A Haptically Enhanced Broadcasting System

Jongeun Cha* Jeha Ryu* Seungjun Kim† Byungha Ahn†

(*) Human-Machine-Computer Interface Lab., Dept. of Mechatronics,
Gwangju Institute of Science and Technology, Korea
(†) System Integration Lab.
E-mail: {gaecha, ryu, zizone, bayhay}@gist.ac.kr

Abstract

In this paper, we discuss a haptically enhanced broadcasting system. Four stages of a proposed system are briefly analyzed: scene capture, edit, transmission, and display with haptic interaction. In order to show usefulness of the proposed system, a potential home shopping scenario is implemented.

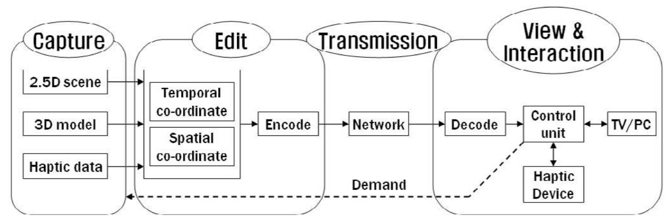

Figure 1: Haptically enhanced broadcasting chain

1. Introduction

In the area of broadcasting system, new technology is being developed and is available in terms of digital multimedia broadcasting through the air or through the Internet. Main multimedia contents are, however, limited to 2D video and sound so that feeling of full immersion is still far from the reality. Interactivity is also being pursued in these days in a very simple form such as selection and retrieval of 2D AV contents. O'Modhrain and Oakley [1, 2] discussed the potential role that haptic or touch feedback might play in supporting a greater sense of immersion in broadcast content. Presenting Touch TV, they showed two potential program scenarios: the creation of authored haptic effects for children's cartoon and the automatic capture of motion data to be streamed and displayed in the context of a live sports broadcast. Unlike the simple addition of touch-enhanced contents to the broadcast media in some scenarios, we are investigating a more comprehensive realistic multimedia broadcasting system that can include haptic interaction in addition to 3D audio-visual contents.

2. Haptically Enhanced Broadcasting System

Fig. 1 shows the proposed haptically enhanced multimedia broadcasting system. Contrary to the traditional broadcasting system, the video media is the sequence of the 2.5D scenes plus virtually synthesized 3D computer graphics models. The 2.5D scene has the depth information in addition to the 2D image. It depicts the geometry of the captured scene in terms of 3-dimensional coordinate from the camera view, not the arbitrary view. The 3D computer graphics models can be easily registered with the 2.5D scene in a 3-dimensional space by Z-keying method or Augmented Reality techniques. Haptic data can be authored or physically sensed (e.g. material property data at each pixel for texture tactile feeling can be authored in the edit stage; motion data can be sensed by physical sensors) and may be synchronized to the audio-visual data to give the viewer haptic effects. The edited hyper media is transmitted through encoding and decoding operations to the viewer site via the Internet. The control unit receiving the media renders the stereo images and 3D sound to the display device by processing the 3-dimensional video media and controls the haptic device to give a haptic interaction to the viewer. In this way, the viewer can passively or actively interact with the 3-dimensional hyper media. Besides viewers can also demand additional data via the bi-directional Internet channel.

3. Home Shopping Scenario

A potentially useful scenario is touching and manipulating 3D model in a home shopping channel. In this scenario,

Proceedings of the First Joint Eurohaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems
0-7695-2310-2/05 $20.00 © 2005 **IEEE**

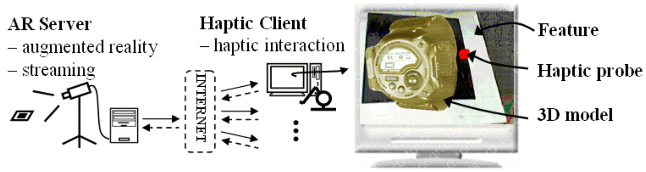

Figure 2: Demonstration system overview

a shopping host tries to advertise a product, a wrist-held MP3 player. He/She explains functions and features of the product and shows the product appearance by rotating it. Then, he may ask the viewers to touch and manipulate the product while he continues to narrate features and functions of the product. To show how the scenario works, we have implemented a simple broadcasting system, which is capable of capturing, editing and delivering video media on the Internet and giving haptic interaction. The demo system is constructed basically following the stages of the broadcasting chain in Fig. 1 , with two major subsystems : AR (Augmented Reality) server and Haptic client. As shown in Fig. 2 , the AR server consists of a typical AR system and a streaming server. This server makes it possible to create a broadcasting content and deliver it via Internet. Therefore, capture, edit and transmission stage are all performed in this server. The view and interaction stages are implemented in the Haptic client system. It receives the content and realizes viewer's interaction with the content via a connected haptic device.

In Capture stage, the home shopping application scenario is captured by a general USB camera and the product is synthesized to a 3D product model with a CAD tool. In Edit stage, the 3D model is augmented to proper location in the 2D video media using a marker-based AR technique. ARToolKit[3] is a software library that can be used to calculate camera position and orientation relative to physical markers in real time. By moving the marker, the shopping host can move the 3D model. In transmission stage, a simple TCP/IP network is used to deliver the 3D model data, video media, and the marker-to-camera transformation matrix. Since the 3D model, which will be augmented to the video media in the viewer part, is the same in each frame, the 3D model data is transferred once when Haptic client connects to the AR server. Then, the video media and marker-to-camera transformation matrix for each frame of the video media is streamed to the client. In View and Interaction stage, the Haptic client augments the 3D model to the video media and overlays the haptic probe, that corresponds to the handle of a haptic device grasped by a viewer relative to the camera reference. The viewer is then able to interact with the 3D model by moving the handle while seeing the product model augmented to the video media properly. The SensAble Technologies PHANTOM[4] makes it possible for users to touch and manipulate 3D model through the help of the GHOST SDK (General Haptic Open Software Toolkit) that eases the task of developing touch-enabled applications. In this demo system, since ARToolKit calculates the marker location through image processing operations, the transformation matrix has a high frequency noise. When the viewer touches the 3D model, therefore he feels some tremor in his hand. The high frequency noise can be eliminated by not updating the transformation matrix when the variation of the matrix is smaller than a preset threshold value.

We have implemented the first demo example based on the broadcasting chain, which is haptically enhanced. It makes us fully immersed into the broadcasted world and provides much interest in experiencing the broadcasted contents.

4. Conclusions and Future Works

In this paper, we discussed a top-level structure of a future realistic broadcasting system that may include sense-of-touch. Also, a potential scenario taking advantages of haptic interaction was presented in which the video media include a 3-dimensional synthesized object. Addition of the haptic interaction to the conventional audio-visual contents will improve the immersion of the viewers together with rich contents.

Haptic interaction in a broadcasting system requires new data format and processing technique in each stage. For example, passive haptic-related data must be prepared in the capture/edit stage and be transmitted along with the audio-visual data plus some camera-related data.

5 Acknowledgements

This work was supported by the Ministry of Information and Communication (MIC) through the Realistic Broadcasting IT Research Center (RBRC) at Gwangju Institute of Science and Technology (GIST).

References

[1] O'Modhrain, S., Oakley, I.: Haptic Interfaces for Virtual Environment and Teleoperator Systems. HAPTICS '04. Proceedings. 12th International Symposium on. (2004) 293–294

[2] O'Modhrain S., Oakley I.: Touch TV: Adding Feeling to Broadcast Media. in proceedings of the European Conference on Interactive Television: from Viewers to Actors, Brighton, UK, (2003) 41–47

[3] ARToolKit computer vision software: http://www.hitl.washington.edu/artoolkit

[4] PHANTOM, SensAable Technologies, http://www.sensable.com/