Luminous Device for the Deaf and Hard of Hearing People

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Abstract
People with hard of hearing and the deaf often face difficulties to recognize things happening in their surroundings. Imagine you cannot hear the sound, because you are with hard of hearing or using iPod with earphones, you would not able to recognize the car coming behind of you. It may cause a fatal collision. The purpose of this study is to develop the device mostly for the deaf or hard of hearing people, for persons temporarily with hard of hearing besides.

The device can be applied to multi modal accessibility, which transforms the sound information to the visual information. It also provides the direction to the sound source using a light. The device is compact in an attempt to be used in everyday life.

Author Keywords
Accessibility, Assistive Technology, Deaf, Hard Hearing, Alert Device

ACM Classification Keywords
H.1.2 [User/Machine Systems]; H.5.1 [Multimedia Information Systems]; H.5.5 [Sound and Music Computing]; K.4.2 [Social Issues]

General Terms

Documentation, Standardization

Introduction

People with hard of hearing, or hearing impaired, and the deaf often face difficulties to recognize things happening in their circumstances. Fire alarm, for instance, sounding the imminent danger, is not accessible to those people.

American with Disabilities Act (ADA) and Section 508 of The Rehabilitation Act require alert systems visually accessible to those at hotels and motels, like other places of public accommodation[6, 7, 2].

The ratio of senior citizens, age 65 and over, is increasing in the global community. Japan in particular is the fastest country in terms of aging. Its ratio of this age group to the entire population is 25.1% (as of Oct. 1, 2013), which is the highest in the world. The fail of the hearing function by aging makes elderly people difficult to obtain various auditory information.

Disability is caused by not only nature but situation. Imagine you hold bags on your both hands. You are not able to use your hands for other purposes. This difficulty is similar to what a person with paralysis has.

When we focus on the deaf or hard of hearing, listening music in large volume and/or concentrating on a smartphone are/is same as disability. When you cannot hear the sound, you are no longer recognizing a car coming behind.

It has been proposed that the danger prediction method using sound localization[5, 4]. However, no device is yet actually suggested. An alert device and an accident prevention device have been demanded[1, 8]. While the device for visual disorder is already developed as Forehead Sensory Recognition System[3], no device for the deaf and hard of hearing people is found.

In this study, authors propose the alert device for the deaf and hard of hearing people. The device offers both sound localization and alert function.

In addition, considering the property of this device as both an attention awakening device and an everyday device, this device's portability and usability must be considered when determining its shape and size.

Device

The device architecture is elaborated in the following sections.

Device Architecture

The device consists of a sound localization unit using microphone array and an alert unit.(fig1). An alert unit is using not only light by LED but also another component such as vibrator, speaker or another 'human acceptable' component for this propose.

A sound localization unit and an alert unit are separated but these are connected by radio.

Usage

A user puts the alert device and the microphone array on his/her body or belongings. Once something happening with certain sound occurs around a user, the sound localization unit detects the direction which the sound comes from. The result of the detection is notified to the alert unit so that it presents the information using alerting component such as flash light.

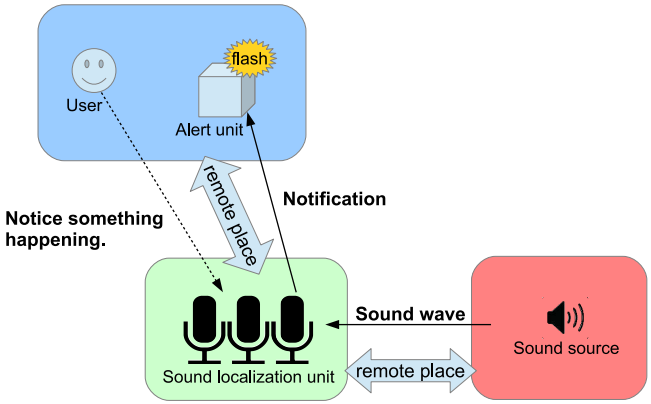

Figure 1: Schematic diagram of device usage.

Prototyping
Prototype device is in fig.2. An alert unit using light by LED and a sound localization unit are connected over smartphone by Bluetooth LE.

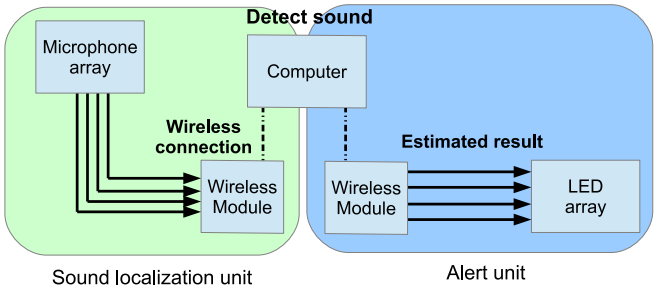

Figure 2: Schematic diagram of prototype device.

Discussion

Separating the sound localization unit and the alert unit gives great advantages to this device.

These advantages make the device possible to be equipped for various use cases. The alert unit attached on glasses, for instance, makes this device as a wearable alert system.

Another way to use this device is to notice the situation in the remote place. For example, when an alert unit is attached to a baby, a person in the next room is able to find something happening around the baby.

Furthermore, the alert unit is attached to a person (User A) and the sound localization unit is attached to another person (User B), User B is able to call User A when User B gets lost.

Separating the localization unit and the alert unit lets us use several components corresponding to various user experience. LED is able to provide the direction using light, vibrators can provide it using haptics and so on.

Conclusion

Authors developed the device, which offers the sound localization and the alert function using light. Separating the sound localization unit and the alert unit creates various use cases and frees users from places. Further studies on this device are in progress. Details will be described, the device and some use cases will be demonstrated at iHAI 2014.

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