Sound Navigation System Based on *Kansei* Interaction

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Abstract

We developed a sound navigation system that can interact with movement using *Kansei* behavioral information. This system is based on unconscious human behavior, such as putting hands over ears while listening to something carefully. We collected candid videos of people to watch their behavior. Observing unconscious behavior is important for developing an idea of the flow of a tangible interactive system because data collected from observation can be applied to an emotion-based interface to control the system.

The sound navigation system was successfully developed into a sound scope headphone to focus on the sound of a target instrument in an orchestra or jazz band. Furthermore, the target sound can be changed from one instrument to another by turning your head in the perceived direction of the target instrument. The headphones were equipped with three sensors: a digital compass to detect head position (when turning left and right), an acceleration sensor (when looking up and down), and a bend sensor for emphasizing the target sound when hands are put on ears.

We found the users, which ranged from young children to elderly people, successfully controlled the headphones and were satisfied with the easy and novel interaction between their movements and the sound.

Keywords

Kansei, Interaction, Sound, Navigation

Introduction

Recently, electronic products are difficult to understand how to use properly. When we first use electronic products, such as mobile phones, PDAs, and remote controls for DVD players, we need to read a manual to understand how to use them. The shapes are too flat and have too many buttons of the same shape to use easily. People should be able to follow the intelligent and logical flow of a product’s interface using one finger to push small buttons. Difficult interfaces separate children, the elderly and handicapped people from the advanced technology of modern life.

Using a *Kansei* approach to operating such products, we focused our attention on developing tangible interaction based on natural human behavior. The concept of *Kansei* information allows people to react unconsciously to physical stimuli.

In a previous study by Lee (2001–2003), we found tangible manipulation increases creativity, which was tested by brainwaves. In daily life, tangible interaction between humans and machines can encourage creativity, so interfaces should be designed based on human behavior.

The idea of developing sound navigation system evolved from observing the behavior of people searching for events in town or looking for lost pets. Such people go outside and turn their head as they look around and listen in different directions. Among our physical senses, our sense of hearing is the only one that is always active and constantly stimulating our behavior. During the development process, we decided to incorporate these behaviors into a musical environment to make the product easy to use. The product supports our desire to listen to a certain musical instrument in an orchestra such as a jazz band or jam session. We will explain how we developed our ideas and applied them for practical use in the real world.

IDEA Development for real world practical application

What is *Kansei*?

The Japanese word *Kansei* can be interpreted in various ways. The word has been used in many research areas ranging from design to engineering. *Kansei* encompasses the meaning of words such as sensitivity, sense, sensibility, feeling, aesthetics, emotion, affection, and intuition, and is deeply connected to the behavior of human beings. *Kansei* also means to increase creativity through images using feeling or emotion.

In this paper, *Kansei* is defined as an unconscious reaction to stimuli interested in. *Kansei* engineering was started to know how people feel on phenomena resulted by design works. It was very difficult to understand the role and definition in design. By the reason, so far, *Kansei* studies have been mainly based on defining its role in design field or human beings. Recently, we focus on the role of control human behavior by scientific view point.

This study is a trial of how to apply *Kansei* into design field for practical use by interacting in a real world. We describe the development of idea and evaluate its working.

The University of Tsukuba first defined *Kansei* in the design and engineering fields during the 1990's. This concept was used in connection with brain and behavioral sciences in the Graduate School of Comprehensive Human Sciences starting in 2001. The meaning of *Kansei* has since come to mean a higher order function of the brain, such as a source of inspiration, intuition, pleasure/displeasure, taste, curiosity, aesthetics, or creation (Fig. 1).
In the design field, *Kansei* can be translated as an unconscious preference of desire to be stimulated. The word conveys a sense of rich interaction between humans and machines.

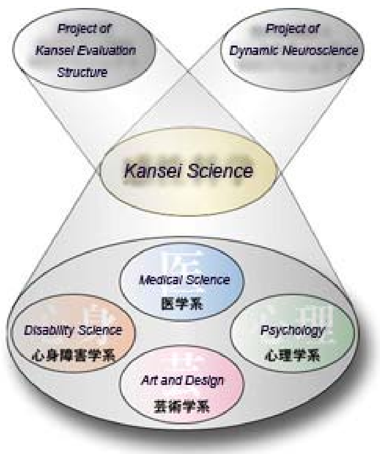

Figure. 1 Structure of *Kansei* Science (Univ. of Tsukuba 2001)

How to develop the idea for practical application?

The idea of *Kansei* interaction was based on people's behavior while searching for events or pets outdoors. We took several candid videos in which people communicated with each other or with the environment. When trying to find a place, we may first try to locate it on a map. We have become accustomed to looking at a map to find places, so we may have forgotten to use our ability to hear sounds that contain useful information about the location we seek, such as an outdoor concert or festival. Figure 2 shows how people behave when they listen to a sound and how they react to it. This figure illustrates tangible interaction: when you want to hear something precisely, you unconsciously put your hands over your ears.

The development process intended to find ways to manipulate sound navigation.

Normally, people can hear and distinguish sounds to determine some action, either intentionally or unconsciously. We set up a simulated environment with sound and location sensors to clarify the target positioning. Figure 3 shows how we set up the environment with sensors.

Fig. 2 Idea of Sound Navigation

Fig. 3 Interactive System for Sound Navigation

The digital compass was attached to a turntable. When people stood on the turn table, they could listen to different sounds through the headphones according to their body positions (Fig. 3). At first, the sounds were programmed deliberately because picking up real sounds in real world was difficult.

Fig. 4 Digital Compass on Turntable

Idea Shifts to “Sound Scope Headphone”

Initially, the system was planned only as a demonstration, but we realized this idea can be applied to listening to instruments based on their physical placement in an orchestra. Listening to the melody of each instrument while performing is impossible, but if this idea could be applied to the real world, we could enjoy the music of each instrument separately. To make this possible, we needed a multi-channel recording to adjust the volumes and panpots with an audio mixer. On this system, we adopted the music source developed by M.Goto (2002).

We developed a set of headphones that were equipped with three sensors: a digital compass to detect head position (when turning left and right), an acceleration sensor (when looking up and down), and a bend sensor for emphasizing the target sound when hands are put on ears to control the ear flip.

We also prepared some multi-channel recorded music for the system. The digital compass detected the location by every degree of position and worked with the music using a graphical user interface. When a user’s head turned right or left, the compass read the positions of the instruments and detected the channel for the instrument located in that direction. On the borderline between instruments, the sounds mixed naturally. The acceleration sensor detected changes in the head’s angle of elevation. By looking up or down, the user could increase the volume of the sound of instrument located farther away or closer, respectively.

The bend sensor was changed to a distance sensor in the redesigned version to control the volume by focusing on a certain instrument clearly instead of using an ear flap. Figure 6 shows the sensors on the latest version of the headphone.

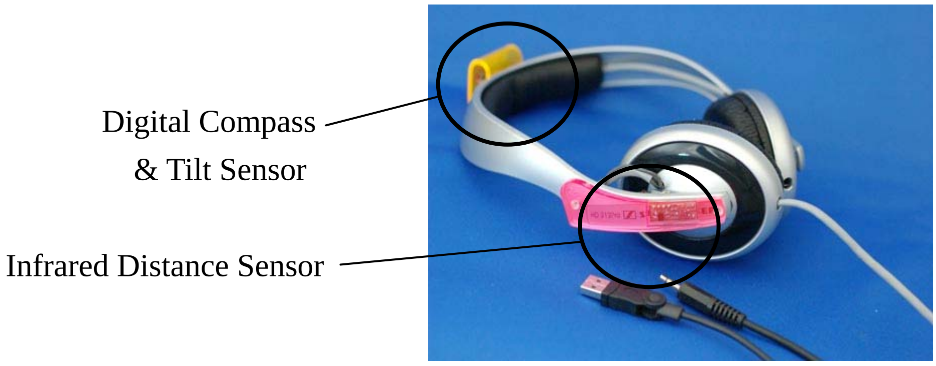

Fig. 5 Sound Scope Headphone

Evaluation of the performance

The system was invited to exhibition in Interactive Tokyo 2005, held at National Museum of Emerging Science and Innovation. There were more than 2,000 people of audience (user) for two days and most of them were young children aged 8~15. We surveyed the reaction on this system by interviewing after their trials to 80 young users. Most of the users satisfied with its simple interface and felt it easy to use. 10% of them took time to be used to the system. They retried the system more than once but most of them got used to the system immediately. Among the users, 35% was female children and there were no gender difference.

There was no error on users' willing to find the sound of instruments but 25% of users put their hands on the distance sensor (Fig.5) without notice and the volume of play changed unexpectedly. The reason of this reaction was resulted by reducing the shape of distance sensor too small.

Table1. Result of users' reaction

Age Group / Reaction	8~9 year old (25)	10~11 (18)	12~13 (19)	14~15 (18)	Total (80)
Easy to use (%)	60(15/25)	81.25(13/18)	84.21(16/19)	66.67(12/18)	70(56/80)
Fun (%)	40(10/25)	31.25(5/18)	15.79(3/19)	33.33(6/18)	30(24/80)
Retry (%)	16(4/25)	11(2/18)	0(0)	11(2/18)	10(8/80)

Discussion

The system could be used by anyone who wanted to listen to the music, even young children. The headphone was finally redesigned to be as slim as possible for ease of use. While listening to the music, the users were not embarrassed to use the headphones and moved their heads freely to look at each instrument in the orchestra (Fig. 6).

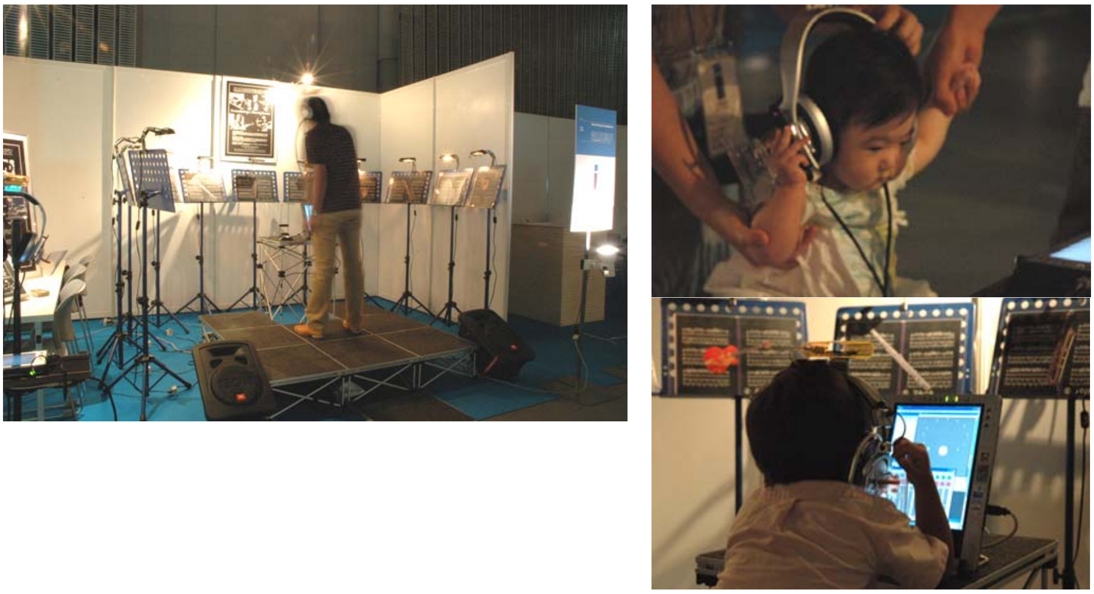

Fig. 6 Performance of Sound Scope Headphone

In this study, we focused on a process of idea development a device for manipulating each sound in a multi-channel recording of music with a set of sound scope headphones. The idea began with observing the everyday behavior of people searching for events or lost pets using their sense of hearing. We developed this idea based on *Kansei* interaction to create a more natural and easier way to use headphones. Within one year, we were able to set up a system in the real world successfully. This gives us more possibilities for addressing human behavior with certain goals in mind. This system was intended for people who want to enjoy the music of individual instruments, but it can give pleasure to a much wider range of people.

So far, in the *Kansei* design approach, there have been few case studies about developing the design of products for practical use. Here, tangible interaction was a key part of developing this idea. The *Kansei* studied will continue applying this way of approach through analyzing brain science.

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References

Goto, M., Hashiguchi, H., Nishimura, T., and Oka, R. 2002. “RWC Music Database: Popular, Classical, and Jazz Music Databases.” In Proceedings of the International Conference on Music Information Retrieval, pp. 287–288, Paris.

Hamanaka, M., Goto, M., Asoh, H., and Otsu, N. (2003), “A Learning-Based Jam Session System that Imitates a Player's Personality Model.” In Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI 2003), pp. 51–58, Acapulco.

Hamanaka, M., Goto, M., Asoh, H., and Otsu, N. (2003), “A Learning-Based Quantization: Unsupervised Estimation of the Model Parameters.” In Proceedings of the International Computer Music Conference, pp. 369–372, Singapore: International Computer Music Association.

Hamanaka, M., Lee, S.H. (2006), “Natural User Interface for Selection of Music”, 7th International Conference on Music Information Retrieval, Canada.

Lee, S.H. (2004), “When you feel, the brain blinks: An analysis of brain waves generated by various behaviors and creation/imagination.” Design and Emotion, Taylor & Francis, pp.409–414, Loughborough.

Papanek, V. (1983), “Design for Human Scale,” Van Nostrand Reinhold Company, pp.13–29.

Warusfel, O. and Eckel, G. 2004. “LISTEN - Augmenting Everyday Environments Through Interactive Soundscapes.” In Proceedings of IEEE Workshop on VR for public consumption, pp. 268–275, Chicago: IEEE Virtual Reality.