

# Intelligent User Interfaces in the Living Room: Usability Design for Personalized Television Applications

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## ABSTRACT

The purpose of this paper is to present our experience from the design of a personalized television application, and the implications for the design of interactive television applications in general. Personalized advertising is a gentle introduction to interactive television applications through a push paradigm that is closer to the established patterns of television use. While personalization is a practice widely used on the Internet, applying personalization techniques over digital television infrastructures presents significant obstacles, which we address with explicit design moves.

## Categories and Subject Descriptors

H.1.2. [User/Machine Systems]: *Human factors*. H.3.2 [Information Storage]: *Record classification*. H.3.3 [Information Search and Retrieval]: *Clustering*. H.5.2 [User Interfaces]: *Interaction styles, Prototyping, Screen design, User-centered design, Input devices and strategies*. H.5.1 [Multimedia Information Systems]: *Video*. J.1 [Administrative Data Processing]: *Business, Marketing*. J.4 [Social and Behavioral Sciences]: *Economics, Psychology*. J.7 [Computers in Other Systems]: *Consumer products*.

## General Terms

Design, Human Factors.

## Keywords

Digital television, usability, personalization, advertising.

## 1. INTRODUCTION

Choosing advertising as a case study may seem controversial. On the one hand television advertising is irritating to a lot of people: research has shown that as much as 30% of people change channels during the advertising-break [10]. On the other hand, some researchers [1] propose that advertising may be a remedy to the Digital Rights Management (DRM) issues that arise when manipulating copyrighted media content in the home.

Therefore, the dynamic insertion of advertising during the play-out of copyrighted media content in the home can substitute the royalty rights paid to media owners. Moreover, the advertising-break has a fixed duration, small hard-disk storage requirements and is relatively simple to integrate with real-time broadcasts. In the following sections, we describe a system that offers dynamic synthesis of the advertising-break at the television set-top box of each home. User privacy is guaranteed by processing user data locally at each set-top box. The system has been designed and tested with the purpose of replacing the broadcast television's advertising-break, but can be extended to handle similar cases of dynamic advertising insertion, such as television content stored on a hard-disk or MP3 music.

A similar design for the dynamic construction of personalized television programs has been also proposed for the case of television news [9], although that treatment does not address the usability aspect and users' response to the application. Furthermore, while personalization is a practice used widely on the Internet by many sites that exploit the huge amount of customer information they collect [2], applying personalization techniques over digital television presents novel and significant design challenges, which have been identified and resolved, as described in the next two sections.

## 2. MOTIVATION AND MENTAL-MODEL FOR PERSONALIZED TELEVISION

The traditional advertising-break consists of a number of short commercials that have been inserted in the broadcasted stream from the transmission point. Every single household within the broadcast footprint watches the same advertisements, in the same sequence at the same time. Media planners acknowledge the fact that a certain percentage of the viewers may not belong in their target group. Although it has been successful in financing the media industry, the traditional mass communication model of advertising is growing inadequate to provide a relevant experience to television viewers [4].

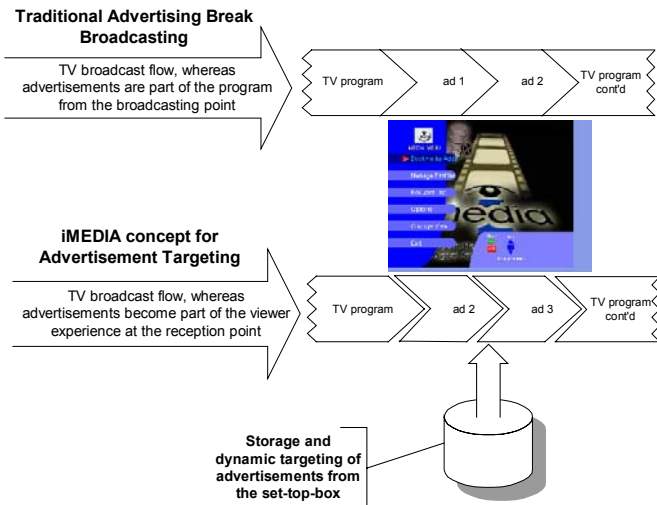
In the past, television viewers had to endure the burden of irrelevant advertising, but lately, technological innovation with devices such as TiVo and ReplayTV has allowed them to record television programs and fast-forward through the advertising breaks. On the one hand, the wide spread use of TiVo-like devices may mean the end of advertising-supported television programming. On the other hand, local-storage and processing of advertising spots may be used to target advertising-breaks for each set-top box, according to household and individual

characteristics. This justification has been considered in the design of the iMEDIA system for personalized advertising-breaks that replace the traditional broadcasted ones.

**Table 1 The resolution strategy of design factors for the case of personalized television advertising**

Design Factor	Resolution Strategy
Real Time Vs Time Shift Broadcasting	Television programming is transmitted as usual, but the advertising break is dynamically created for each set-top box. The overall experience is seamless for the viewer
Group Vs Individual	Each set-top box holds general household demographics and optionally individual demographics and preferences
Interactive Vs Passive	Some advertisement spots may have additional interactive content. The viewer is notified and has the option to 'bookmark' an advertisement for later browsing of interactive content

Table 1 illustrates the generic factors that apply to user interface design for personalized television applications [3] and the respective resolution strategy that was followed for the case of personalized television advertising.

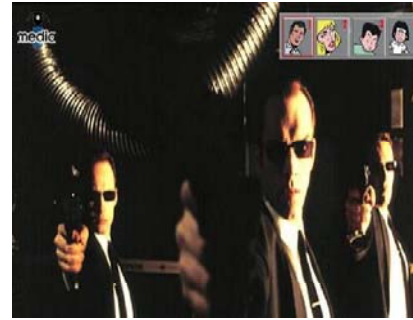


**Figure 1 A personalized advertising-break in contrast with the traditional advertising-break**

The users of iMEDIA may choose to watch a personalized advertising-break, and also be presented with opportunities for browsing through interactive advertisement content. The main benefit of personalized prerecorded advertising (Figure 1) is that it does not distort the predominantly passive television consumption patterns [6], because from the user's point of view the experience remains the same with optional personalization and interactivity. In addition to targeted messages, the iMEDIA system offers the option of interactive content, which can be accessed either in-sync with the advertisement break, or, preferably, at a later time.

Zimmerman and Kurapati [11], in a test of a recommendation system for television programs, found that users were concerned with how and why the system suggested new programs. Visibility

of system status becomes very important when system output is identical among different situations: personalized advertising looks just like normal advertising, although it may be targeted to either the individual or the household level. The solution given, as depicted in Figure 3, consisted of two parts: 1) 'Push' the current status of the system, each time there is a new session, by using icons on the screen, 2) 'pull' the status with a special hardwired key, instead of having to navigate through menus.



**Figure 2 Just before the advertising-break a set of icons may appear (top-right) indicating at which level (household, individual, group) the break is targeted**

In summary, the iMEDIA flow of an advertising-break challenges the traditional one, because it does not distort the currently passive viewing patterns, while it enhances the advertising-break experience by offering relevant commercials. The advertising-break is created dynamically from a pool of advertisement spots that have been downloaded from a hidden broadcast channel and stored on the hard disk of the set-top box. The exact commercials to be included on a given advertising-break are selected by the classification and targeting sub-system, which is based on media planning industry's standard procedures, as described in the next section.

### 3. PERSONALIZED ADVERTISING

Since we are solely interested in the set-top box user's response to the personalized advertising experience, the objective of this section is to outline the rationale of the method used for personalizing advertising breaks [8].

According to the advertising research literature, advertisement effectiveness is improved through better targeting of viewers. Targeting is usually based on accurate consumer data about demographics and psychographics. The need of marketers for accurate data collides with users' concern for privacy intrusion. Protection of users' privacy was recognized and a solution for the benefit of both advertisers and users was implemented in the form of classification rules and exploitation of locally available data.

To achieve personalization for advertisements in the digital broadcast television domain, we applied theories and tools from advertising. Marketers segment consumers with similar characteristics to fine-tune their offerings [5]. The stereotype-based approach offers an effective way for marketers to predict consumers' attitude towards advertised products. For testing purposes, we used a version of the VALS (Values and Lifestyles) segmentation. This widely used model divides the whole population into eight clusters of consumers (<http://www.sric-bi.com/VALS/types.shtml>).

Ideally, the assignment of a set-top box user into a cluster is performed by means of a psychographic questionnaire that

classifies each user into the respective stereotype. Since forcing all users of a personalized system to explicitly fill-in such questionnaires is unrealistic, we use a sample of the population, which provides input for the classification and the targeting process. The whole population is assigned into the VALS clusters by using classification rules extracted through discriminant analysis from the sample. Classification rules are then applied on data locally available, at each set-top box. Locally available data include 1) demographic data provided upon subscription to the service, 2) advertisement satisfaction that is implicitly collected by means of ‘Bookmark’ and ‘Contact-me’ button and 3) media consumption data, such as programs watched.

The classification rules have the form (if  $X$  then  $Y$ ) where  $X$  may include demographic and media consumption data and  $Y$  denotes the cluster that a user belongs to. These rules are continuously applied to the local data for each individual, so that the cluster to which the viewer belongs can be determined dynamically and reassessed if needed. Moreover, as the amount of data that is being monitored for panel-users increases, updated classification rules are developed, thus adjusting the classification of the population into clusters. Although there is reduced accuracy —when compared with the use of the original VALS questionnaires— the result is better targeting than traditional mass media advertising.

In summary, the iMEDIA approach offers a way for enhancing advertisement effectiveness for the digital television, without sacrificing consumer privacy given that we only use data locally available at each set-top box.

#### 4. IMPLICATIONS FOR THE DESIGN OF INTELLIGENT USER INTERFACES FOR TELEVISION

In addition to the specific findings for the personalized advertising case [7], our research also revealed a number of generic challenges that apply to the design of television user interfaces in general. The design of usable interactive television applications should address explicitly the following issues:

**TV Program** Our research suggests that the point of reference when designing applications for interactive television should remain the traditional television program. Interactivity should be minimal and performed around the television program.

**Navigation** There is a trade-off between the existence of special function keys on the remote control and displaying the functionality visually in an on-screen user interface.

**Text Input** Most television users would not use a keyboard, because it is cumbersome to use while sitting on a couch or a chair. The alternatives for alphanumeric input are 1) virtual on-screen keyboard and, 2) the cellular phone type of text input.

**Personalization** From the side of the television viewer, personalized television programming is a gentle introduction to interactive television applications through a push paradigm that is closer to the established patterns of television use. From the side of the television program provider, personalized television programming is a showcase of a radical shift in the mentality of broadcasting a linear program towards making television viewing a dynamic and personalized experience.

Finally, we demonstrated that delivering personalized media content over a digital television infrastructure demands a different approach from the Internet and the PC interaction paradigms and requires methods borrowed from the broadcasting mentality of content delivery.

#### 5. ACKNOWLEDGMENTS

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