Training System of New Rural Professional Farmers Based on Collaborative Filtering

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Abstract. Cultivating new agricultural operators is an important measure to implement the strategy of rural revitalization, and the training of professional farmers is the key to speed up the construction of new professional farmers. Because the existing training system does not consider the different learning needs of different individuals, the user's satisfaction with the training system is low under the unified output mode. Therefore, this paper proposes a new type of rural professional farmer training system based on collaborative filtering. In this paper, MYD-JA5D2X development board is used as the core component of the system architecture, and efficient interfaces are set up to meet the operational requirements of the system. In the logical design of system operation, user portraits including age, education, agricultural field, retrieval records and browsing records are constructed, and the resources with the highest degree of fitting with the actual needs of users are matched according to user portraits in massive training resources by means of collaborative filtering. The test results show that the user's learning time for the output resources of the design system is more than 70%, and the satisfaction rate is 96. 5%.

Keywords: Collaborative filtering, Rural new vocational farmer training system, System architecture, User portrait, Resource matching, Fitness

1 Introduction

The concept of Collaborative Filtering Recommendation (CFR) was first proposed in 1992 and first used in Tapestry. It is a recommendation system based on personalized recommendation method. The method is mainly to find the similarity of users as the goal, according to the degree of user preferences to predict. The calculation principle is to judge the similarity of users by using the historical data of users, find the set of users who are most similar to users through the calculated similarity, and recommend products that users like [1]. It can be divided into three recommendation algorithms: User-based, Item-based and Model-based [1]. The user-based collaborative filtering recommendation algorithm is to find users with similar interests to the target user in the user group through the analysis of the target user's interests, and synthesize the evaluation of these similar users on a certain item to form a prediction of the system on the degree

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to which the target user likes the item, and then recommend the target users [2]. The item-based collaborative filtering recommendation algorithm is to find out similar items to the target user's favorite items by analyzing the target user's favorite items, and recommend these items to the target user [3]. Model-based recommendation algorithm is to use some modeling methods of statistics or machine learning to model and preprocess the user's rating information offline, and use the established preference model to recommend users online [4].

The concept of persona was first proposed by Alan Cooper of Interaction Design: "Personas are a concrete representation of target users.", which refers to the virtual representation of a real user. It is a target model based on a series of attribute data. Household portrait, namely household information labeling, refers to the labeling household model abstracted from household attributes, household preferences, living habits, household behavior and other information. Popularly speaking, it is to label the household, and the label is the characteristic identification refined through the analysis of household information [4]. Labeling can be used to describe users with more general and understandable characteristics, which can make users easier to understand and can be processed by computers. As the foundation of data, it perfectly abstracts the information panorama of individual households, provides enough data foundation for further accurate and rapid analysis of important information such as household habits and consumption habits, and lays the foundation for the data age.

With the development of Internet, the household portrait we are talking about now contains a new connotation-usually the household portrait is a labeled household model abstracted from the information of household learning characteristics, network browsing content, network social activities and consumption. Constructing the core work of household portrait is mainly to analyze and mine the massive data stored in the server and database, and to label the household. "Label" is the identification of a certain dimension characteristic of the household. The specific label form can refer to the label of one of the households in a station as shown in the figure below.

Under the background of increasing attention to the "three rural" issues, training new professional farmers has become one of the important means to solve the problem of rural development [5]. Through the relevant guidance of the Party Central Committee and the government on the training and education of farmers, we can see that their attention to this decision has reached a high level [6]. The training of new-type professional farmers in rural areas is to train young and middle-aged farmers with junior high school, senior high school (vocational high school, secondary school) and above education level who are willing to engage in agricultural production, management and service to have crop production, flower horticulture production, animal breeding, aquaculture, economic forest production, agricultural machinery use and maintenance [7]. On this basis, in order to ensure the effect and quality of vocational farmer training, and adapt to the urgency and long-term requirements of vocational farmer training, it is necessary to build a training system with strong pertinence. Compared with other types of training, the main problem in the training of new vocational farmers in rural areas is that the coverage of training resources is relatively large and the types are relatively large, which affects the efficiency of learning to a certain extent.

As an information filtering technology, the application of collaborative filtering in relevant information systems has achieved rapid development in recent years. Different from the direct analysis method based on content [8], collaborative filtering introduces user interest parameters, and realizes further in-depth analysis of information by calculating resources with high matching degree. It is of great application value to apply it to the design of the training system for new vocational farmers in rural areas. Therefore, this paper proposes a new type of rural professional farmer training system based on collaborative filtering, and through the way of experimental testing to analyze and verify the performance of the designed system.

2 System architecture settings

In order to ensure that the system can meet the needs of users of different scales, this paper strengthens the setting of processing efficiency in the hardware architecture design stage of the system [7]. MYD-JA5D2X development board is used as the core component of the system architecture, which is equipped with ARM Cortex-A5 core. Under the action of ATSAMA5D2x processor, the running frequency can reach 500MHz. The ATSAMA5D2x processor system has three main processing units, namely the Cortex-A53 Application Processing Unit (APU), a 64-bit quad-core CPU based on the Arm V8 architecture [9]; the Cortex-R5 Real Time Processing Unit (RPU), based on the Arm V7 architecture; 32-bit dual real-time processing unit-based on dedicated tightly coupled memory (TCM) [10]. Not only that, this paper also set up 256MB DDR3 SDRAM and 256MB Nand Flash, 4MB SPI Flash and 64KB EEPROM for the system, through this way to ensure that it can realize the comprehensive processing of a variety of new rural vocational farmer training resources. The specific system architecture is shown in Figure 1.

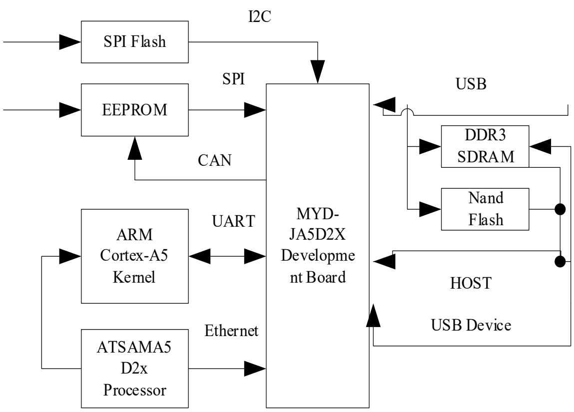

Fig. 1. System architecture design

As shown in Figure 1, in terms of interface settings, this paper builds standard communication interfaces including USB HOST, USB Device, Ethernet, UART, CAN, SPI and I2C for the system architecture. With the help of 200pins golden finger, it can quickly and conveniently connect with other application hardware. With this design, it is ensured that the system can support multiple high-speed interface protocols.

3 System operation logic design

3.1 Build user portraits

In order to ensure that the learning resources output by the training system for new vocational farmers in rural areas can have a high degree of fit with the actual needs of users, this paper first constructs a user portrait based on the basic data of users.

Let X be a user image constructed based on the basic information of the user, which can be expressed as:

$$X = \{x_1, x_2, x_3, x_4, x_5\} \quad (1)$$

Where, x_1 represents the age information of the user, x_2 represents the education information of the user, x_3 represents the agricultural field corresponding to the user, x_4 represents the history retrieval record of the user and x_5 represents the history browsing record of the users. It can be seen from formula (1) that the user portrait constructed in this paper contains both objective parameters and subjective parameters reflecting user behavior. Among them, the statistics of age and learning information is the basic evaluation of the user's learning ability, which ensures that the type of training resources output by the system can match the user's actual learning ability [11]. The statistics of the agricultural field, retrieval records and browsing records is to further analyze the learning needs of users, so as to improve the fitness between the training resources output by the design system and the actual needs of users.

In this way, the construction of user portraits is realized, and the data base is provided for the subsequent resource output of the system.

3.2 Training resource output based on collaborative filtering

On the basis of the above, this paper uses collaborative filtering to determine the final output of the training resources. According to the user portrait constructed above, the fitness between training resources and user needs is calculated.

First, x_3 is used to determine the scope of the target resource, which can be expressed as:

$$p = sim(P \rightarrow x_3) \quad (2)$$

Where p represents the target training resource output range, sim represents the fitting function, and P represents all target training resources.

The computation to determine the final output resource in the range of p can be expressed as:

$$p' = sim_{max}(p \to x_4) \cap sim_{max}(p \to x_5) \quad (3)$$

Where p' represents the training resource of the final output of the system, and sim_{max} represents the maximum value of the fitting function. It should be noted that the constraint function of equation (3) is $p' \in k$, and k represents the learning ability, and its calculation method can be expressed as:

$$k = \lambda x_1 + \beta x_2 \quad (4)$$

Where λ represents the coefficient of the relationship between age and learning ability, and β represents the coefficient of the relationship between learning and learning ability.

In this way, the training resources output by the system can meet the learning needs of users to the maximum extent.

4 System application test

4.1 Test environment

During the testing phase, MyEclipse12.0 is the basic development environment. Apache-tomcat-7.2.4 is the logical language of the testing environment. MySQL 6.2.4 is the database carrier of the testing environment, and python3.7.2 is the editing tool of the test environment. On this basis, the overall development environment is set in a distributed computing platform [12]. The platform details are Apache Hadoop 2.1.0. The corresponding CPU parameters are Intel (R) Core (TM) i7-5960 CPU@6.0GHz, and the memory size is 64GB. During the testing phase, Windows 8 was used as the operating system. For the preparation of test data, this paper takes the corresponding resources in the training target system of rural new vocational farmers as the test data of the system, totaling 10225 training resources, covering different aspects of breeding, planting, technology, management and so on.

In this environment, the user's satisfaction with the training content output by the training system and the user's learning of the training resources are tested respectively.

4.2 Test results and analysis

In this paper, 200 users are tested. Firstly, the effective time and the total time of learning training resources are counted from the background to determine the user's interest in the system output training resources. The resulting data are shown in Table 1 below.

Table 1. Comparison between the effective duration of user resource learning and the total duration of resources

Number of users counted	Total duration of resources/h	Effective learning time/h
1	13.5	10.9
50	675	506
100	1350	904
150	2025	1518
200	2700	2052
250	3375	2632
300	4050	3118

Considering the difference of each user's learning ability and actual experience, the total learning time is compared with the actual effective time of the resource to judge the fitting degree between the resource and the user's needs. The data results are shown in Figure 2.

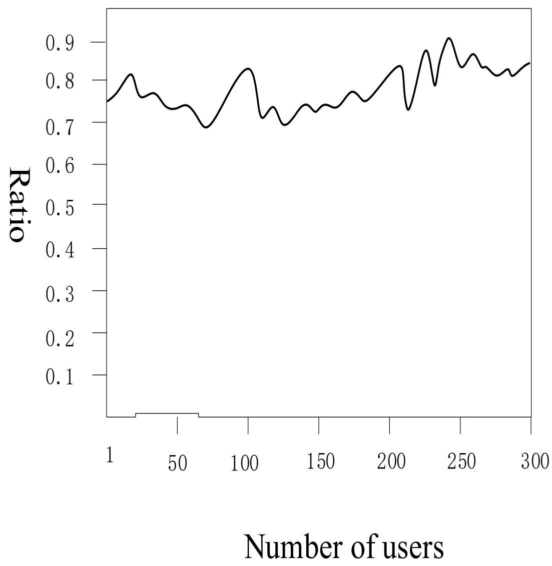

Fig. 2. Comparison of user requirements and resource fit

It can be seen from Figure 2 that the user's learning of the output resources of the new rural vocational farmer training system designed in this paper is at a high level, in which the ratio of the actual learning time to the total training time is basically stable at more than 0.75, and the maximum value is more than 0.8, which indicates that the resources and user needs have a high degree of fitting. The application value of the system designed in this paper in the actual training is verified.

On this basis, 200 test users were visited and their satisfaction with the system was counted, and the data results are shown in Table 2.

Table 2. Statistical table of users' satisfaction with the training system for rural new vocational farmers

Feedback results	Number of person	Proportion/%
Very satisfied	64	32.00
Quite satisfied	92	46.00
Satisfied	37	18.50
Needs to be improved	5	2.50
Not satisfied	2	1.00

By observing the data in Table 2, it can be seen that in the satisfaction feedback results, 32.0% of the users are very satisfied with the design training system, 46.0% of the users are very satisfied with the design training system, and 18.5% of users are satisfied with it. The analysis of the above data shows that the overall satisfaction of the system has reached 96.5%. Then, the user groups whose feedback results are to be improved and dissatisfied are further followed up, and it is found that there are some opinions on the application of system pages and related basic display settings, but they are satisfied with the actual operation effect of the system. Through the above analysis, it is not difficult to see that the new rural vocational farmer training system based on the collaborative filtering designed in this paper can meet the learning needs of users in function.

5 Conclusion

Cultivating new professional farmers in rural areas is an important way to help rural areas achieve new development. It will play an internal driving role in the long-term construction in the future. This paper proposes a new type of rural vocational farmer training system based on collaborative filtering. The system can achieve high-precision matching of relevant training resources according to the actual needs of users and can effectively improve the effect of rural new type of vocational farmer training. Through the research results of this paper, it can provide valuable reference for the promotion of related training work.

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