Sound Scope Headphones

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1 Introduction

We designed the Sound Scope Headphones so that they would let users control an audio mixer through natural movements, and thus enable a musical novice to separately listen to each player's performance. The main advantage of the headphones is that they detect natural movement, such as head movement or placing a hand behind an ear, and uses the detected movements to control an audio mixer while the user listens to music. Three sensors are mounted on the headphones: a digital compass, a tilt sensor, and a distance sensor (Figure 1).

Previously reported headphones with sensors to detect the direction the user is facing or the location of the head can escalate the musical presence and create a realistic impression, but do not control the volumes and panpots of each part according to the user's wishes [Warusfel and Eckel ; Wu et al. ; Goudeseune and Kaczmarski]. With these headphones, it is difficult to clearly hear a particular part from among many other parts, including some that the user would prefer not to hear.

In contrast, our headphones let a user listening to music scope a particular part that he or she wants to hear. For example, when listening to jazz, one might want to clearly hear the guitar or reduce the sound of the sax. By moving your head left or right, you can hear from a frontal position. By looking up or down, you can better hear the parts allocated to a more distant or a closer position. By simply putting your hand behind your ear, you can adjust the distance sensor on the headphones and focus on a particular part you want to hear (http://music.iit.tsukuba.ac.jp/hamanaka/SSH.mpg).

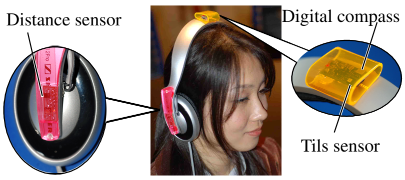

Figure 1: *Three sensors mounted to headphones.*

2 How parts are scoped

The usability of our headphones depends on the quality of the links between the mixer manipulations and the natural movement while the user listens to music. We use three links.

Link from the facing direction. When a user moves his head leftwards (rightwards), the part normally heard from the left (right) side can be heard from a frontal position as the digital compass detects the change in the direction the user faces. This allows a user, through natural movement, to scope the part which he wants to hear most clearly and hear it from a frontal position.

Link from the face's angle of elevation. When there are several parts in the frontal position, the user might not be able to hear the desired part clearly after turning his head left or right to hear it from a frontal position. In such a case, the user can change the mix by moving his head up or down and the tilt sensor will detect the change in the face's angle of elevation. By looking up or down, respectively, the user increases the volume of each part located farther away or more closely.

Link from the distance between hand and ear. The distance sensor detects the motion of putting a hand behind one's ear while listening to the sound from a frontal position. The distance between hand and ear determines the area indicating whether each part is audible. For example, when a user places her hand close to her ear, she can hear only the parts from a frontal position. When the user removes her hand, she can hear all the parts except those behind her. When the user puts her hand in a middle position, she can hear the parts located in the front half position. Therefore, the user can focus on a part she wants to listen to by adjusting the distance between her hand and ear.

3 Conclusion

The Sound Scope Headphones enable the wearer to control an audio mixer through natural movements. We are now developing applications for the headphones. For example, Figure 2 shows real instruments where the light brightness is controlled depending on each part's sound-level. This allows the user to understand each part's sound-level visually as well as aurally. This should help musical novices who do not know the sound of each instrument learn the relationship between instrument and sound.

Figure 2: *Lighting depending on each part's sound-level.*

References

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