Pull-Navi

A novel tactile navigation interface by pulling the ears

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Introduction and Method

Previous studies on navigation for walking have mainly used visual or acoustic sensations, which are not intuitive and can even be dangerous because they may block visual and auditory information from the surrounding environment. Some other studies have used tactile stimulation, which is more intuitive and less annoying, on the hand or arm to generate a pseudo-pulling force [1][2][3]. However, the devices tended to become large and heavy. Maeda [4] achieved walk navigation by using Galvanic Vestibular Stimulation, but such electrical stimulation to the head has some clinical challenges for practical daily use.

We propose a new method for navigating the user by pulling their ears. There are three merits of our method.

The first merit is its naturalness. Our method requires quite a small force to pull the ears, and the users can be "tempted" to walk to the guided direction without any pain or enforced feelings. This is presumably because we were commonly pulled by our ears at a young age.

The second merit is its numerous degrees of freedom (DOF). While most previous tactile navigation systems have achieved one or at most two DOF navigations, our new method can direct full 3-DOF directions (right, left, front, back, up and down). This feature is quite useful for indoor situations, such as navigation in complex department stores or transfer at subway stations.

The final merit is its compact architecture. Since quite small forces are required for pulling the ears, we can use small and lightweight motors. Future miniaturization will be easy and we have already developed a glasses-mounted prototype to date.

System and Experiment

Our interface is composed of two clips attached to the earlobes, six DC motors to pull each ear in three directions, a microprocessor to control the motors and a helmet to mount the motors. The user wears the helmet and attaches it to the earlobes via the clips.

We confirmed experimentally that the users were inevitably tempted to move right /left when their right/left ears were pulled right/left. When both ears were pulled forward/backward, the users were tempted to walk faster/slower. Interestingly, when both ears were pulled up/down, the users were tempted to walk up/down stairs if there were stairs in front of them.

We have already exhibited our first prototype at a workshop and over 100 people experienced our interface. As a result, almost all the people moved in the navigated direction. We also confirmed that they kept feeling the navigating sensation when the ears were continuously pulled. This stability is quite useful for navigation of the user to the destination.

Although there have been many studies on tactile navigation systems, none of the systems are currently in practical use except for some devices for visually handicapped people. With the advantages of the Pull-Navi, we hope that it will become the first successful tactile walking guidance system.

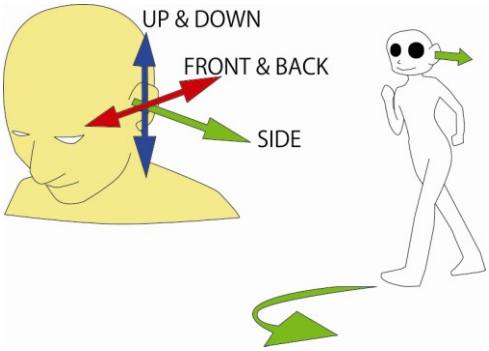

Figure 1. Images of navigation by pulling the ears

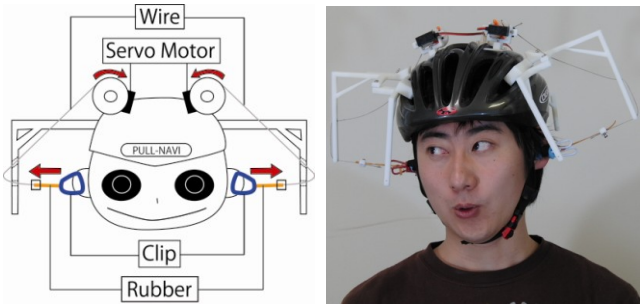

Figure 2. Overview of our system

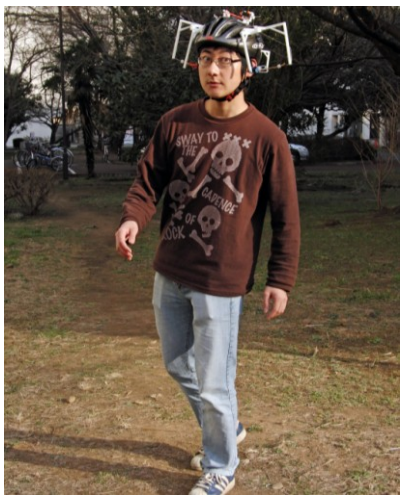

Figure 3. Scene of experience

References

[1] N. Nakamura, Y. Fukui: Development of Human Navigation System "HapticNavi" using GyroCube, XVth Triennial Congress of the International Ergonomics Association 2003, pp.352-355, 2003

[2] T. Amemiya, T. Maeda: Asymmetric Oscillation Distorts the Perceived Heaviness of Handheld Objects, IEEE Transactions on Haptics, Vol. 1, No. 1, pp. 9-18, 2008.

[3] cabboots : http://www.freymartin.de/en/projects/cabboots

[4] T. Maeda, H. Ando, T. Amemiya, M. Inami, N. Nagaya, M. Sugimoto: Shaking The World: Galvanic Vestibular Stimulation As A Novel Sensation Interface, ACM SIGGRAPH 2005 Emerging Technologies, 2005.