Touching Tales: Design Issues in Creating Haptic Content

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ABSTRACT
Despite continual consumer demand for richer broadcast media, there have been few examinations of senses other than vision and hearing in this domain. This paper considers the role that touch may be able to play in future broadcast systems. We have begun to explore the addition of haptic cues to children's cartoons, and through this process unearthed a number of practical design issues unique to this domain. Some of these are discussed in this paper, including how the psychological distinction between passive and active touch influences broadcast media, and how this in turn affects notions of interactivity. We also discuss focus as it relates to the haptic display of individual aspects of complex scenes. The goal of this paper is to introduce this novel and unexplored topic, and to provide a discussion that motivates further research.

Keywords
Haptic, broadcast, interactive TV

INTRODUCTION
There is a continual demand from the viewing public for richer broadcast media. This is illustrated by the rapid adoption of new audio and video technologies such as Dolby 5.1 and wide-screen TV. However, even within the development of the newest technologies, such as Interactive TV, the use of senses other than vision and hearing has remained relatively unexplored. Specifically, despite research linking haptic, or touch, feedback to increases in involvement and immersion in virtual environments [3] its use has not been formally examined in a viewing scenario.

THE TOUCHING TALES PROJECT
The Touching Tales project aims to address this omission. It is an ongoing work and involves the creation, and eventual evaluation, of broadcast media containing tightly coupled audio, video and haptic content. An important aspect of the project is the theoretical and practical exploration of the various novel design issues that apply to the addition of touch to an audio video stream. These design issues are the focus of this paper.

DESIGN ISSUES
Scenario development
The first design challenge for this project was to create a scenario that would enable us to display haptic feedback.

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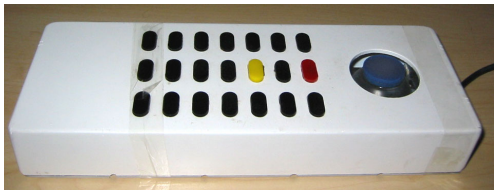

Figure 1. Haptic remote control handset.

This entailed the specification of a viewing domain that would support the addition of haptic cues, an output device that would display the cues, and the integration of this device into the sit-back, living room environment typical of broadcast viewing. The domain we selected was children's cartoons, simply due to the fact that they are relatively easy to create, and that children are an audience that seem likely to accept the addition of novel feedback to their broadcast experience. To deliver haptic effects within a viewing scenario, we created a prototype touch-enabled TV remote control that integrated an existing consumer force feedback device: the Gravis Xterminator Force [2]. This gaming device contains a small two DOF force feedback actuator, and is priced at a level accessible to most consumers. Figure 1 is a picture of our prototype force-feedback handset; users place their fingers over the circular area to experience haptic cues.

Active and passive touch
Beyond these practical considerations, essentially a definition of context, many other issues cropped up during the design and implementation phases of our first few cartoons. First and foremost we observed the relevance of the psychologically founded distinction between passive and active touch [1]. Passive touch refers to situations in which touch stimuli are presented and a user is unable to move to explore these sensations. Active touch, on the other hand, is characterized by interactive exploration; perception is mediated by action. Active touch is normally used in unconstrained interactions in the real world. To explain through an example, imagine a scene in a cartoon where the protagonist is pushing a ball up a hill. This action might be haptically rendered as a tug on the viewer's hand as the character pushes, or as a force that resists the viewer's own motion as they try to push on the ball. The first of these representations is passive, it simply happens to the viewer, while the second is active, the viewer has to actually move to and push the ball. This kind of exploration is enabled in our system through our choice of hardware: a gaming joystick that natively supports coupled input and output.

The literature on touch strongly suggests that stimuli that support active exploration will be much more compelling and immersive than stimuli that do not, and we therefore feel that integrating active haptic cues into the media we create will be vital. The ability to physically mimic the actions of a character on a screen, and receive an appropriate percept in response, will be a more powerful mechanism for involving users than simply presenting a passive, non-interactive, cue.

The role of interactivity

This idea of active haptic perception in the context of broadcast media leads to an interesting perspective on interactivity. Given that active touch requires motion, it is possible to construct viewing experiences where the user can interact with objects, possibly even moving them around, but not alter any deeper aspects of the content. Essentially, we can create a dynamic experience by allowing users to interact with the haptic presentation of an on-screen object, but not allow this interaction to affect more fundamental parts of the broadcast content, such as the pace, or the outcome of the events depicted. An important side effect of this form of interactivity is that it is optional; users can choose whether or not they wish to experience the haptic cues without influencing the high-level content of the programme.

This approach, which we have dubbed *presentation-level interaction*, may also have further applicability. It is possible to extend the limited interactivity present in active haptic interactions to the audio and visual content. To return to the example of a character pushing a ball, there is the potential to use the viewer's movement, which is the source of the haptic presentation of the object, to also influence its visual and audio presentation. As the user pushes against the ball its on-screen movement could become more rapid, and its spatialised audio location could be adjusted accordingly. This combination of interactive media in three modalities seems likely to engender a high level of immersion in viewers. However, such manipulations are limited to cartoon style (or more accurately object-based, or client side) presentations where the audio and visual media can be adjusted dynamically and on the fly.

Issues of focus

Another crucial issue relates to the focus of the haptic feedback. The hardware we selected as a display device supports the presentation of a single force at any one time. This is representative of currently available devices, but does not map well onto broadcast presentation. Typically, a broadcast, and specifically a cartoon, contains a number of characters or significant objects at any one time. Audio and video presentations support the combination of stimuli from these complex scenes in such a way that the viewer can easily decode them back to their component parts. For example, it is relatively easy to observe the visual interactions of two characters, and any sound effects produced or background music playing typically does not obstruct the perception of their dialogue. Part of the reason for the simple perception and integration of this complex information is that the art of film-making includes well-established techniques specifying how to combine these media effectively.

However, this is not the case for haptic cues. Furthermore, with the haptic devices currently available limited to the presentation of a single force at any one time, it is likely to be challenging to determine what aspect of a scene should be displayed. This issue can be couched in terms of the focus of the haptic feedback. In the case of our previous example, if the ball was being rolled by only one of several displayed characters, a question arises regarding what perspective we should "feel" the scene from? For instance, if all forces displayed relate to the actions of a single character, that character becomes the focus of the haptic feedback. Such an approach seems likely to lead to viewers strongly identifying with the character: feeling what that one individual feels.

An alternative approach would be to present forces from the perspective of the environment the events depicted take place within. For instance, if a character throws a ball against a wall, the haptic stimuli generated would relate to the impact of the ball on the wall, not from the characters throwing action. This approach resembles the use of audio: in the throwing scenario mentioned, the critical audio event would also be the impact of the ball against the wall, and not the character's motion as it was thrown. It seems likely that the best solution will be a combination of these approaches, and the Touching Tales project hopes to generate design rules describing how this can be best achieved.

CONCLUSIONS AND FUTURE WORK

Our explorations on this topic have raised many issues; there are many avenues for future work. Currently, we are investigating whether or not haptics can direct attention in the media rich scenario of broadcast viewing: can a haptic cue determine what is important to a viewer, or will it simply be overwhelmed by the accompanying audio and video presentation? Also, we hope to consider the ramifications of presenting each individual in a group of viewers with different haptic stimuli. Will each user gain a different understanding of the story, and how will this effect the social interactions that take place around the viewing experience?

In conclusion, we have briefly presented the motivations for, and in more depth some practical observations on, the addition of touch to broadcast media. We believe that this new area of research holds promise and that this paper sets the stage for further explorations of this topic.

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