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INFORMATION SYSTEMS IN THE LIVING ROOM: A CASE STUDY OF PERSONALIZED INTERACTIVE TV DESIGN *

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ABSTRACT

The birth of the World Wide Web (WWW) in 1993, particularly its graphical user interface, offered marketers opportunities that were previously unimaginable. The WWW allows advanced marketing activities and more particularly interactive marketing, as the user is actively involved in responding to the vendor's promotion campaign. Interactive TV, also referred to as iTV, combines the appeal and mass audience of traditional TV with the interactive features such as those currently available on the Web. Although personalisation is a practice used widely on the Internet by many sites, applying personalisation techniques over interactive television presents a number of difficulties. In this paper we focus on the design and testing process of the User Interface (UI) for the Interactive & Personalized Advertisement TV viewer. We argue that there are a lot of challenges involved in the designing of interactive TV applications. These are related with the differences of the medium from the traditional PC based Information Systems in terms of input and output devices, viewing environment, number of users and low level of expertise in PC usage.

1. INTRODUCTION

As digital technology and consumer behaviour evolve, marketers can and need to continuously enhance the value of their digital marketing offering. The birth of the World Wide Web (WWW) in 1993, and particularly its graphical user interface, offered marketers opportunities that were previously unimaginable (Poon and Jevons, 1997).

Interactive TV, also referred to as iTV, combines the appeal and mass audience of traditional TV with the interactive features currently available on the Web (Developer, 1999) offering viewers 'one-click' access to services and information. For the marketer, the great potential of interactivity rests in the capability the Web offers for better understanding the viewer's behaviour and building personalised relations with individual consumers.

In the context of iTV advertising, personalisation refers to the use of technology and viewer information to tailor commercials and their respective interactive content to each individual viewer profile. Using such

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viewer information, either obtained previously or provided in real-time, the stream of advertisements adapts to fit that viewer's explicit or implicit (advertiser inferred) needs.

While personalisation is a practice used widely on the Internet by many sites that exploit the huge amount of customer information they collect, applying personalisation techniques over interactive television presents significant obstacles:

Broadcast environment: unlike the Internet, where each web-page is delivered individually to each user's computer upon request, iTV content is broadcast to all TV sets. Delivering personalised content over a broadcasting platform is a contradiction in terms. This would require transmitting as many streams as the different TV sets. Thus, other techniques need to be applied in order to make this happen. These techniques typically involve a set-top box or other similar terminal device that stores some personalised content and controls the interactivity.

Targeting individuals: Whereas the personal computer typically has only one user at a time, the television is often viewed by groups of people in both private and public areas. Consequently, personalising and targeting advertisements effectively presents technological, business-related and practical challenges. Even if we only consider household viewership, it remains a difficult issue how to identify and target individual household members or whether to target the whole household as a group. While it is technically possible to identify which member(s) of the household is (are) currently watching TV (e.g. through active badges, 'hidden eye' technologies. or remote-control functionality), this is something not perceived positively by viewers.

Viewing environment: TV viewing experience usually occurs in the relaxing home atmosphere, mainly for infotainment. Any interface that requires significant computer-literacy will not match the average viewer profile. The input device (primarily a remote-control) offers limited functionality and the TV set as display (output) device has certain restrictions in terms of appearance of data, fonts, and colours—closely related to the viewing distance. Nevertheless, in order to implement interactive and personalized advertising, the Information System comprising the backbone of that platform, should be supported in terms of functionality from a minimalist interface provided to the Viewers.

In this paper we focus on the design and testing process of the User Interface (UI) for an Interactive & Personalized Advertisement TV viewer. As we described above, the challenges of designing interactive TV applications are based on the differences of the medium from the traditional PC based Information Systems in terms of input and output devices, viewing environment, number of users, low level of expertise in PC usage. The multiple design alternatives must be evaluated for specific user communities and for specific benchmark tasks. An effective design for one community of users may be inappropriate for another community. An efficient design for one class of tasks may be inefficient for another class. Therefore, the approach to the UI design process is heavily based on User requirements provided by the Users, the application of Information Systems UI design theory, principles and guidelines in the challenging TV Viewing environment, and, finally, the continuous evaluation of the interface in terms of usability. All these, conflict with each other, so we provide the basic parameters—tasks, users, interaction devices input/output characteristics—in order to balance the tradeoffs and make decisions about the form and function of the UI.

Human Computer Interaction fundamental principles are presented in the next section along with the major characteristics—differences between Television and Computers and the usability methods among which the appropriate ones will be selected; in Section 3 we present a comprehensive description of the methodology employed for the design of the User Interface and the challenges we faced during the UI design; in Section 4 we provide a specific example of the design; in Section 5 we discuss the evaluation methodology and outline the testing results; Section 6 includes the conclusions and further research.

2. BACKGROUND THEORY

Human-computer interaction (HCI) is the scientific field related to usability of systems. It is described by Dix (1996) as the study of people, computer technology and the ways these influence each other. Preece et al (1994) defines usability as a measure of the ease with which a system can be learned or used, its safety,

effectiveness and efficiency, and the attitude of its users towards it. In the early days of computing the majority of users were technical experts whereas nowadays users have a wide range of knowledge and experience, making usability a very important design consideration. Underlying all HCI research and design is the belief that the people using a computer system should come first. Their needs, capabilities and preferences for performing various activities should inform the ways in which systems are designed and implemented. People should not have to change radically to "fit in with the system", the system should be designed to match their requirements (Brooke et al, 1990).

User Centered design is a widespread practice in the domain of User interface design. According to Brooke et al (1990) a User-centred design is an approach to interactive system development which focuses specifically on making systems usable and safe for their users. User-centred systems empower users and motivate users to learn and explore new system solutions. The benefits include increased productivity, enhanced quality of work, reductions in support and training costs and improved user health and safety. Preece (1994) defines the objective of the user centered design as the system production that are easy to learn and use by their intended users, and that are safe and effective in facilitating the activities that people want to undertake.

The most effective approach to user-centred design is the construction and iterative refinement of product mock-ups—also referred to as the prototyping process (Nielsen, 1993). Rapid prototyping is a method used for early collection of user feedback, on the basis of rough product mock-ups, intended to replicate the look and feel of the final system, although they may not function and operate as the final product. HCI literature distinguishes between two broad classes of prototypes: these are the high and low fidelity prototypes. The fidelity of a prototype is measured against how much the mock up resembles the final product, in terms of look and feel and not actual operation: If a prototype feels to the end user as a final product then it is said to be a high fidelity one (Rudd et al, 1996).

An important aspect in the design of TV Viewer Interface is to understand the characteristics of the Television in comparison to the characteristics of Computers in order to provide further insights for the design of this novel TV UI. Table 1 compares television and computers along a number of dimensions.

Characteristic	Television	Computers
Screen resolution (amount of information displayed)	Relatively poor	Varies from medium-sized screens to potentially very large screens
Input devices	Remote control and optional wireless keyboard that are best for small amounts of input and user actions	Mouse and keyboard sitting on desk in fixed positions leading to fast homing time for hands
Viewing distance	Several meters	A few inches
User posture	Relaxed, reclined	Upright, straight
Room	Living room, bedroom (ambiance and tradition implies relaxation)	Home office (paperwork, tax returns, etc. close by: ambiance implies work)
Integration opportunities with other things on same device	Various broadcast shows	Productivity applications, user's personal data, user's work data
Number of users	Social: many people can see screen (often, several people will be in the room when the TV is on)	Solitary: few people can see the screen (user is usually alone while computing)
User engagement	Passive: the viewer receives whatever the network executives decide to put on	Active: user issues commands and the computer obeys

Table 1: *A comparison between TV and Computers along several dimensions affecting the User Interface design (Source: Jacob Nielsen, "Useit.com")*

Table 2 presents a summary of the usability inspection methods, necessary to perform in order to meet user's needs. It is apparent that the methods are intended to supplement each other, since they address different parts of the usability engineering lifecycle, and their advantages and disadvantages can partly make up for each other. It is therefore highly recommended not to rely on a single usability method to the exclusion of the others.

There are many possible ways for combining the various usability methods, and for each design we may need a slightly different combination, depending on its exact characteristics. The choice of a usability evaluation method depends on the following:

- Stage of design (early, middle, late),
- Novelty of project (well defined versus exploratory), and
- Number of expected users.

Method Name	Lifecycle Stage	Users Needed	Advantages	Disadvantages
Heuristic evaluation	Early design	None	Individual usability problems	No real users
Performance measures	Competitive analysis	At least 10	Results easy to compare	Does not find individual usability problems
Thinking aloud (coaching)	Formative evaluation	3-5	Pinpoints users misconceptions	Unnatural for users
Observation	Task analysis, follow-up studies	3 or more	Suggests function and features. Reveals users' real tasks	No experimenter control
Questionnaires	Task analysis, follow-up studies	At least 30	Finds subjective user preferences.	Pilot work need (to prevent misunderstandings
Interviews	Task analysis	5	Flexible, in-depth attitude and experience probing	Time consuming. Hard to analyze and compare
Focus groups	Task analysis, user involvement	6-9 per group	Spontaneous reactions and group dynamics.	Hard to analyze
Logging actual use	Final testing	At least 20	Finds highly used features	Analysis programs needed for huge mass of data. Violation of users privacy.
User feedback	Follow-up Studies	Hundreds	Tracks changes in user requirements and views	Special organization needed to handle replies

Table 2: *Summary of the usability methods (Source: Jacob Nielsen, "Usability Engineering")*

3. THE IMEDIA PROTOTYPE DESIGN: METHODOLOGY AND CHALLENGES

In this section we present our approach towards personalised interactive TV advertisement that has been developed as part of the iMEDIA (Intelligent Mediaton Environment for Digital Interactive Advertising) research project. iMEDIA aims to provide an intelligent mediation platform for enhancing consumer and supplier relationships, by establishing the necessary methodologies, practices and technologies for:

- the broadcasting of personalised interactive advertising to targeted consumer clusters, providing gateways for access to product catalogues in other digital environments,
- the analysis of interactive consumer behaviour for assessing advertising effectiveness, and
- the empowerment of TV audience as interactive viewers and active consumers with total control over their private personal information.

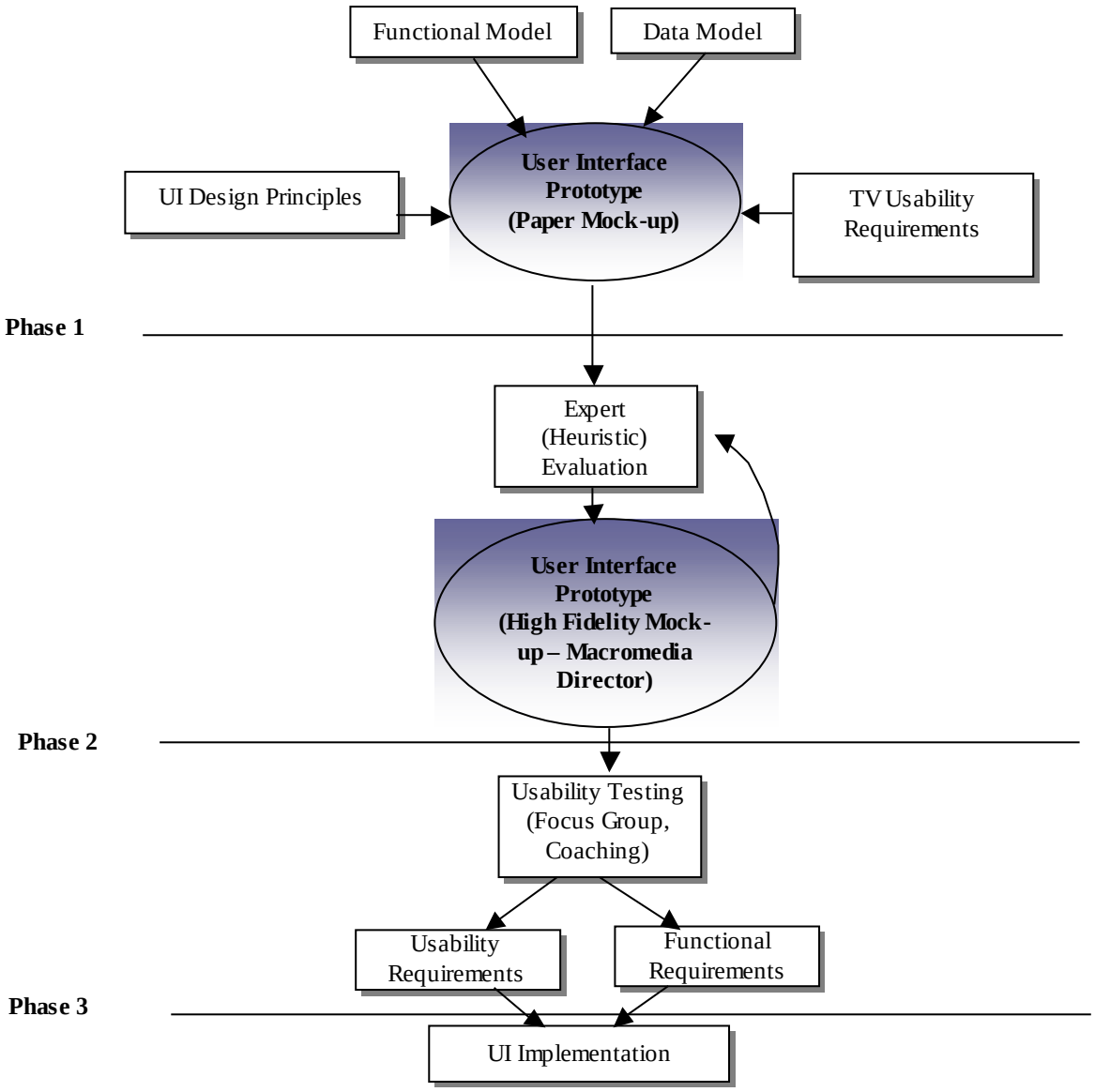

Figure 1: *Prototype Design Methodology*

Our approach for developing the first iMEDIA viewer interface prototype consists of three phases (Figure 1). The input for the first phase are the User Requirements collected in facilitated workshops by iMEDIA partners representing the whole range of the Interactive TV Business Model (Advertisers, Advertising Agencies, TV Channels, Technology Providers) as well as consumer surveys in Greece and Italy in May 2000. The objective of this method was to refine and complete through an iterative process the initial requirements providing input for the system's development. Additionally, at the first phase a paper mock-up was developed based on the UI design Principles: the TV Usability requirements. In the next phase the paper mock-up was subjected to Expert (Heuristic) evaluation to remove early usability problems and proceed with

the development of the User interface. We used Macromedia Director to incorporate videos and prepare a scenario as close as possible to the actual TV Viewing experience. Entering the third phase, the usability testing was performed using Focus Groups and one-to-one coaching method.

Design Challenges

In designing the iMedia user interface we faced hard choices on a number of issues. These include navigation, the appearance of messages and on-line help, reversibility, the availability of a special administrator profile, and the choice between using on-screen soft-keys versus the use of specialized remote control keys, as presented below.

Navigation: Users should always be aware of where the actually are, what they can do, what they can perform and where they came from. Following an assessment of input devices the well-known remote control has turned out to meet the requirements in the best way, assuming the appropriate graphical UI. The navigation concept of four arrow keys moving a focus area on the active controls on the screen has proved to be the best solution for interactive TV applications.

TV Program: Our research suggests that the point of reference when designing UIs for the iTV should remain the traditional TV program—for some time to come at least. Interactivity should be minimal and performed around the TV program. Therefore, we suggest the use of menus that pop up in front of the video and picture in picture functionality wherever there is a strong need for full screen interactivity (e.g. form fill-in).

Messages: Tasks with high frequency of use should have a few confirmation messages, or resort just on status messages running in parallel with the current interaction. Ideally, fatal actions should be minimal and error messages should be eliminated. Furthermore the system must offer error prevention and assist the user for task completion or exiting from menu hierarchies.

Online help: This would be achieved with the display of an optional tool tip bar, which presents short help about the highlighted item. Furthermore a remote control button or a special per menu item could provide access to in depth help.

Hardwired vs. Softwired UI: There is a trade-off between the existence of special function keys on the remote and hiding the functionality and the access to it, in an on-screen UI. The latter may be realized by using four colored buttons on the remote, which are associated with some functionality displayed on the TV screen, on a per application basis. Another popular approach to this issue is the use of a general navigation mechanism, such as four cursor keys and a selector/OK button.

Reversing actions: The existence of an undo/back button, will allow users to explore in more confidence interactive content, as they could always reverse their last action.

Menus & Forms: We suggested the use of menus for the navigation among the main iMEDIA choices. The menus are laid over the current TV program. The menu navigation is performed with the cursor and selector keys. Menus are complemented with forms where user input is required.

Input Devices: Information systems that use the TV as their interaction mechanism differ in a number of ways from traditional systems based on personal computers. Since the interface is designed with an interactive television setting in mind, the natural choice for an input device is some kind of remote control. The user must be able to carry out all actions available in a whole range of interactive television services using the same device, including controlling a video (pause, rewind etc.), entering a personal code, and moving a pointer/cursor. Most television users will not use a keyboard, because it is cumbersome to use while sitting on a couch or a chair. Next, we discuss some alternatives for alphanumeric input.

- *Virtual Keyboard*: The virtual keyboard (Figure 2) solution is very effective with naïve users. Except from cursor movement and selection, no further knowledge is needed. The virtual keyboard is slow and irritating for expert users.

Figure 2: *Microsoft's WebTV virtual keyboard*

- *Mobile Style of Text Input*: We would not consider alphanumeric input with the numeric keypad of the remote control if mobile phones and the short-messages services (SMS) sent using this method had not been so successful worldwide. The mobile style of text input proves both familiar and relatively fast for many categories of users.
- *Remote Control*: Remote control is the preferred and most popular input device for iTV. Early iTV designs should be based on this form of input, to minimize the cognitive load imposed on computer illiterate people. We used a fairly common remote control, which is found in the TiVo set top boxes (Figure 3).

Figure 3: *Remote Control for the iMEDIA prototype*

Output Device: The resolution and screen display characteristics of a TV screen are significantly less than that of most computer monitors. Pages that are designed for the PC screen will be unattractive or even unreadable on a TV. Also, certain backgrounds display distorted and unreadable on TV screens. In general, people who watch television sit further away from their screens than those who sit in front of a computer monitor. To make it easy for viewers to read and understand interactive content, authors must avoid small font and icon sizes .

4. USE CASE BASED USER INTERFACE DESIGN

The iMEDIA Viewer interface is based on a number of Use Cases. These form a formal description of the User Requirements and were collected at the first phase of the project. Use Case based design is a formal

notation for describing system interfaces and interactions among entities and the end user. Use Cases are an integral part within the Rational Unified Process software engineering methodology that employs the Unified Modeling Language notation.

Our research in the domain of user interfaces for interactive TV applications suggests that Use Case based system design is excessively machine-centric and as a matter of fact inadequate for describing the human part of the interface. Therefore, we decided to build upon the proven strength of use cases as an implementation oriented notation and at the same time exploit human-centric issues by incorporating a number of new attributes. In the following paragraphs we briefly present for demonstration purposes the design of the 'Activate/Deactivate Viewer' Use Case.

Use Case	Activate/Deactivate Viewer
Description	The purpose of this use case is to illustrate the action taken by the viewer in order to activate his/her profile. When a viewer sits in front of the TV set, he/she has to let the set-top box know who is watching. The system presents a list of profiles and lets the user select his/her identity.
Interaction Style	Direct manipulation
Attributes	Profile icons
Appearance	Semi-transparent overlaid to a part of the TV screen.
Issues	Ideally advertisers would like to know who is in front of the TV just before the advertisement break, in order to serve targeted advertising. Interface alternatives: ▪ display an intrusive menu with profiles overlaid to the program a few seconds before the break. ▪ Use the number keys for selecting profile, although there is a conflict with the use of number keys as TV channel selectors. Alternatively we can use the arrow and selector keys. ▪ overlaid menu remains for a timeout period of 5-10 seconds, which is reset for every key press, so that more than one viewer have the time to indicate their presence.

User Action	System Response
User watches normal program flow.	A few minutes before the next ad break, a set of icons, representing profiles appears on the TV, prompting for activation.
Remote control holder indicates –optionally- his/her presence. Furthermore he/she can indicate the presence of others, too.	Active profile-icons are highlighted.

5. USER-TEST METHODOLOGY AND EVALUATION RESULTS

In this section we describe the methodology used for the evaluation of the Viewer Interface (mock-up demo). A concrete methodology is based on sound objectives, relative to the stage and the general objectives of the project. Test environment set-up, facilities, staff is described and measured tasks are defined. Finally we define user profiles and results analysis approach.

Before starting the testing session, all users attended an introductory presentation of the system functionality and were shown the testing sessions content. The objective of these practices was to smooth the learning curve that every new system imposes on its users. In doing so, we expected to reduce the non-sampling errors, and research bias that are usually present in the introduction of breakthrough technologies.

Test Tasks (Scenarios)

The users were asked to perform three scenarios, as defined in the use cases. In each case, we use the same videos sequences, so the users remain focused in the interface elements being tested. We have also used

ordinary and common—to our Greek audience—program and advertisements for the same reason: user engagement with the tested elements. Finally, the scenarios we used are a replication of the normal TV flow of a program, interrupted by ads and then continued, in order to provide a relevant and familiar—compared to the current TV experience—testing environment.

Activate/Deactivate Viewer, Bookmark and Contact me: The user is asked to watch a program flow, which is interrupted by a set of three advertisements. This scenario starts with the normal program, which at a certain point of time is overlaid with an activate/deactivate user system request. The user is expected to press the corresponding to his/her profile remote control button, in order to indicate his/her presence. Then comes the advertising break whereas, the second ad contains a "bookmark" and a "contact me" button. By pressing the "contact me" button, a consumer request form appears which confirms the promise of the advertiser to get in touch with the consumer, through an alternative medium such as email or phone. Then the program is continued upon an assumed ending. The user is expected to become aware of the existence of added value services and understand the implications of his/her confirmation. If the user clicks the bookmark button, he/she is asked by the system to indicate his/her profile, and the currently transmitted advertisement is stored in the Set-top box for viewing later, at viewer's convenience. Following the end of the advertisement break, the program continues.

Interact with Advertisement: We assume that the user has bookmarked several advertisements during the previous sessions. The user is asked to take the initiative to interact further with one of them. The user is expected to open the main menu and navigate to one of the bookmarked advertisements, then, browse through the pages of the interactive ad and complete the session by returning to the normal program flow. During the menu selection process, the normal program continuous in the background.

User Profile Management: We assume that several member profiles have been inserted in the system. The user is asked to perform a set of actions relative to his/her profile. These include viewing the sections of his/her profile and editing a specific field. The user is expected to navigate through the profile management menus and forms.

At this stage the iMEDIA TV viewer interface development the most appropriate methods for user testing—as explained in a previous section—are the focus group and coaching sessions. These two methods give complementary results. The former stimulates group dynamics and reveals new issues, while the latter allows for in depth interviewing of specific user profiles, along the dimensions defined through heuristic and focus group evaluation.

Focus Group Key Findings

The main points of the focus group results are summarized as follows:

- In general, the focus group downplayed on the importance of the iMEDIA menu system and profile management functionality. The rationale for both positions was the low task frequency and the high penetration of mobile phones providing consumers experience with the more complex mobile phone menus.
- The focus group stimulated a debate among the participants, which was focused on the 'activate profile' functionality. They were doubtful, whether viewers will be using this functionality. Provision of targeted ads is questionable as a form of adequate incentive. More likely, viewers will be temped with personalization based on previous interactions and free sampling of products.
- The 'contact me' functionality, although useful as an immediate type of interaction, was considered intrusive to the program and advertisement flow. Alternatives such as auto-completion of the form fields and simple interactivity overlaid to the program were suggested. The 'bookmark' functionality was found very promising, although the term used (bookmark) should be revised. Moreover, participants found no thematic distinction between the 'contact me' and 'bookmark' functionality, except at the level of immediacy. Finally they were sceptical about the feasibility of the later-on interaction unless some incentive or reminder is provided.

- In addition to the interactive advertisement options during the regular commercial, the participants got highly involved with the notion of interactive content. The idea of a scaled down, in terms of complexity and number of pages, web site was a favorite. Moreover participants stretched the importance of rich multimedia and proposed a kind of low interactivity or 'passive interactivity'. Ideally, the interactive TV should eliminate the need.
- During the focus group session the horizontal theme of remote control interactivity was continuously mentioned. A group of the participants was fond of the cursor navigation, while an opposing point of view stretched for the familiarity of the numeric keypad. Ideally, both methods should be tested with a statistically significant sample of users. Furthermore, both methods could be available as a system option to users.

Coaching Evaluation Key Findings

The main points of the coaching evaluation results are summarized here, alongside with brief participant profiles. We chose not to test through the profile form-fields and functionality, because, as suggested by the focus group, it is a low frequency task.

- The single most important fact was the reconfirmation of the diffusion of innovation theory. Technology aficionados belong in the innovators group and welcome more or less everything that is new. Additionally, when asked for their suggestions, they value customization, complexity and features. Next come the early adopters group, who value convenience and ease of use, although they tend to be fairly sophisticated users. This group, from a marketing point of view, is the most promising one, as they tend to be opinion leaders for the majority to follow. In our point of view, whatever user interface is offered to innovators and early adopters will be considered adequate, assuming it is a valid one. The challenge is how to lure into using the interactive features, the early and late majority groups.
- One more interesting aspect discovered through the in depth interviews, was the different preferences relative to the interactive advertisement options. The 'contact me' scenario was favoured for products low in search qualities and users with little computer experience, while the bookmark option was preferred from middle-aged users and for products high in search qualities, such as services or expensive and complex goods.
- Last but not least, we have received some negative feedback about various key system features. The terminology of the 'contact me' and 'bookmark' functionality was considered as ill chosen and not sufficiently descriptive. The 'bookmark' term was judged as irrelevant to the TV experience. The rationale for this was based on the fact that TV is about entertainment and not information search, in contrast to the web and library experience. According to our test users opinions the difference between the two terms was based on a time axis and not functional one. 'Contact me' is about impulse action, while 'bookmark' is about later and non-linear or asynchronous to the program flow interactivity. Finally, TV viewers value highly the normal TV programming, implying a need for associated services and not substituted to the current TV features.

6. CONCLUSIONS & FURTHER RESEARCH

Interactive and Personalized TV offers significant opportunities to advertisers, advertising agencies, and TV Channels. Most importantly it can turn passive viewers into active participants enhancing their TV viewing experience. The design of the viewer interface has to deal with a number of challenging issues underlying the nature of the medium. Traditional IS User Interface design struggles to offer the experience required by TV Viewers. In this paper we presented our approach for the design of the Interactive & Personalized TV-viewer interface and its application to the iMEDIA project. We outlined the major forces affecting the user experience in the emerging field of the interactive TV. These forces, more often than not, conflict with each other, so we offer suggestions on how to balance the struggle among them. The result of the user evaluation

is a valuable set of issues raised by users, mapping down alternatives, providing insights and revealing new issues that can be used towards the development of an interactive TV system that addresses viewer needs.

Further research would address the customization of the interface to accommodate diverse user groups, the capitalisation of the experience gained by the use of mobile telephones as input devices, the reduction of viewer actions needed to interact with the medium, and the simplification of the mechanism declaring a viewer's presence in front of the TV to enable the personalization of advertisements. Finally, an important contribution would be to define the most efficient classes of interactive advertisements (apart from the 'bookmark' and 'contact' type); ads that allow viewers to instantly interact with them while not distracting their attention from the next advertising message.

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