suggesTv: A Content Recommendation Application for Digital Television

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ABSTRACT
With the expansion of TV channels in the digital era, viewers are exposed to an excessive amount of programs to choose from. Consequently, personalized recommendation systems are desirable in order to enable viewers to navigate and find interesting programs. This paper describes an application that provides program recommendations for viewers in real-time. The application, called suggesTv, shows the top rated content and the programs that are being broadcast at the moment, based on information stored in his ContentWise profile.

Keywords
Recommendation Systems, Digital Television, Interactive TV.

1. INTRODUCTION
Digital television arrived with a large increase in the number of TV channels, providing the user with multiple viewing options and a rich list of programs to choose from. The standard features provided by a set-top box (STB) allow the viewer to browse the Electronic Program Guide (EPG) or to zap over the available channels, both difficult tasks due to the large number of options.

During the last years, the STBs have incorporated new features and increased computing capacity. Most modern models of STBs can connect to the Internet and run applications to enhance the user experience during a TV show. This opens new opportunities in the development of applications – referred to as recommender systems – that can help the viewer in finding the best content for his/her tastes. The STB application proposed in this paper uses an external recommendation engine, called ContentWise, (i) to recommend the user with TV programs related to the user preferences, (ii) to show the most viewed and top rated content currently on air, and (iii) to suggest similar content.

The remainder of the paper is organized as follows. Section 2 describes the ContentWise recommendation engine. Section 3 presents the suggesTv application and its integration with the ContentWise service. Section 4 describes the related work and compares it to suggesTv. Finally, section 5 draws some conclusions and perspectives for future work in this field.

WebMedia'11: Proceedings of the 17th Brazilian Symposium on Multimedia and the Web. VIII Workshop on Ongoing Undergraduate Research.
October 3 -6, 2011, Florianópolis, SC, Brazil.
ISSN 2175-9650.
SBC - Brazilian Computer Society

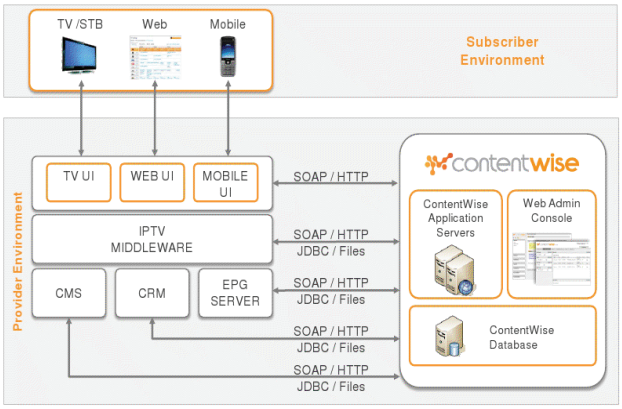

Figure 1. ContentWise high-level architecture [10].

2. CONTENTWISE ENGINE
ContentWise is a high scalable, real-time content recommendation engine for Digital Media and IPTV that helps to improve the viewer experience [1]. It can recommend any digital media content available, such as TV programs, TV channels, on-demand content, movies, music and ringtones.

The high-level architecture of the ContentWise engine is shown in Figure 1. Different clients may exist in the subscriber environment, such as STBs, Web clients and mobile phone applications; these can access ContentWise, hosted in the provider environment, through its multi-protocol interfaces.

The system was designed to work with any type of TV service - such as VoD (video on demand), Linear TV and Web TV – and any device – such as STBs, connected TVs, mobile phones, email and web applications [2]. ContentWise provides Web Services based on the SOAP [3] protocol, allowing it to provide recommendation data in XML format over HTTP (Hypertext Transfer Protocol).

ContentWise uses information related to users and content metadata as input. It identifies the user via a unique ID, while further personal data is not strictly necessary. User's tastes, viewing habits and trends are defined according to a number of different techniques. It also provides real-time recommendations based on the analysis of both historical and real-time data. Ad hoc reports give the tool the ability to measure the effectiveness of the recommendations and to take corrective actions.

ContentWise can provide both anonymous recommendations (e.g., top content) and personalized recommendations. The latter make use of either collaborative filtering or content-based filtering [4]. Collaborative filtering is based on relationships

among items discovered by analyzing the collected ratings, while content-based filtering is based on the analysis of the available textual information (e.g., list of actors, genre, and program plot), enriched with latent semantic analysis (LSA). Table 1 summarizes the ContentWise recommending functionalities.

Table 1. Description of some ContentWise algorithms

Name	Algorithm family	Based on
Top Content	Top-rated / Top-viewed	Ratings and media consumption tracking
Related content recommendations	Content-based filtering	Similar content by genre, cast, director, and other metadata
Item-based collaborative recommendations	Collaborative filtering	"Users who have watched this also watch this"
User-profile collaborative filtering	Collaborative filtering	Clusters of users with similar profiles and preferences
Social recommendations	Collaborative filtering	Preferences of social network friends

3. SUGGESTV

In this work, a Java-based application that runs on digital TVs and STBs, called suggesTv, was designed and developed. SuggesTv provides content recommendations, and offers different functionalities to logged users with respect to non-logged users.

Non-logged users avail of standard keyword-based search functionalities and may browse a customizable EPG, which allows access to non-personalized lists of items such as: (i) *top content*, (ii) *similar items*, and (iii) *also-viewed items*. Users can access top content currently on air at any time. These items represent the top-rated and most-viewed programs. Furthermore, when a user opens the description of a program, he can also access a list of similar content - e.g., programs with the same actors as the current program - and a list of also-viewed content – i.e., programs that have been watched by users who have enjoyed the current program. The former are based on a content-based filtering algorithm, while the latter is obtained through a collaborative filtering algorithm.

On the other hand, if a user is logged in, the application can collect his implicit preferences (i.e., what the user watches) and explicit ones (i.e., what the user rates) – hereinafter referred to as the *user profile*. Thus, in addition to the aforementioned non-personalized lists of items, suggesTv recommends content that matches the user profile using collaborative or content-based filtering algorithms.

The application runs on top of Java TV [5], which is a Java framework specially tailored for television systems. Java TV abstracts features such as retrieving broadcaster data, EPG and working with media players. The User Interface (UI) was created using the HAVi library, which provides a set of graphic components suitable for building UIs for digital TV applications.

Figure 2. Recommended live programs.

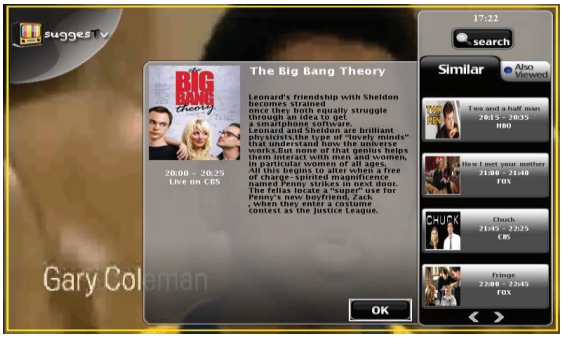

Figure 3. Similar and also viewed programs.

The application integrates the Web Services provided by ContentWise using kSoap 2.1.2 [6], an implementation of SOAP for Java ME. Although this library made easier the creation of requests and the return of responses in XML format, some classes had to be reimplemented, because the APIs provided by ContentWise were not fully supported by Java ME.

In a typical scenario, the user accesses the application through a remote control and, initially, he can only view the top content and search for a particular program. The user can also log into the system in order to enable further recommendation functionalities based on his profile. Figure 2 shows an interaction in which the user, after logging into the system, gets a personalized list of programs currently on air that match the preferences registered in his ContentWise profile. Whenever the user views the details of a content (e.g., from the top-content screen), lists of similar and also-viewed programs become available, as shown by Figure 3.

4. RELATED WORK

Many TV personalized systems have been developed to help the viewers facing with the increasing offer of new services. While the first recommendation systems used explicit approaches to register the viewer's preferences, recent works try to infer these preferences automatically.

PTV [7] is a client-server system providing an Internet-based personalized TV listings service. It is a system accessible from the Web or through a WAP (Wireless Application Protocol) interface and provides personalized recommendation to the viewer based on the collaborative filtering approach. The personalized TV guide system [8] runs on standalone set-top boxes (without the possibility to access an external server for the recommendations) and it is compliant with MHP. Besides the

traditional functions, such as program navigation and search, this system is characterized by recommending programs with high preferences according to explicit and implicit feedback. The system saves the user profile in the STB and it does not support multiple users. Maia [9] describes an EPG that supports customization and recommendation. It is based on Ginga middleware and allows the creation of personal programming guides using data sent by TV programs providers, automatic channel tuning that runs whenever a selected program is going to start, synchronous and asynchronous recommendations based only on selected program categories and subcategories, login accounts that associates personal configurations and preferences to each user. The TV Navigation System [10] is a STB integrated system that provides recommendations depending on viewers' habits. The TV Navigation System works on the ISDB-T middleware and all the information about profile and service are stored in the STB.

Table 2 summarizes the comparison between suggesTv and other related works in terms of supported platform, filtering capabilities, where the data is stored and multi-user support. The main differences are the use of Web Services and the profile data maintained on the server. SuggesTv provides the possibility to filter the recommendations and to access the system using different profiles without weighing on the STB resources. This choice improves the usability of suggesTv because the application does not need to use the STB internal memory, saving space for others uses. In this way, the load onto STB is minimum and suggesTv can run on the majority of existing STBs.

Table 2. Comparative Analysis of Related Work

Name	Platform	Filter	Data stored	Multi user
PTV	Web	✘	remote (HTTP server)	✘
Personalized TV	STB - MHP	✔	local (STB)	✘
MyPersonalEPG	STB - Ginga	✔	local (STB)	✔
TV Navigation System	STB - ISDB-T	✘	local (STB)	✔
suggesTv	STB - MHP	✔	remote (web service)	✔

5. FINAL REMARKS

A variety of new services and content became available with the introduction of digital TV systems. The excess of available TV content requires the implementation of new mechanisms to offer facilities to the viewers. These new mechanisms are known as recommendation systems. The possibility of having instant access to programs that may please the viewer is very important in this new era of digital television. SuggesTv is a native STB application, so the viewers are not required to change the focus from the TV set to another device to find information related to the programs they are watching.

Using the ContentWise solution, suggesTv users can update their profiles by using any supported device (e.g., PC and mobile phone) and have access to it directly on the TV screen. The user profile will be always synchronized through the SOAP interfaces between suggesTv and ContentWise. In addition, SuggesTv allows users to find related TV programs based on their preferences and based on the most rated contents that are being broadcast at the moment. It is possible to filter the recommendations using the pre-implemented filters.

The future work around suggesTv includes deploying it on a real STB using MHP middleware [11]. It will also be interesting to port the application to a different middleware, such as Ginga, for example. The application still needs to define more filters in order to refine recommendations. In order to improve the graphic interface, a usability study is highly desired. A further update will be the possibility of allowing the user to create and update his ContentWise profile through suggestTv. Finally, it will be interesting to provide recommendations for groups of users with similar interests, and to integrate the application with the most popular social networks in order to obtain program ratings, posted messages related to a program and recommendations sent by members of his circle of friends.

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