Increasing the Appeal of Mobile TV Using Haptic Feedback

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Abstract
With the abundance of large-screen displays, mobile device users currently have little motivation to stream video content and TV broadcasts to their device—the desire to watch content 'on the move' does not currently outweigh the necessity of viewing this content on a miniaturised screen. However, the value and appeal of mobile TV broadcasts can be increased by the addition of a haptic-feedback channel to supplement the traditional video and audio streams.

This position paper describes our work into developing the hardware for a mobile haptic feedback system that uses ultrasonic air pressure waves to create vibrations on the viewer's hands. We believe our solution is particularly suitable for conveying the haptic channel of TV broadcasts as it has the ability to produce multiple, simultaneous points of feedback of differing textures and intensities, without the user needing to be in contact with the device. This technology in turn will allow users to convey an additional stream of information in their videos by recording or tagging regions of their broadcast with haptic information.

Keywords
Ultrasonic feedback, mobile TV, haptic feedback, back-of-device feedback.

Figure 1: Prototype ultrasonic haptic TV concept. The user hears, sees and feels the content in the video stream.

ACM Classification Keywords

H5.2 [Information interfaces and presentation]: User Interfaces - Graphical user interfaces.

Introduction

An ever-increasing number of mobile devices are capable of receiving and viewing live or on-demand streaming media. However, the widespread availability of large-screen displays mean users lack motivation to pay for and view such content (even the ability to view this content while 'on the move' does not provide sufficient motivation). One method for increasing the appeal of these broadcasts is by the addition of a haptic output channel. This is especially appropriate on mobile devices as they are almost always grasped in the user's hands (as opposed to traditional TV where users passively sit on a couch). Furthermore, many broadcast sporting events already record the forces being inflicted on participants or machinery (for example, amateur boxing gloves may contain force sensors and almost all motor-racing cars contain numerous force sensors).

A large body of work (for example Cha et al. [1]) has developed the architecture required to broadcast haptic events as part of a TV stream, however there is still significant work required to address the design issues and options for conveying these haptic sensations to the user. Our interest is in developing the next generation of mobile haptic feedback that advances past the current status-quo of vibration motors. We believe that ultrasonic haptic feedback can provide a far greater diversity of vibrations for conveying the embedded haptic sensations to the user.

Haptic TV

Haptically-enhanced TV broadcasts are often included in the design of next generation streaming media—with a haptic channel included when encoding the transmission data [2, 4]. However, many implementations focus on the technical issues with capturing and transmitting haptic information, with less consideration given to the device used to convey these sensations. Methods suggested for conveying this information include a "haptic display" [4], PHANTOM device [6], game controller and modified haptic remote control [7]. These scenarios all consider traditional TV viewing, on a couch in front of a large screen. Lee et al. [5] consider the possibility of Mobile haptic TV with a strap-on tactile array.

Ultrasonic Haptic Feedback

Ultrasonic haptic feedback provides multi-point, contactless haptic feedback on a single side of a mobile device. This feedback supplements a traditional audio and video stream by creating ultrasonic air pressure waves that the user feels as vibrations on their hand. The concept is demonstrated in Figure 1. The user wears headphones for the audio, while viewing the screen and feeling the haptic feedback on the fingers and palm of both hands.

Ultrasonic haptic feedback uses the phenomenon of acoustic radiation pressure—where a pressure field is exerted on an interfering object—to provide haptic feedback to the user [3]. This is demonstrated in Figure 2 where small pieces of tape rise when the feedback is triggered.

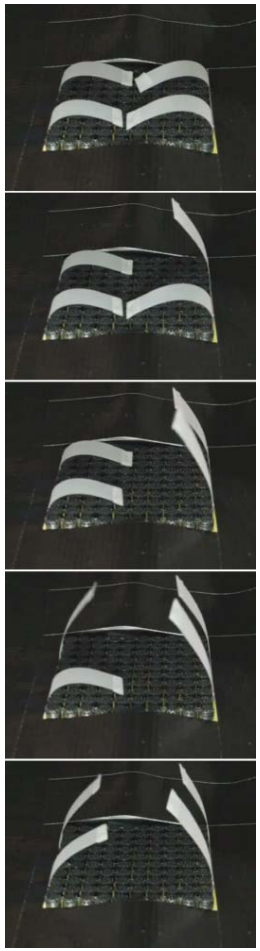

Figure 2: Small pieces of tape are pushed into the air when different regions of the feedback array are triggered

Taking Haptic TV into the Social Medium

Introducing haptic streams to mobile TV videos and broadcast streams opens a range of interesting research paths and questions. These include:

1. How can everyday users encode a haptic channel in videos they have recorded on their mobile devices? Can built-in sensors, such as accelerometers, be used to sense the forces being placed on the user? For example, imagine a user recording their trip down a hydroslide, over a mountain biking track or on a fair-ground ride.

2. How could users add haptic sensations to video streams post-recording? Could haptic feedback be used to emphasise pertinent events in the video stream, if so, how?

3. How well can haptic sensations convey the feeling that the broadcast recorder wished to achieve?

4. How does the ultrasonic haptic feedback system facilitate sharing of haptic sensations between physically close users, given they do not have to grasp the device?

Summary

This position paper has presented our vision of the future of mobile-TV streaming: the inclusion of a haptic feedback channel. This new technology opens a range of opportunities for the next generation of mobile TV.

References

[1] Cha, J., Ho, Y.-S., Kim, Y., Ryu, J., and Oakley, I., A Framework for Haptic Broadcasting. IEEE MultiMedia, 2009. **16**(3): p. 16–27.

[2] Cha, J., Ryu, J., Kim, S., Eom, S., and Ahn, B., Haptic Interaction in Realistic Multimedia Broadcasting, in *Advances in Multimedia Information Processing*. 2004, Springer Berlin / Heidelberg. p. 482–490.

[3] Iwamoto, T., Tatezono, M., Hoshi, T., and Shinoda, H. Airborne Ultrasound Tactile Display. In *ACM SIGGRAPH 2008 New Tech Demos*. 2008. Los Angeles, California: ACM

[4] Kim, S.-Y., Yoon, S.-U., and Ho, Y.-S., Realistic Broadcasting Using Multi-Modal Immersive Media, in *Advances in Mulitmedia Information Processing*. 2005, Springer Berlin / Heidelberg. p. 164–175.

[5] Lee, B.-C., Lee, J., Cha, J., Seo, C., and Ryu, J. Immersive Live Sports Experience with Vibrotactile Sensation. In *INTERACT*. 2005: Springer Berlin / Heidelberg

[6] Massie, T.H. and Salisbury., J.K. The PHANTOM Haptic Interface: A Device for Probing Virtual Objects. In *Haptic Interfaces for Virtual Environment and Teleoperator Systems*. 1994. Chicago, IL, USA

[7] O'Modhrain, S. and Oakley, I. Touch TV: Adding Feeling to Broadcast Media. In *European Conference on Interactive Television*. 2003