Bringing Back the Analogue Feeling to TV User Interfaces – the Continuous Interaction Principle

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Abstract
TV and interactive TV are offering more and more functionality and content. Using the TV has become a complicated task, especially when looking at the selection of content using the remote control. To overcome this problem we have started to develop a new way to enhance remote control interaction with a TV that enables the user to have a special type of haptic feedback when interacting with a TV system called Continuous Interaction Principle. This concept brings a kind of analogue feeling back to the user and aims to enhance the interaction with large numbers of content elements. We present design and development of the continuous interaction principle and discuss current open research question as well as future work.

Author Keywords
continuous input, touch input, interaction technology, interactive TV, remote control

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Measurement, Design, Human Factors

Introduction and Motivation

Over the last decade, user interfaces of I(P)TV systems were undergoing continuous developments and changes. The available functions as well as the content offered via these systems have multiplied. This increase in offered content and user interface (UI) complexity also poses challenges to users when navigating and using these systems and makes activities as simple as watching TV more and more complicated. There is a clear need to investigate possible solutions for enhancing the interaction of these types of systems, and new forms of interaction have been proposed in the scientific community to overcome current limitations and enhance the interaction of standard remote controls. A variety of attempts to enhance the standard remote control have been presented, including touch-sensitive areas [9], remote controls that are position sensitive or even include gesture [1,18] or enable the user to point and click [15]. Other examples range from introducing Wii-like interactions [8], speech based interaction [2] or second screen approaches such as smart phone applications or other ubiquitous computing solutions [3]. Despite the huge efforts, the adoption and diffusion of new forms of interaction is still limited. In everyday life, new ways to interact with TV interfaces still suffer from diffusion (e.g. not everybody owns a smartphone or tablet) as well as availability issues (e.g. a tablet in a family is not always available when watching TV).

To overcome the clear limitations of standard approaches to provide a joyful user experience when browsing through content, our solution offers the ability to continuously interact with the on-screen content using a patented interaction mechanism which additionally provides haptic feedback.

Interaction Technologies

The "Standard" Remote Control

The majority of people associates watching TV with the use of a remote control. While the limitations of standard remote controls have been reported in detail (e.g. [11]), the majority of TV-related devices are still controlled with an ordinary remote control using infra-red signals. During the past 50 years, the remote control has seen a series of major changes. These changes include the extension of the number of buttons along with an increase of functionality, the reduction of buttons in combination with on-screen UIs [13,14], as well as the usage of touch and speech as alternative means for input (e.g. [16,17]).

Touch

To enhance or replace remote controls with touch-based input has been already been suggested by Enns and Mackenzie [9] in the last millennium. While touch interaction was well researched within the last 20 years it still seems to have difficulties to enter in today's living rooms [16]. Touch-based interaction for remote controls could help to simplify the interaction, supporting flexibility in terms of task-oriented support, by simply changing the number of buttons shown on the screen.

Touch interaction can pose a set of usability problems, including the limitation that touch interfaces cannot be used blindly (compared to a standard remote control were users can feel the buttons). Additionally, most touch-enabled devices do not support infrared signal emission which is still the standard for most standard TV devices; thus, new forms of communication with the TV and iTV system like Wi-Fi are needed and have to be supported by all involved devices.

Figure 1: moveable element of the input device: pulled (upmost picture), neutral (middle), pushed (lower picture), circular interaction (bottom picture)

Continuous Interaction

The main goal of our research was to develop a form of interaction principle that will allow users to browse in large quantities of content in a simple and efficient way, for example large Video on Demand stores with thousands of movies or extensive channel lists offered by some IPTV providers.

The main tasks that are supported are browsing large quantities of content, and easily interacting with the content (pause/forward/back), changing channels, and controlling the volume. This is in line with findings on the most often used functions and buttons [12].

Based on a variety of ethnographic studies [4 - 7] investigating current user behaviors and user needs in the field, and given the enormous amounts of content offered in terms of TV channels as well as on a video on demand basis, during our iterative user-centered development process we came up with the idea that the user should be able to search continuously in the content, by simply navigating deeper into it.

The system consists of two parts: an input device (Figure 1) that enables continuous input and feedback by shifting the upper plate on the remote control, and the corresponding user interface. The more the plate is pushed, the faster the cards depicted on the user interface are moved and vice versa (cf. Figure 2).

The movable element is based on an interaction solution that enables continuous feedback to the user: the harder/faster the user pushes, the more resistance (force feedback) is perceived, which is also reflected in the graphical user interface and the presentation of items on the screen.

The remote control is also position sensitive: turning it counter-clockwise (roll) and shifting the plate activates the volume function, while clockwise turning (roll) is activating the video forward/rewind function. Turning it upwards (yaw) pauses the currently played video content, while turning it upside down (rolling 180 degrees) for several seconds is turns off the TV system.

The depth of menus is designed based on previous work on enhancing the usability of iTV systems [13] and error recovery is supported as users can go back to the main menu by repeatedly pressing the back button. To support the continuous interaction moving forward and back (push/pull), the graphical user interface takes up this metaphor and provides a list of elements that the user can browse through in only two directions similar to index cards (Figure 2).

To investigate the continuous interaction principle, a series of prototypes has been built for the input device. We have been experimenting with various forms, ranging from the shape of a standard remote control to the (finally selected) monolithic form (Figure 1). Fully functional prototypes have also been built for two types of ring-shaped and circular interaction (Fig. 1 bottom).

The overall goal of the design concept is to support users in their most preferred activities: searching through media content and simply watching media content. The current UI prototype offers the most relevant functions of an IPTV system including changing TV channels, using an Electronic Program Guide (EPG), browsing through Video on Demand (VOD) libraries, controlling volume levels, and using transport controls like play/pause or skipping forward or backward in video content.

Figure 2: The aura design concept user interface

Figure 3: the continuous input remote control

Usability and UX Study

To investigate the optimal way how to support the continuous interaction principle, a usability and user experience study has been carried out. The Continuous Interaction Principle was evaluated using the monolithic remote control depicted in Figure 3.

Study set-up and participants

The study was conducted in a lab equipped as living room. Twelve persons took part in the study, six were female and six were male. The age of our participants ranged from 18 to 55 years. All participants had normal or corrected to normal sight and all were right-handed. To observe the users interacting with the system we used three network cameras, which were remote-controllable. A microphone was used to record comments and interview answers.

The study started with a short pre-interview on media usage and remote control usage habits. Subsequently, participants performed a warm-up task (switching through channels) and four regular tasks. The tasks consisted of two sets of four tasks and were fully counterbalanced for the participants. Tasks included typical TV tasks like finding a broadcast in the EPG, searching a VOD movie, using the channel list and turning the system off. Finally, participants filled in the SUS (Standard Usability Scale) questionnaire and the AttrakDiff [10] questionnaire (www.attrakdiff.de), followed by a final interview.

To investigate the usability of the continuous interaction principle we measured the following indicators: Task success, task completion time, and task rating (perceived difficulty to perform the task on a 5 point scale from very easy to very difficult).

Overview on Results

The continuous interaction principle is overall usable, with some room for improvement. Usability for the continuous interaction principle was rated as acceptable with a mean SUS score of 72. Overall task completion was very high (42 of 48 tasks), and most errors in interaction were related to precision problems or overshooting. Participants were overlooking navigation items, had problems with speed or accuracy.

To investigate the perceived user experience, we used the user experience questionnaire of Hassenzahl [10] called AttrakDiff. The continuous input was rated high regarding the pragmatic quality (Mean 0.87, SD 1.02 on a scale from -2 to 2), and very high regarding attractiveness (mean = 1.51, SD=1.12) as well as overall hedonic quality (mean=1.64, SD=0.83). A closer inspection revealed that the continuous input remote control scored slightly better for the stimulation dimension (mean=1.85, SD=0.80) than for the identification dimension (mean=1.44, SD=0.91).

In the final interview, the majority of participants stated that using the remote control with the interface felt natural for them (9 out of 12), while assigning the solution average precision.

Summary and Discussion

The goal of the continuous interaction principle was to design and develop an interaction solution that offers users a usable way to browse through large quantities of content and provides an enhanced user experience. The solution takes into account the specific usage situation in the living room, allowing the user to interact with the content without the need to look at the remote control by providing haptic feedback.

To support frequent functions like volume control and power on/off, the continuous interaction principle uses position-dependent information from the remote control to perform these actions. Using such a way of interaction for frequently used functions should be used sparingly, as users might not detect the additional functionalities themselves. The continuous interaction principle overall supports a lean back behavior of the users, as the control requires only little learning effort.

The evaluation of the continuous interaction principle showed that it offers acceptable usability and users are capable to use this interaction mechanism with no to little learning effort. Results indicate that the solution overall is experienced as improvement in terms of user experience, despite some usability flaws and average usability ratings for the SUS and the AttrakDiff questionnaire, which were outweighed by the excellent ratings for hedonic quality.

During the evaluation we observed that some users had problems with overshooting menu items as well as choosing a menu item precisely, which is also reflected in the precision ratings during the interview. Finding a good balance between precision and speed of the user interface and the respective movement on the moveable plate is an important insight of the study.

We also faced some limitations during the evaluation. Results might be influenced by the fact that it was a first time usage and that participants were not used to this kind of interaction mechanism. Additionally, while offering the opportunity to quickly navigate through long lists of content, the interaction concept does not support quick access to information or functionalities (e.g. a search functionality) or shortcuts.

Our ongoing goal is to find out how to enhance the continuous interaction principle and how to make the feedback more implicit so the user is just "sensing it" better without noticing a difference, and how this is related to user experience. Thus, we want to have feedback from discussions with the community regarding the overall concept, to understand which shape and form factor suits it well, and to understand how it can be applied in other domains and areas.

Future Work

What we understood until now is that the continuous interaction principle is helpful to browse in content but does not allow quick access to information, as direct search is evidently less supported. Our next step will thus be the integration of a speech recognition system [17] to allow the user to search for specific terms, e.g. by simply stating "George Clooney" and getting a list of all movies with the actor which can then be browsed in a convenient way.

For the next iteration we will also extend the user interface functionality to make the prototype complete for various types of interactive TV services. This should allow a more complete evaluation in terms of typical interactive TV and IPTV tasks. Furthermore, this helps us to evaluate the applicability of this kind of reduced user interface and interaction approach to interact with current IPTV services, and facilitates comparing it to other novel interaction technologies on the market.

A second research area is the extension and integration of the current user interface principle on different devices including second screen approaches like tablets and smart phones, and the extension of the principle to support multi-screen interaction.

We are currently enhancing the continuous interaction principle by providing a technically improved continuous input remote control as well as by developing a touch sensitive remote control with a different layout and visual feedback for touch gestures performed using LED feedback. Our goal is to continue to investigate the continuous input principle to develop it to a ready to market technology.

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