

Social Television and User Interaction

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At first glance, the notion of social interactive television seems to be a tautology. Television watching has always been a social activity. People watch television together in their living rooms, and outside their homes they talk about last night's football match; and even call each other to recommend an interesting program. Unfortunately, until recently, research on social interactive television has been scarce. One limiting factor for the development of innovative services for the home is the interactive technology behind user interaction, which was limited to the remote control. Fortunately, a number of studies concentrate on extending interactive methods, for example by using contextual information. This article reviews the state of the art in these two directions: the social aspects of television and user interaction. We conclude with a research agenda for further research, which might transform current interactive television services into shared experiences.

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1. INTRODUCTION

“Interactive television represents means of linking individuals together by providing each with an electronically mediated representation of the other's voice and visual presence”. Wellens [1979]

Despite the many criticisms on the quality of television content and on the passive nature of the activity, the social uses of television have also been documented in well-regarded research. In particular, the use of audiovisual content as a placeholder for starting and sustaining relationships is an everyday experience for the majority of television users. Nevertheless, the pressures of daily life and the increase in the number of scattered households make joint television viewing increasingly difficult.

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This article explores contemporary research on (1) the social capabilities offered by interactive television systems and (2) the interactive and navigational capabilities of the services. On the one hand, current interactive devices such as the remote control limit the possibilities for interactive television to provide enriching experiences. On the other hand, innovative services will emerge from the inclusion of social communications in the television domain.

In this article we first review the state of the art, analyze previous research, and finally propose a research agenda.

2. STATE OF THE ART

We survey two essential pillars in interactive digital television systems: user interaction and social communication. In the first, remote controls are inadequate, and in some cases difficult to use, so research oriented to providing non-intrusive user interaction is required. In the second, research on the social practices that relate to TV might enhance the interpersonal communication value of interactive TV applications.

2.1 User Interaction

Traditional interactive television settings use the remote control as a single control device, which imposes a number of restrictions on how people can interact with content at home. For example, viewers have to be in front of the television set, only one person has actual control over the content, text input to search content or to chat becomes a complex operation, the number of key pads is limited to four arrows, channel numbers, and color buttons, and the functionality mapped in the remote control must be made larger and thus more difficult to operate.

There have been interesting discoveries on extending remote control capabilities. Examples include the use of everyday objects [Aroyo 2007]; paper-based devices [Berglund 2006]; gesture recognizers [Kim 2004]; voice recognizers [Berglund 2004]; and digital devices at home such as mobile phones [Cesar 2007a; Lin 2005]. Gestures, paper, voice, and everyday objects provide more natural ways for interacting with television content, while digital devices provide feedback capabilities (e.g., a second screen for extra television material).

We have organized previous research on input devices into three major categories: extension of traditional remote controls, augmentation of everyday objects such as pillows or paper, and repurposing of other personal devices such as mobile phones.

The first research technique is to extend current models to new uses. For example, Berglund and Johansson [2004] present results for multimodal capabilities for remote controls and Kim et al. [2004] propose the inclusion of gesture capabilities; the latter is especially timely, given the success of the Wii remote control.¹

Apart from extending the utility of the remote control, interesting research has also resulted from rethinking the possibilities of everyday objects. Berglund et al. [2006] present an extensive user study on making use of digital ink and paper to select television programs. In addition, an active pillow with situational sensors provides a mechanism for indirect content control [Aroyo 2007]. Other everyday objects such as tables can be considered for manipulating media content.² Finally, contextual information gathered by

¹ The Wii remote control represents a major revolution because it introduces the concept of several remote controls in a shared setting (television screen).

² During the Passepartout project, Philips Research presented the prototype of a table for selecting and manipulating media content at home.

⁴ <http://www.passepartout-project.org/>.



Fig. 1. Home setting investigated in the Passepartout⁴ project. The home includes a number of rendering and interactive devices such as screens, a table, and an interactive pillow.



Fig. 2. (Left) Navigating content in a nonintrusive manner [Cesar 2007a]. (Right) “Authoring from the couch” by including overlay media (ink, in this case) over media content [Cesar 2007b].

sensors in a room provides non-intrusive information that can be used for interacting with content. Fig. 1 shows a sketch of a future household in which a number of interactive devices and techniques can be used to interact with audiovisual content.

In addition, mobile devices have been used to control personal video recorders at home. For example, mobile devices can be used for secondary and personal display at home and to control interactive television, as shown by Robertson et al. [1996]; Karanastasi et al. [2005]; and Cesar et al. [2007]. Most interesting is research on providing universal remote controls [Nichols 2002], so not only television content can be controlled but, for example, the house lighting as well.

Finally, digital devices such as pen-enabled tablet PCs have been used to annotate and manipulate audiovisual content. For example, Cesar et al. [2006] presented the “authoring from the couch” paradigm, which allows viewers to enrich television content using a mobile phone from the sofa. shows some examples of using mobile phones as extended remote controls.

2.2 Social Interactive Television

The study of social interactive television is not new; back in 1979 Wellens wrote “interactive television represents means of linking individuals together by providing each

with an electronically mediated representation of the other's voice and visual presence". During the last couple of years a number of researchers have revisited and reshaped social interactive television in terms of human connectedness [Agamanolis 2006]; design guidelines [Oehlberg 2006]; theoretical frameworks [Chorianopoulos 2007]; systems [Luyten 2006]; and user evaluation [Geerts 2006].

Regarding design guidelines, Oehlberg et al. [2006] proposed a number of design strategies for social communications between distant viewers (Fig. 3). For example, if synchronous television watching takes place remotely, the main requirement is to facilitate the communication of basic information that discloses status, preference, and activity of distant viewers. The overall goal is to aid conversation flow with minimal disruption of the television content flow.

In terms of theoretical frameworks, Chorianopoulos [2007] defined a taxonomy of the social aspects of television based on two dimensions: presence and type of communication. The first concerns presence (co-located viewers or distance viewing) and the second identifies the type of communication (synchronous or asynchronous).

A number of social interactive television systems (e.g., Telebuddies [Luyten 2006]; Amigo TV [Coppens 2005]; and Joost⁵ (Fig. 4)) have recently been developed. They



Fig. 3. System set-up for distance content-enriched communication with ITV and possible solution for presence awareness [Oehlberg 2006].



Fig. 4. The Joost user interface includes semi-transparent interactive widgets.

⁵ <http://www.joost.com/>

Table I. The Application Domains of the Articles

Article	Domain	Research Issue
Bernhaupt et al. [2007]	User interaction	Television-watching practice and input devices
Rice and Alm [2007]	User interaction	User interfaces for older adults
Hemmerlyckx-Deleersnijder and Thorne[2007]	Social interactive television	Enriched domestic video-calling via television
Harboe et al. [2007]	Socially interactive television	Social practices related to watching television

provide instant messaging capabilities like messages and chat and status information about “buddies”. They enhance the television-watching experience by including synchronous communication. On the other hand, Cesar et al. [2007b] proposed a solution for asynchronous communication via sharing enriched fragments of television programs among friends.

Fortunately, not only were systems developed but studies were published as well. For example, Geerts [2006] compared voice and text chat and highlighted the difficulty of text entry for a television environment, while Weisz [2007] demonstrated the connectedness factor, while providing chat capabilities for television viewers.

2.3 Representative Articles

We have chosen four representative articles on research in social interactive television and user interaction. As shown in Table , Bernhaupt et al. [2007] and Rice and Alm [2007] focused on user interaction, while Hemmerlyckx-Deleersnijder and Thorne [2007] and Harboe et al. [2007] studied social interactive television.

Bernhaupt et al. [2007] presented innovative methodologies, based on creative and playful probes, to examine interaction techniques both at home and outside. Their research focused specifically on the future development of remote control devices. Rice and Alm [200] studied how to design innovative user interfaces for a marginalized segment of television viewers, older adults. While the core of these papers is user interaction, the authors proposed solutions for sociable interfaces as well.

The other two papers focus completely on socially interactive television. First, Hemmerlyckx-Deleersnijder and Thorne [2007] proposed new methods for enriching social communication. They focused on video conference calls that take place over television, and argued that better presence awareness, visualization, and contextual sharing would enrich the shared experience. Finally, Harboe et al. [2007] presented test results on the potential uses of various (conceptual) devices for social television. For example, prototype tests on audio connection while watching television.

Each of these papers utilizes different methodologies to obtain results from users. As shown in Table , ethnographic studies, Wizard of Oz testing, and prototype testing are among the methodologies in the articles. Depending on the topic and the research issues, a specific methodology or combination of them should be employed.

Bernhaupt et al. [2007] used ethnographic studies in order to understand what the current trends in the living room and beyond are. The article presents the results of two studies: the living room context and beyond. Their study confirms previous findings (e.g., the complexity of the remote control). Their major contribution is the use of innovative methods for ethnographic studies, namely, creative and playful probes that allows the evaluators to stimulate the creativity of the participants.

Table II. The Methodology of Each Article

Article	Methodology
Bernhaupt et al. [2007]	Ethnographic studies
Rice and Alm [2007]	Interactive theatre Wizard of Oz
Hemmerlyckx-Deleersnijder and Thorne[2007]	Home trials Wizard of Oz
Harboe et al. [2007]	Prototype testing Focus groups

Rice and Alm [2007] made use of two kinds of usability methodologies. First, in a live-performance, professional actors, a facilitator, older adults, and researchers presented innovative ideas for user interfaces in a tangible form. The interactive theatre was followed by user-generated dialogue and paper prototyping, and then 19 people were recruited for Wizard of Oz testing.

Hemmerlyckx-Deleersnijder and Thorne [2007] used field trials and Wizard of Oz testing. For the field trials, three geographically separate households used the prototypes for two to three months, and then, due to its quick prototyping capabilities, Wizard of Oz testing was done, which helped the prototyping phase before the final system is developed.

Finally, Harboe et al. [2007] did home trials and focus groups, and then reported on the results for innovative socially interactive television systems. The participants were connected for one hour to watch a program agreed upon in advance in order to investigate their reactions to a working prototype in which an audio link was activated. Then, seven focus groups were organized to validate and extend previous results. During the focus groups, participants were asked to discuss their ideas from a number of storyboards depicting scenarios for socially interactive television.

The major results presented in these articles are summarized in Table , including the development of creative and cultural probes for ethnographic studies about the home, development of navigational techniques that mimic real-world artifacts for the development of interactive television services, the enhancement of video-conferencing systems with conversational context-sharing, and the development of new concepts for socially interactive television

The studies by Bernhaupt et al. [2007] confirm previous research on the topic [Kubey and Csikszentmihalyi 1990]. For example, the participants considered television viewing as a background activity and as “doing something together”. Moreover, people liked the idea of an extended home, that is, family members could access content and control devices at home while they are away. Nevertheless, major concerns were raised about security and privacy.

Rice and Alm [2007] gathered comprehensive requirements that employed interactive theatre and paper prototyping. The results demonstrate the following: (1) the need for an etiquette when engaging with socially interactive television systems (e.g., when to initiate a conversation); (2) the complexity of remote controls and the potential usage of the voice as an interaction method; (3) the importance of presence awareness; and (4) customization of applications for older adults so as to limit functionality. Finally, the article suggests a number of layouts and navigation techniques for a video message service, including a carousel-like interface, semi-transparent layers, and a traditional scrolling interface. The authors conclude that navigational techniques that mimic aspects

Table III. Overview of the Articles' Contributions

Article	Main Contribution
Bernhaupt et al. [2007]	Development of innovative cultural probes Privacy and security are issues Complexity of the remote control
Rice and Alm [2007]	Need for an etiquette for social television Complexity of the remote control Importance of presence awareness Unobtrusive methods for user interaction (e.g., voice)
Hemmerlyckx-Deleersnijder and Thorne [2007]	Presence awareness (e.g., photo frame) Context-sharing enriches the communication process Privacy is an issue
Harboe et al. [2007]	Social television might not fit (1) everyone and (2) all situations Remote control is not an option Need for an etiquette for social television Importance of presence awareness

of real-life artifacts were better suited for the participants (for example, organizing video messages in a photo-album style).

Hemmerlyckx-Deleersnijder and Thorne [2007] identified a number of technologies such as presence awareness that enrich social communication among separated family members by using, for example, photo frames, and sharing each other's contexts via explicit or implicit actions. Presence awareness helps to initiate a conference call via an eye contact sensor located in the photo frame, for example. Moreover, evidence of everyday activities such as photos or drawings can be collected and used later to enrich communication. For example, everyday activities or objects can be shown in a photo frame or in an interactive table to other family members or friends at other locations and used to frame conversations. In addition, the family gains a common place for sharing (e.g., photo frame or interactive table) and a continual sense of being together despite distance. According to Hemmerlyckx-Deleersnijder and Thorne [2007], even though privacy was a major issue, it was outweighed by the sense of constant nearness provided by presence awareness. It is important to note, though, that this study was limited to families separated by geography where trust was not an issue. This research is closely related to the work of Agamanolis [2006] on presence awareness and to that of Huang [2007] on physical artifacts that contribute to feelings of connectedness.

Notably, Harboe et al. [2007] found that socially interactive television may not be appropriate for all kind of programs, since there are situations in which participants would not like to interrupt the media flow. Nevertheless, sports and reality TV were identified as potential programs in which to include social capabilities. The authors also suggested further research on social television etiquette and on nonvisual cues. Presence

awareness was identified as a key component of future social systems and for solving the problem of selecting a program to watch in common with others. Group modeling research could facilitate the selection of content that would fit the preferences of a particular group of viewers [Masthoff 2004]. Finally, in terms of user interaction, text input was rejected, and participants agreed that more natural and non-intrusive methods should be used.

The articles mentioned here are representative of current research on social television and user interaction. In summary, they agree that current remote controls are inadequate for social television and on the need for more natural and nonintrusive methods for interacting with television content, as well as on the use of everyday objects and physical artifacts. Extended home and social communications were seen as opportunities to enrich the experience of sharing in socially interactive television, even though this may not be appropriate for every kind of program. However, there were major concerns about privacy and security raised during the studies.

4. RESEARCH AGENDA

This article concludes with a proposal for a research agenda for future social interactive television systems and user interaction. Until recently research on these topics have been scarce and to the date not a uniform body of work can be found on the topic. Table summarizes the proposed agenda.

Table IV. Research Agenda for Socially Interactive Television and User Interaction.

Topic	Subtopic	Research Agenda
User Interaction	Extension of traditional remote controls	Voice Gestures
	Augmentation of everyday objects	Natural ways to interact with media content Nonintrusive methods
	Repurposing of other devices	Handheld devices as universal remote controls
Social Communications	Synchronous communications (distance viewers)	Presence awareness that aids communication flow Studies on CSCW Identifying genres that fit social television models Social interactive television etiquette Nonverbal communication
	Synchronous communications (collocated viewers)	Social protocols for sharing television control over the viewers
	Asynchronous communications (distance viewers)	Sharing fragments of video as gift-giving Online communities
	Asynchronous communications (collocated viewers)	Studies on how to store and save current status of communication

In terms of user interaction, further research should pay special attention to the environment: watching television alone in the living room is not the same as watching it with the family. Moreover, the interactive devices that surround a user at a specific moment will determine the way he or she interacts with television content. The final goal is to provide the most natural and nonintrusive user interaction techniques.

Research and systems that provide innovative user interaction techniques already exist, but mostly as prototypes. Hence we propose the integration of full working systems that enhance the end-user capabilities in selecting, navigating, and manipulating digital media at home. Furthermore we suggest taking advantage of existing everyday objects (such as paper) to gather information via sensors that can interact with content. In addition, we encourage the study of voice and gesture systems, which are more natural ways to interact. However, voice or gesture interactions might disturb others in the same room, so such interactions will depend on the user's current situation (e.g., alone, with friends, with parents, etc.). Finally, using personal devices such as mobile phones in new ways might not only benefit the interactive capabilities of the phones, but their rendering capabilities as well. In any case, it is important to mention that one solution is not a substitute for another; they should be cumulative.

Social communication in the television environment is an emerging field in both academia and industry, and major research and theoretical study on the impact of the technology on the medium are still needed. One essential topic, presence awareness, plays a major role and needs innovative solutions that go beyond concepts imported from the web (e.g., buddy lists). Presence awareness should aid the communication flow and be as unobtrusive as possible. Potential problems of scalability in terms of how many buddies fit in the virtual living room and privacy issues should also be taken into account. How to adopt results from collaborative work systems to the television paradigm is another important and interesting topic, as are studies on sharing fragments of television programs, similar to those on gift-giving by Bentley [2006] and Taylor [2002]. Gift-giving and sharing fragments of television content are potentially strong business models; but issues such as copyright control, versioning control, and the underlying technology and innovative architectures for sharing need further research. In terms of the social enrichment of television content by users, new social protocols for controlling television content are needed.

To summarize: the final goal of social interactive television is to provide the users enriched shared experiences.

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