A Metaphor for Personalized Television Programming[1][2]

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Abstract. Traditional human-computer interaction settings involve a task-oriented approach where the human interacts with an application to accomplish a particular goal. The emergence of media-rich computer-mediated leisure applications requires a fresh view of the current paradigms and a careful examination of how this change of perspective affects their relevance. This paper proposes a metaphor for accessing personalized television programming and suggests an approach for integrating the metaphor into the design of a television user interface. The proposed metaphor is tested in the design of a personalized advertising service. The results of the empirical research are discussed and the suitability of the metaphor for other television programs is examined.

1. Personalized Television Programming and Metaphors for All

Long before consumers could access digital TV applications, researchers predicted a shift in the way television programs were going to be produced, transmitted and consumed. Nicholas Negroponte (1995) said that: 'TV benefits most from thinking of it in terms of bits. Once in the machine, there is no need to view them in the order they were sent', implying that some kind of logic —either user choice or from some other source— could be applied on the television content. Then he went on to forecast with accuracy the ability to time-shift broadcast transmissions: 'All of a sudden television becomes a random access medium, more like a book or newspaper, browsable and changeable, no longer dependent on the time or day, or time required for delivery'. This change of television use patterns requires a new user interface paradigm. The

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accessibility of a novel information system for a wide group of users can be ensured using a familiar metaphor. 'Metaphors for All' have been studied before in the case of the emerging mobile commerce services (Karvonen 2000).

For the purpose of this work, digital television is defined as a device, which features Digital Video Broadcasting (DVB) reception, persistent local storage (Hard Disk Drive-HDD) and data processing abilities. This research focuses on the broadcast mentality of delivering broadband information to masses of people. It also examines future scenarios of satellite transmission, instead of today's popular optical media and Internet unicast distribution mechanisms. The broadcasting mentality enforces an unequal relation between the producer and the consumer, one that may seem arbitrary in today's Internet world. On the contrary, there is strong evidence that the broadcast relation, established and enforced by mass communication, is often the most economically efficient compromise between the needs of the producer and the needs of the consumer. The broadcasting mentality for the delivery of personalized multimedia information has been also replicated and proposed as a more accessible method for using the Web (Kapyla et al. 1998), although its adaptation for the Internet environment was in the end not commercially successful.

Our research is based on the realization that the currently dominant metaphor for the personal computer —i.e. the desktop metaphor— is not appropriate for television, because it is adapted to fundamentally different user and task sets. Therefore, there is a need to design a user interface for digital television that considers the user as a television viewer. In summary, the rationale behind the necessity for reexamining the traditional set of human-interface paradigms is an evolving complex set of features, such as digital broadcasts coupled with rich metadata, digital recording of programs and random access playback, local processing logic, dynamic presentation of content and services, and, most crucially, a different context of use.

The rest of this paper is organized as follows: Section 2 introduces the metaphor for personalized television programming, describes the rationale behind its choice and makes an analogy with the development of the desktop metaphor. Section 3 provides an overview of related scientific disciplines for the purpose of identifying forces that affect the design of applications for digital television. Section 4 presents the problem of personalization for television advertisements, offers a user interface solution based on the proposed metaphor and analyses the results from empirical testing. Section 5 discusses the fitness of the proposed metaphor to other types of personalized television programming.

2.   The Virtual Channel Metaphor

Strong evidence of the importance of a metaphor as a basis for human-computer interaction is provided by O'Brien et al. (1999), in an ethnographic study of a digital set-top box trial, in which they point out the need for a 'working model' of the technology being employed by users in home activities. They discuss the need for a conceptual model for digital set-top box usage, because household members appeared confused about the location of their data and how the system worked. Therefore, there is a need to develop a metaphor for digital set-top box storage and presentation

of programming that moves away from the desktop-web couple and the notion of information retrieval and active search. Digital broadcasting transmission and persistent local storage should be used to augment television as a medium of entertainment and passive discovery. We therefore propose the following metaphor and predicted benefits.

Metaphor. The digital set-top box can be imagined as a virtual television channel provider, where audiovisuals, applications and data are produced from a combination of local storage and real time broadcast transmissions.

Motivation. The organization of television programs into a small number of personalized virtual channels simplifies the choice from a vast array of available broadcasts and stored programs. The presentation of television programs from virtual channels gives more control to the television viewer, who becomes an important factor in the televised content. The virtual channel metaphor suggests only a minimal shift from the current television metaphor of use, while, at the same time, it focuses the research on the design of a user interface for managing virtual television channels.

By making an analogy to the development approach used for the personal computer human interface, it is possible to identify and focus on a small set of attainable actions that have to be performed towards the direction of a human interface for the digital television. XEROX Star's designers, Johnson et al. (1989), distinguish among four levels of system architecture: 1) Machine and network, 2) Window and file manager, 3) User interface, 4) Document editor. Smith et al. (1982) offer a design methodology and a number of principles. Both of these reference works describe in detail how the desktop metaphor and guided user interface was developed to model, complement and augment office work —i.e. use of documents, mails, memos, network files and printers. Apart from being further evidence to the inappropriateness of the personal computer paradigm for the digital television, the above works emphasize the need to have a conceptual model of use —conveyed through a metaphor— and a number of representative activities after which the user interface will be modeled.

The proposed metaphor has been initially employed into a personalized advertising service. In addition to the virtual channel metaphor, the design of personalized advertising is based on an explicit analysis of the forces that affect the use of digital television applications. Design forces' analysis addresses the issues that are generic in the user interfaces for all types of digital television applications.

3.   Forces that Affect the Design of Digital Television Applications

The field of HCI has been benefited by a multidisciplinary approach to design problems (Ballay 1994). Besides proven methodologies and multiple design iterations, successful user interfaces demand a diverse array of design specialties. For the case of digital television, an exploratory literature review has revealed three important disciplines of design: 1) Broadcasting and consumer electronics engineering, 2) ethnographic study of media consumption at home and 3) Interactive and multimedia content creation. Researchers from the respective fields have addressed the design case of multimedia services in the home, but there is currently no aggregate effort towards the direction of a holistic design for digital television applications. Following

a survey of diverse scientific perspectives into the field of digital television applications, the most useful findings from each discipline have been collected and analyzed.

The next paragraphs are representative of the approach that has been followed for the analysis of the related scientific disciplines. Each paragraph presents an instance of the role of a discipline to the design of digital television applications and a respective design force. This formal method of analysis, as suggested by Alexander (1964), provides a well-defined environment of relationships and dependencies.

Broadcasting and Consumer Electronics Engineering

The broadcasting model of computing encompasses a radical shift in the mentality of application development process and tools. Milenkovic (1997) highlights the differences with the client-server mentality, describes the carousel concept and explains why the characteristics of the networking infrastructure are an important factor in the type of feasibly deployed applications. Engineers should also justify the use of digital local storage (Whittingham 2000), which currently makes inroads on a multitude of consumer electronics products (Bell 2002). Persistent local storage takes viewer control one big step further —from simple channel selection with the remote— by offering the opportunity for non-linear local programming and content selection.

Design Force. The design should integrate seamlessly and reflect appropriately both the broadcasting computing model and local storage functionality.

Dependency. Both types of programming, stored and broadcast, should be available, without sacrificing easy access to either type of content. Each type should complement instead of competing with the other.

Ethnographic Study of Media Consumption in the Home

The role of ethnographic research in the home, regarding the use of digital television applications, is instrumental. There has been an important technology-driven shift in the household's media consumption patterns every decade or so —in the 80's there was the PC (Vitalari et al. 1985) and in the 90's there was the Internet (Kraut et al. 1996). It is likely, that the first decade of the new millennium will see the introduction of a new range of home entertainment appliances. This trend is already apparent and has been studied with ethnographic methods in the case of the digital set-top box. O'Brien et al. (1999) identified that the 'concentration of functionality' sometimes works against the solitary use of information technology.

Design Force. Different designs are needed for family viewing in the living room and single users in their bedrooms.

Dependency. The system should be designed to handle either group or solitary use and to provide means of adapting to different situations if both are desirable.

Interactive and Multimedia Content Production

When contemplating the impact of technical change on the media industry, there is a common pitfall to avoid. It goes under the view that new technologies and media will completely substitute the old ones, rather than coexist —for example that television and radio would mean the end of newspapers, or that the PC will bring the paperless office. Henry Jenkins (2001), the director of the program in 'Comparative Media

Studies' at MIT, opposes the popular view that interactive television will support only the needs of the channel surfers by making an analogy: 'With the rise of printing, intensive reading was theoretically displaced by extensive reading: readers read more books and spent less time on each. But intensive reading never totally vanished.'

Design Force. Design should support both interactive and passive users.

Dependency. Interactivity can be feasibly deployed over digital television, although current television patterns of use are passive.

4. Case Study: The Design of Personalized Television Advertising

Personalized television advertising—although it does not contain an extensive user interface—offers a number of advantages as a test-bed for applying the proposed metaphor. Advertising is, together with subscriptions, the main financial lever behind commercial television. Market success for digital television depends on the evolution and adaptation of advertising models to the new environment. Additionally, the advertising break has a fixed duration, small hard-disk storage requirements and is relatively simpler to integrate with real-time broadcasts. A personalized television advertising prototype was designed using the design forces' analysis (Table 1), within the IMEDIA (Intelligent Mediation Environment for Digital Interactive Advertising) project[3].

Design Force	Dependency and Resolution Strategy
Real Time Vs Time Shift	Television programming is transmitted as usual, although 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 The previously identified design forces are explicitly addressed in the design of the personalized adverting system

The IMEDIA system offered a prototype implementation for enhancing advertisement effectiveness for the digital television environment. According to the advertising research literature, advertisement effectiveness is improved through better targeting of viewers. Targeting is based on accurate consumer data such as demographics, psychographics and buying behavior. The need of marketers for accurate data collides with the consumers' concern for privacy intrusion. Protection of consumer privacy is recognized and a solution for the benefit of both advertisers and viewers has been

suggested (Lekakos and Giaglis 2002). Personalized prerecorded advertising does not distort the predominant passive television consumption patterns, because from the user's point of view the experience remains the same with optional personalization and interactivity.

From testing with users, it was found that a number of basic human factors principles hold true for the television user interface. For example, 'visibility of system status' (Norman 1990) 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. On the other hand, user testing revealed that a task bar was considered irrelevant to the television experience. The solution given 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. In general, the findings from user testing in the case of personalized advertising suggested directions for the design of both digital television applications and devices (Lekakos et al. 2001).
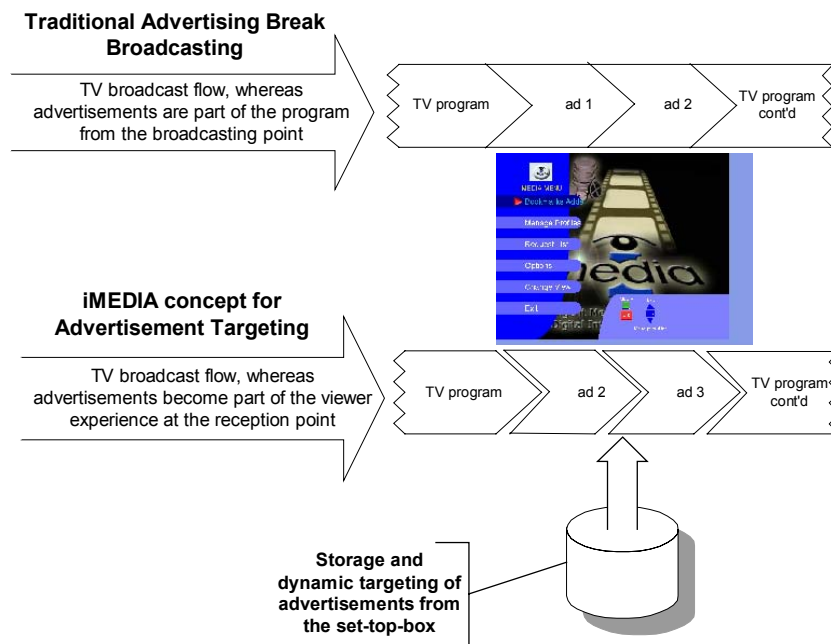

Figure 1 A personalized advertising break that is based on the virtual channel metaphor

From the part of the television viewer, personalized advertising is a gentle introduction to the virtual channel metaphor through a push paradigm that is closer to the established patterns of television use. From the part of the television program provider, personalized advertising is a showcase of a radical shift in the mentality of broadcasting a linear program towards making television viewing a dynamic and

personalized experience. As depicted in figure 1, 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 spots 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 detail in Lekakos and Giaglis (2002).

5.   Applying the Metaphor

A limitation of the virtual channel metaphor in the case of personalized advertising is that it addresses only the problem of organization and presentation of content within a single television airtime segment —the advertising break— while it misses the case of organizing television channels as a whole. Nevertheless, the above case offered the opportunity to successfully test the technical feasibility of dynamic synthesis of stored and broadcasted content for the production of a seamless, yet personalized television experience. The viewer remains passive in terms of involvement with the digital television system, while the overall experience is improved, which represents a strong case against the popular trend to make television totally interactive. The case of personalized television advertising has also demonstrated the validity of the virtual channel metaphor and suggests that further evidence is needed from other important classes of digital television programming, like the personalized television program guide (Smyth and Cotter 2000) and personalized television news (Merialdo et al. 1999), and transcoding applications.

The proposed metaphor may be refined and enhanced, as it is being applied and tested with the above types of television programming. By making an analogy with the desktop metaphor, it is evident that there are multiple commercial implementations of the same basic human interface principles for interacting with personal computers —Windows, Mac and Unix variants to name the most popular. In this fashion, the virtual channel metaphor may be implemented to support diverse commercial policy objectives. It may also be complemented with other metaphors and use paradigms, in order to support easy access to digital television applications that offer multiple cameras, such as sports and game shows.

Following the test of personalized advertising, empirical research will continue with prototyping and user testing of an enhanced television program guide that is based on the proposed metaphor of personalized television programming. The empirical research will also be complemented with a desk-research of interactive and personalized television news. Television news have been implemented and published extensively in the past —'News of the Future' from the MIT MEDIA lab (Gruhl and Bender 2000) and related activities in the area of 'Multimedia Indexing' offer resources for understanding the important case of television news.

Overall, the virtual channel metaphor has proved to be an invaluable tool for thinking about personalized television programming. Television producers should start to think of their programming in terms of discrete modules—audiovisual, executable code, data—and in terms of their dynamic synthesis personalized for the digital television user in the form of virtual channels.

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