A profile based recommendation system for TV-Anytime annotated content

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Abstract— **The enormous offer of video content on the internet and TV broadcast networks requires new instruments to assist people in selecting the appropriate content. Currently, video retrieval is done with one dimensional keyword based search tools, which are far too inadequate to filter out all the irrelevant content. User ratings could improve the search results but this method has a big dependency on the community itself.**

This paper introduces a TV-Anytime based personalisation system that recommends video content according to the individual user profile. By continuously monitoring user interactions, this profile gets updated and reflects the user's interests. These monitored user interactions are twofold: implicit feedback of the viewing behaviour and explicit user feedback consisting of ratings. A complete test setup has been deployed to evaluate the user interaction mechanism and the designed recommendation algorithm. The results of the user tests are presented in this study.

Keywords— **Personalisation, Algorithm, User Profiling, Recommendation, TV-Anytime**

I. Introduction

NOWADAYS , the offer of video content on the internet is abundant and is still increasing. The web 2.0 video sites like YouTube and Metacafe, are extremely popular. In addition, the number of available TV channels has increased enormously by the introduction of digital television.

These new services complicated video retrieval for the end user who can only consume a small fractions of the overwhelming quantity of video content. Furthermore, a lot of videos are annoying, irrelevant or not in the field of interest of the user. Most video sites use a keyword based search tool to address these issues. Nevertheless, this rudimentary search tool is not capable to weed out irrelevant content. A second filtering based on user ratings can assist, but has a big dependency on the community itself.

The situation for digital TV is even worse. To find the most suited television programme, one has to thumb through a thick printed TV guide, or make an appeal to an Electronic Program Guide (EPG). However, most of these EPGs still lack intelligence and do not provide a personalised solution [1].

To solve this problem, we built a recommendation system, that dynamically creates a profile for each viewer and recommends the video content that best matches this profile. The TV-Anytime metadata standard [2] is used for the description of these content items in our implementation. This recommendation system can be deployed in an internet video service, mediagateway or EPG to assist the consumers in choosing the appropriate content [3].

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II. The profile structure

The user profile consists of a set of metadata terms t_i, e. g. "soccer", "Antonio Banderas", "violence", etc. Each term, t_i, belongs to a field, f_i, where

$$\forall i : f_i \in \{ \text{ Genre, Actor, Director, Coworker, Keyword, Spoken language, Title, Caption language } \}$$

A user appreciation, u_i, varying from -1 to +1, is associated with each term as well. Therefore, the profile is stored in the database in the form of 3-tuples, (t_i, f_i, u_i).

All metadata information is not equally important. For instance, a content genre, may be more significant than a keyword. As a result, we should assign an importance factor, $W(f_i)$, to reflect the relative importance of each field, f_i. The values of $W(f_i)$ used in our implementation are fixed (Fig. 1) and were determined by a small user survey before the user tests. In future versions, the value of these weights could be optimalized through time-dependency and personalisation.

These 3-tuples are constantly updated in an implicit and explicit way. The time the user spends on watching the video will be used to implicitly update the user profile. The early termination of a video, for example, could be interpreted by the system as negative input for the algorithm. The profile can be explicitly updated by a star rating system as well. When a person grants a score to a video, every term t_i with field f_i of that content item, is updated or inserted into the user profile as (t_i, f_i, u_i) with the following rules:

- If there is already a 3-tuple in the profile with specified term t_i and field f_i, its user appreciation is updated:

$$u' = (1 - \alpha) \cdot u + \alpha \cdot \beta \tag{1}$$

where u' stands for the new appreciation of t_i, u represents the old appreciation of the term, α is a parameter between 0 and 1 that specifies the learning rate and β symbolizes the score from the implicit or explicit rating mechanism and ranges from -1 to +1.

- If there is not yet a 3-tuple in the profile with specified term t_i and field f_i, it is inserted with:

$$u' = \beta \tag{2}$$

III. Recommendation algorithm

The following sequence is used by the algorithm to obtain the recommendation score.

1. Extract the usable information from the TV-Anytime metadata of the content item.
2. Check which of these terms, t_i, are present in the current user profile.

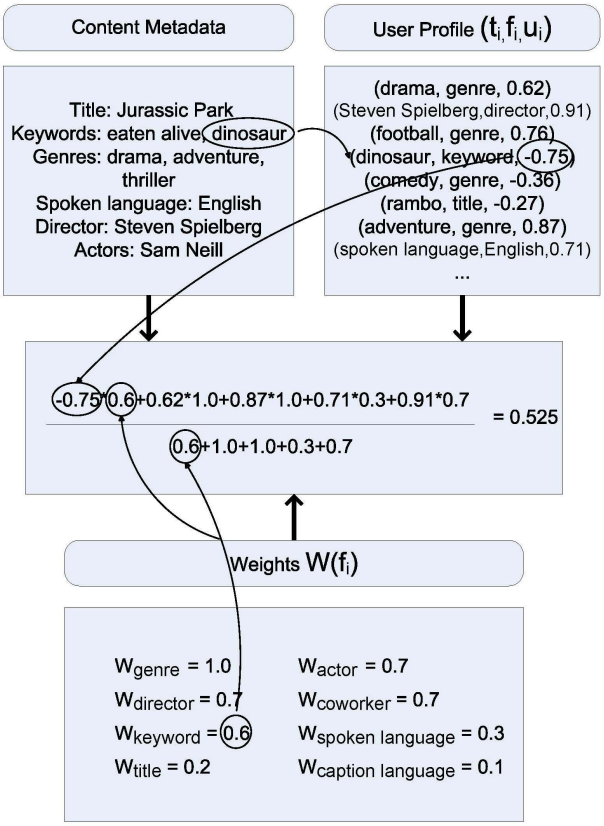

Fig. 1. algorithm example

3. Collect the user appreciations, u_i, of these terms t_i, from the user profile and calculate the recommendation score(S) as a weighted average of these user appreciations:

$$S = \frac{\sum_i u_i \cdot W(f_i)}{\sum_i W(f_i)} \qquad S \in [-1, 1] \tag{3}$$

where i iterates over every term, t_i, that was selected in step 2, u_i is the user appreciation of the term and $W(f_i)$ represents the weight of the field, f_i.
Fig. 1 illustrates this algorithm for the movie "Jurassic Park" and a fictitious user profile.

IV. Evaluation

To evaluate the system, 10 users were invited to watch content during an average of ten days. We requested to consume 5 to 10 video fragments each day and explicitly demanded to rate the videos through granting a number of stars.

To evaluate the user tests, we compared the user score (after a mapping to the interval $[-1, 1]$) with the score calculated by the algorithm before rating. The algorithm uses all the previous ratings and watching behavior to predict the user appreciation for each video. The first thing we noticed, was the little difference in algorithm performance between the several days. Because an initial user profile was set up by asking the user's favourite genres, a reliable notion of the user's preferences was already available. A detailed profile with more terms is needed to improve the recommendations. Therefore more data than available in the user tests and a longer evaluation period is required to achieve a significant performance improvement in time.

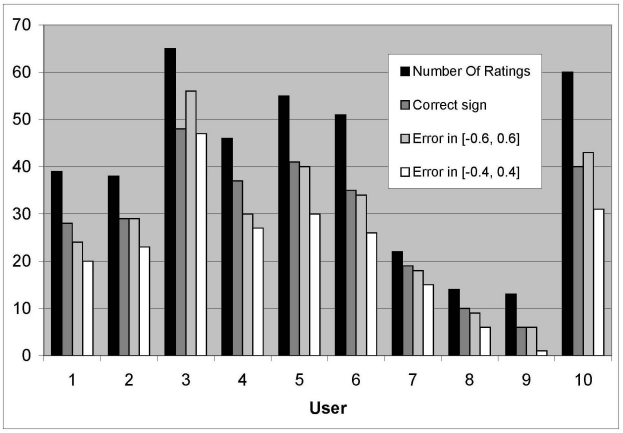

Fig. 2. Evaluation: graph1

A representation of our user tests is shown in Fig. 2. For every test user, four bars are printed. The first bar stands for the number of videos that were rated. The second bar represents the cases in which the user score had the same sign as our algorithm score. Predicting the sign of the user score is useful when services have to make a binary choice, e. g. whether or not to record or offer a specific video. The third bar reports the cases in which the difference between the algorithm score and the user score, (i.e. the algorithm error) is between -0.6 and 0.6. These predictions have an error of three or less stars. The last bar are the predictions that have an algorithm error between -0.4 and 0.4, which denotes an error of two or less stars. This evaluation illustrates the practicability of the algorithm. Nevertheless, there is room for improvement in future algorithm designs.

V. Conclusion

This paper proposed a recommendation algorithm that can be deployed in an internet video service, mediagateway or EPG to assist consumers in selecting content. The structure of the user profile, a set of 3-tuples, is described together with the update mechanism. User profiles are updated in an explicit way by means of a rating system as well as in an implicit way by logging the user's behaviour. We designed a weighted average recommendation algorithm that predicts the user appreciations for content items based on the user profile. A user evaluation proved the practicability of the recommendations system. Nevertheless, the results indicate a margin for beter recommendations in future algorithm designs.

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