

## Study on Personalized Recommendation Technology of Digital TV Programs

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**Abstract**—This paper aims at one of key technologies in digital television development ---intelligent personalized recommendation technology of digital TV programs for study. This paper proposes to take advantage of ample TV-Anytime to describe metadata so as to perform specific plans of guide service for TV programs based on TV-Anytime metadata specification. It combines technology such as data mining and artificial intelligence etc with a view of building a personalized TV program recommendation system on the framework of the multi-agent. Besides, a hybrid algorithm with content filtering and collaborative filtering based on the systematical recommendation algorithm has been put forward. In order to overcome the deficiencies of traditional collaborative filtering algorithm which relies on users' explicit evaluation, the paper represents an improved algorithm with the footing of content collaborative filtering.

**Keywords**- Digital TV; Recommendation Technology; Collaborative Filtering Algorithm

### I. INTRODUCTION

The rapid development of information society urgently requires people to find out their own information from the vast Internet Ocean. In this context, the personalized and active information filtering service, as a new kind of intelligent information one, has gained much concern. Personalization of information filtering targets at unique information needs of each user and filters high-efficient and integrated information from different information among a large number of users. The service changes fundamentally the way people get access to information, from traditional "looking for information by people" to "looking for people in information".

For a better service for digital TV subscribers, electronic program guide (EPG) have been widely used in the United States, Europe and other countries where digital television develop earlier thus it has become one of the most basic digital TV businesses. According to statistics, EPG has the highest click-through rate in all digital TV business and has become an industry with rapid development, thus a batch of professional companies for developing and producing EPG have come out such as American TV Guide etc.. A lot of money has been spent in digital TV set-top box and EPG tender all over China and there have been increasingly high demands for EPG with the transition from set-top boxes to interactive type. Hence, providing personalized intelligent recommended program service for digital TV subscribers is a major business in the digital TV operation.

### II. MEDIA METADATA RESEARCH

As a personalized recommendation system for digital television programs, the data is very important. So the used data standard directly affects the users' modeling, algorithm selection as well as system implementation. The key of efficient information retrieval and management is to define a unified form to describe information content, that is, media metadata. Metadata is usually defined as "data about data" for providing information description of media content. For the field of digital television, the metadata comes from television and is used in program guide and navigation information. In addition, TV metadata have been more widely applied with the development of digital interactive TV, such as: personalized television, distance education, wireless video surveillance, remote conference, which will bring more business opportunities.

For the sake of standardization issues in multimedia content description, International Organization for Standardization (ISO) has pioneered to develop the MPEG-7 standard, that is, multimedia content description interface. MPEG-7 provides a common, flexible framework for multimedia content production and interoperability for systems and application for production, management, publishing and using audio and multimedia. Meanwhile, media platform for digital TV, TV-Anytime can provide multimedia description standards and mechanisms suitable for personal audio and video acquisition, management and storage. TV-Anytime is an application of MPEG-7 with the most important contribution to developing a content description standard in television field which does not only provides rich program description but also provides global program guide information standards and implementation mechanism information.

### III. RECOMMENDATION TECHNOLOGY RESEARCH

The current study shows that personalized recommendation system in TV field can be divided into two types: one aims at content-based real-time audio and video analysis to obtain content description information and the other depends on transmitted program together with contents. Comparatively speaking, the former method does not require description information transmission or saves transmission bandwidth. However, it needs real-time analysis of video information in a terminal system which has a high need for hardware systems due to a large amount of computing and the analysis results are less ideal lacking for practical use at

this stage. The latter method is born in the television production and broadcast with unification with more abundant description, thus bringing more accurate recommendation. So the research focuses on metadata personalized recommendation system.

The personalized web-based system separates program guide services from TV system, thus users can get service with the help of the Internet which is inconvenient. In addition, the dominant technology can roughly describe users' preference characteristics only to a certain extent, dynamic usable to change with users' preferences.

Through research and analysis on personalized recommendation in the TV field, the summary is as follows:

1) The standard description and users' information description should be used in order to improve system openness. DVB and ATSC are both used for the description information specification for the purpose of program guide which is not very suitable for the application of personalization due to their simplification. Instead, MPEG-7 and TV-Anytime metadata specifications have been widely used owe to their rich content description and standard users information description. By comparison, TV-Anytime is more suitable for the field of digital television, though it does not describe how to generate user description metadata, in particular, does not involve the method to calculate the preference index.

2) The users' modeling needs adaptive learning ability in that the original interest topic of some users will be gradually forgotten and new interests will gradually appear with time passing by. The handmade user model is static in that the user model will not have any change once the user customization is completed. Thus, the static, immutable characteristics do not fit obviously for the inherent gradient interest. When the user model cannot reflect users' interest well, the user will have to customize it which brings extra burden to the user.

3) Personalized TV programs intelligent recommendation system designs to minimize audience participation for the users' direct feedback in that completely dependence on the user easily reduces users' activity to use the system. Psychological research from Carroll and Rosson shows that users do not intend to participate in a training system, even if they are aware that training on the system will benefit them. The handmade custom modeling method is completely dependent on the users and restricted in practical applications, so automatic modeling method should be used without the users' active participation.

4) The traditional collaborative filtering algorithm is not suitable for personalized recommendation in the TV field. This lies in that: on one hand, the algorithm depends on the explicit evaluation of users, on assumption that different users often appreciate and evaluate the same program; On the other hand, it ignores the content analysis and cannot grasp what users are really interested in.

It is based on the above reason that television program recommendation system more focuses on how to accurately describe the user's interests and viewing habits; how to dynamically change and track user interest; how to apply the

filtering mechanism to user programs recommendation and so on and so forth.

#### IV. INFORMATION FILTERING ALGORITHM

The filter algorithm uses a hybrid algorithm with content-based filtering and collaborative filtering. The principle of the hybrid filtering tends to both compare the similarity of resources and user model for content-based recommendation and engage in analysis on user similarity with the view of identifying a group of users with similar interests for collaborate filtering. The mixed filtering can give the advantages of two filtering methods to offset the shortcomings with a better recommendation performance. Furthermore, the paper also centers round shortcomings of traditional collaborative filtering algorithm to propose an improved algorithm \_content-based collaborative filtering. Through comparison of user description, the similar users depending on collaborative filtering are determined.

Content based filtering

Content-based filtering algorithm such as

$$RI(u, p) = \sum Wi * Sim(Ui, Pi) \quad (1)$$

In it, RI represents recommended index, U represents user's description, P stands for program description, Sim (u, p) indicates similarity between the content descriptor instance i and user's description i.e. recommended index of content descriptor instance i in the user's description. If the user's description does not include the instance, then the similarity default is 0. W denotes the right weight for the descriptor, which takes into different impact from different content descriptions on audience's program choice into account. Through analysis and calculation according to the above equation in content description in program guide information and comparison of the recommended index and similarity threshold artificially set, favorite and non-favorite programs can be distinguished and through recommended index, the recommended program orders that audience like can be decided.

The content filtering features simplification and practices. Once the user description is generated, the information filtering can run in real time. However, the recommended quality of the algorithm is directly related to user description file. If the user description file fails to describe the user's interest correctly or completely, then the recommended quality may be affected. In addition, it is short of "creation" in that it is only recommend based on users' description without digging out new interest from users.

#### V. COLLABORATIVE FILTERING

Traditional collaborative filtering rests in the neighboring users' evaluation to produce a list of recommendations for the target users. The user's evaluation on one hand is used to calculate the similarity between users and on the other hand the information source to produce recommended information for the target user. However, the explicit evaluation in practice use is difficult. After all, the user is actually very reluctant to publish explicit evaluation, even though they know this will help to provide better service for them.

Therefore, data from user's rating is quite sparse compared with the large number of resources. In large-scale e-commerce systems, users' evaluated projects generally do not exceed 1% of the total number. In this case, the projects rated by two users jointly are fewer. In case of extremely sparse or lacking of user's rating, the traditional similarity measurement method cannot be used. On the other hand, it is also important to pay attention to television features at this stage - real-time broadcast. TV programs have dynamic broadcast, even if the audience is willing to comment, the program has also been over when recommendation at this time has no meaning. Therefore, the traditional collaborative filtering on scores is not suitable for personalized recommendation system in the TV field. This paper thus proposes an improved collaborative filtering algorithm - content-based collaborative filtering. The content-based collaborative filtering resorts to resources analysis to predict the evaluation of users on other resources, which can increase the density of the resource evaluation, making it easier to find the similarity between the users. Instead, the most adjacent the user's searching in the traditional collaborative filtering algorithm relies solely on the evaluation from different users on the same content, while ignores completely analysis of program content. Thus, even if two users hold the same evaluation on similar programs, they can be still assumed as to have different interests. The innovation of the collaborative filtering algorithm lies in consideration of analysis of evaluation contents, that is, comparison between searching the nearest neighbor users and user's description profile.

## VI. SUMMARY

The paper bases on TV-Anytime metadata specification to combine data mining and artificial intelligence technology to build a personalized and intelligent recommendation system for digital TV programs on Multi-Agent framework. The system resorts to collection and analysis of user information to learn the user's interests and behavior, thereby achieve the purpose of active recommendation. This paper put forward system granularity model of users' interest on the user's modeling strategies. Based on the model, this chapter proposes fuzzy inference algorithm for automatic user's modeling and gains users' interest characteristics through analytical reasoning on their viewing behavior. Based on the systematic recommendation algorithm, the paper uses the content based filtering and collaborative filtering mechanism combination to realize both comparison among resources and the similarity of each user's model for content-based recommendation as well as analysis of users' similarity with the purpose of identifying a group of users with similar interests by means of collaborative filtering. The hybrid filtering algorithm maximizes favourable factors and minimizes unfavourable ones with a better recommendation performance. The traditional collaborative filtering algorithm relies on the explicit evaluation of the user, not suitable for the field of television. For the sake of this, this paper presents an improved algorithm - content-based collaborative filtering which resorts to resources analysis to predict the evaluation of users on other resources to increase the density of the

resource evaluation, making it easier to find the similarity between users.

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