purpose of drawing portrait of agricultural users, characteristics of the agricultural industry and actual needs of agricultural information service, it builds a user portrait model in the agricultural field. At the same time, the situational recommendation system of agricultural science and technology resources based on user portraits is constructed by comprehensively considering the influence of multidimensional situational factors such as the time, geographical location, categories of agricultural production and changes in users' interests on the demand for agricultural information resources. Through practical application, the system realizes the individualized recommendation of agricultural information resources based on situational awareness and user interest adaptation, and satisfies the individualized demand of agricultural users for agricultural information better.

1. Introduction
In the era of information explosion, "information overload" leads to "information lost" of users, which requires more time and energy to filter the required information. The traditional information service system is difficult to help users find the information they need quickly. From the current situation of information service, the traditional services that I provide can no longer meet the diversified, dynamic and personalized agricultural information needs of farmers. From the perspective of the development of the times, personalized information services will become an irresistible trend. With the development of science and technology, the application of user portrait technology in information recommendation has been rising constantly. It also proves that its advantages can solve the problem of "information overload" well. It also proves that its advantages can solve the problem of "information overload" well in practice. If it is applied to the field of agricultural information service, it will be an effective means to solve the lack of information needed by farmers.

Therefore, this article builds agricultural user portraits based on multiple scientific and technological resources and user behavior data in the agricultural field. Meanwhile, situational recommendation algorithm is introduced to perceive users' real-time interests and preferences, so as to provide accurate
information services for users, realize the self-adaptation of information services and users, meet users' personalized information needs and improve user satisfaction.

2. Related Works

2.1. User Portrait Concept
User portrait was put forward by Alan Cooper, the father of interaction design, who believed that "user portrait is a virtual representation of real users and a target user model based on a series of real data"[1]. User portraits, also known as user roles, are collections of user feature tags[2]. Through the collection and mining of user information, the feature tags that can best represent users are extracted, so as to provide users with high-quality, personalized and professional knowledge resource services.

2.2. Recommendation Based on User Portrait
User portrait is a newly emerging technical hotspot in recent years, which has been widely applied in various fields, especially in the field of e-commerce [3]. In addition, in other fields, such as tourism, Internet finance, news media, social networks, medical and health, library services [4-11], etc., user portrait technology is constantly being recognized and fully explored and used by the public.

However, the research on resource recommendation in the agricultural field is still in the exploratory stage. Weiyang Jia[12] has realized the research of personalized agricultural information recommendation model based on conversation sub portrait and evaluation molecular portrait respectively based on the group user portrait. Yi Shi[13] designed a recommendation system of agricultural science and Technology Periodicals Based on user portrait, which was based on user portrait technology and personalized recommendation technology.

This paper will first analyze the resources and user Situation in the agricultural field, and then use the theory and method of user portrait to construct the agricultural user portrait. Meanwhile, considering the impact of Situation factors on recommendation, we improve the traditional recommendation algorithm and establish a situational recommendation model. Finally, an accurate recommendation system for agricultural science and technology resources is constructed to provide personalized recommendation services for users.

3. System Framework
Based on the knowledge resources of multi-agricultural science and technology and user information preferences, the user image technology and situational recommendation algorithm are used to construct a situational recommendation system for agricultural science and technology resources. The system framework is shown in Fig 1.

![Fig.1 System framework](image)
4. System Construction

4.1. Agricultural User Portrait Construction

This section introduces the construction process of agricultural user portrait from two aspects: user tag system and portrait construction method.

4.1.1. User Tag System Construction

The user tag can be understood as a visual representation of a user's feature symbol (such as user's age, gender, education, preferences, etc.). By integrating all the user's tags, the "portrait outline" can be outlined. Therefore, the process of making a portrait for the user is how to match the corresponding label, and the tag is the core work of constructing the user's portrait.

Based on the in-depth analysis of the purpose of drawing user portrait in the agricultural field, the characteristics of the agricultural industry and the actual needs of agricultural information service, the user tag system with three dimensions of user basic attributes, user behavior attributes and user situation attributes is constructed and the tag granularity is divided. Specific agricultural user portrait tag system and label granularity are shown in Table 1.

| Category                     | Attribute                      | Description                                                                 |
|------------------------------|--------------------------------|------------------------------------------------------------------------------|
| Basic attribute              | User ID                        | User unique ID                                                               |
|                              | User name                      | User account or user name                                                    |
|                              | Age                            | 18 years old, 18-30, 31-40, 41-50, 51-60, 61 and above                     |
|                              | Education level                | primary school, middle school, high school, undergraduate and postgraduate   |
|                              | User type                      | Ordinary farmers, large-scale farmer, agricultural technician, scientific researcher, members of association or cooperative organization, employee of agricultural park |
|                              | Agricultural production category| Food crop; cash crop; vegetable, fruit, fruit tree, flower, poultry, livestock, aquaculture, fertilizer, pesticide, etc. |
|                              | Contact information            | Mobile number                                                                |
| User behavior attribute      | Search                         | Search term, search result click                                             |
|                              | Browse                         | Browse content, browse time                                                  |
|                              | Collection                     | Collection content                                                           |
|                              | consulting                     | Consultation Q&A content                                                     |
| User situation attribute     | Time                           | January, February, March, April, May, June, July, August, September, October, November, December; spring, summer, autumn, winter |
|                              | Area                           | Northern China region, Eastern China region, Southern China region, Central China, Northwest region, Southwest region; Beijing, Tianjin, Hebei, Shandong and other 34 provincial-level administrative regions |

4.1.2. User Portrait Construction Method

Based on the established user tag system, the basic information attribute tag, content preference attribute tag and scene attribute tag of users are obtained. Then the agricultural user portrait is built around these three dimensions. The build process is shown in Fig 2.
Fig. 2 Build process

(1) User Data Collection

User data acquisition is the premise of user portrait construction. In general, data acquisition methods are explicit acquisition, implicit acquisition and inference acquisition. In this paper, agricultural user portrait data acquisition mainly through user registration information, search log, browse log, consultation interactive information and other explicit and implicit ways.

(2) Data Preprocessing

Since the acquired data is noisy, incomplete, and inconsistent, it is necessary to preprocess the data to improve data availability and lay the foundation for subsequent data analysis and mining. Therefore, through data cleaning, data integration, data protocol, data conversion and other data preprocessing operations on the acquired user data, a standardized and unified data format is formed. In this way, the user basic information base, the user historical behavior information base, and the user Situation information database are established to facilitate subsequent data analysis and mining.

**User behavior information.** The system makes statistical analysis on the length of time users stay while browsing resources and whether they collect or not. Set the value of user’s click/collection behavior as \{0,1\}, the non-click/collection resource is represented by 0, and the click/collection is represented by 1. Meanwhile, users’ browsing time is limited. If the browsing time exceeds 15 minutes, users’ evaluation of the resource is 5 points, the evaluation of 10-15 minutes is 4 points, the evaluation of 5-10 minutes is 3 points, the evaluation of 3-5 minutes is 2 points, and the evaluation of 3 minutes is 1 point. The browsing time data summary table is shown in table 2.

| Browse time       | Score |
|-------------------|-------|
| More than 15 minutes | 5     |
| 10-15 minutes      | 4     |
| 5-10 minutes       | 3     |
| 3-5 minutes        | 2     |
| Less than 3 minutes | 1     |

**User Situational Information.** According to the user login browsing content, the system time of the user computer host and the IP address accessed by the network are obtained, and the user Situational information is obtained through conversion and mapping of the time and IP address data. The system time directly corresponds to the time information mapping table (as shown in Table 3), and saves the
season of the time; For the IP address of the user to access the network, the system uses the IP address query interface of NetEase to obtain the province and city where the IP belongs, and saves the information and corresponds to the regional information mapping table (as shown in Table 4). In the end, we get standardized situational data. Whenever the user logs in, the situation information will be updated to ensure the real-time information.

Table 3. Time information mapping table

| Season | Month                      |
|--------|----------------------------|
| Spring | March, April, May          |
| Summer | June, July, August         |
| Autumn | September, October, November |
| Winter | December, January, February |

Table 4. Geographic information mapping table

| Region                       | Province                                                                 |
|------------------------------|---------------------------------------------------------------------------|
| Northern China region        | Beijing, Tianjin, Shanxi, Hebei, Inner Mongolia                           |
| Eastern China region         | Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Taiwan     |
| Southern China region        | Guangdong, Guangxi, Hainan, Hong Kong, Macau                             |
| Central China                | Henan, Hubei, Hunan                                                      |
| Northwest region             | Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang                              |
| Southwest region             | Chongqing, Sichuan, Guizhou, Yunnan, Tibet                               |
| North-East region            | Heilongjiang, Jilin, Liaoning                                            |

(3) User Behavior Data Mining

By analyzing the user's behavior logs such as browsing and retrieval, the main points of interest of the user can be analyzed and mined. The research uses the natural language processing toolkit HanLP (Han Language Processing), which has a high degree of named entity recognition, to mine and analyze the search terms and browsing content entered by users to obtain user interest tags. By calling HanLP keyword extraction toolkit, and using agricultural vocabulary to build a user-defined dictionary, the user behavior information is extracted and the weight of keywords is calculated. At the same time, record the extraction date of the label. According to the number of keywords and date, the Top 10 tags are selected as user preference tags.

(4) User Portrait Generation

Through the three-dimensional analysis and mining of agricultural users, user portrait information is obtained and mapped to user portrait tags to generate user portraits. At the same time, considering that the user's interest will decay over time, the user's behavior information is re-analyzed regularly every week to calculate the portrait tags.

4.2. Contextual recommendation

4.2.1. Resource tag

Agricultural resources are extracted and labeled. Based on the user portrait tag, as a feature vocabulary, hanlp is used to extract the keywords of resources, and the semantic similarity between keywords and tags is calculated. The tag with the highest similarity in TOP10 is selected as the label of this resource.

4.2.2. Context recommendation model

By using the idea of collaborative filtering, a scoring matrix is constructed on the three dimensions of user, resource, and contextual information. On the basis of traditional recommendation, the accuracy of user recommendation can be improved by adding contextual information, while effectively solving the system "cold start" problem. The recommended model is shown in Fig 3:
5. System Development
This system uses B/S (Browser/Server) structure and Java spring framework to realize agricultural science and technology resources display platform. It collects basic information, behavior information and situation information of users by guiding users to register and designing data embedding points in front of web pages. At the same time, it provides users with agricultural science and technology resources retrieval and information recommendation. The system mainly includes resource retrieval, personalized recommendation and other functions. The front page is shown in Fig 4.

Fig. 4. System Home Page
6. Conclusion
This study considers multi-dimensional contextual factors such as the time, geographic location, agricultural production category, and user interest changes of agricultural users, and establishes a three-dimensional agricultural user portrait labeling system in three dimensions: user basic context attributes, user behavior attributes, and user spatiotemporal context attributes. At the same time, the construction process of user portrait based on tag system is proposed, and the user portrait and recommendation algorithm are integrated to build a comprehensive recommendation model of multi-dimensional context integration. Through the above methods, we developed a situational recommendation system for agricultural science and technology resources based on user portraits, realized the personalized recommendation of agricultural information resources based on context perception and user interest adaptation, and better met the personalized needs of agricultural users for agricultural information at different times and regions.

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