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Automatically Providing Tactile Alert Based on Environmental Audio

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ABSTRACT

Users with hearing impairments and those listening to audio content at high volume via headphones are unable to hear information delivered via the auditory channel. This disclosure describes techniques, implemented with user permission, to detect and analyze environmental sounds depending on the user context. If the sounds are determined to include information of relevance to the user, the user is alerted via tactile feedback delivered by an appropriate user device such as a smartwatch. The alert is connected to a notification on the device that includes the relevant auditory information converted to a suitable form, such as text, visuals, etc.

KEYWORDS

- Public announcement
- Environmental sound
- Ambient sound
- Tactile feedback
- Haptics
- Vibration alert
- Hearing impairment
- Speech-To-Text

BACKGROUND

Users with hearing impairments are unable to hear information delivered via the auditory channel, such as general announcements made via speakers in public environments (e.g., airports, public transportation, stores, etc.), safety alarms (e.g., fire, smoke, etc.), ringtones of other people's devices, and so on. In case there are no visual cues related to the auditory content,

such users must rely on alternate mechanisms to get to know relevant information. Such mechanisms can include explicit requests to others for help. The issue also affects users who may be listening to audio content via headphones, e.g., listening to music, participating in a meeting, etc.

Wearable devices, such as smartwatches, fitness bands, etc. have the capability to alert users regarding audio notifications via tactile means, such as vibrations on the skin. While such mechanisms are useful to attract the attention of those who are hearing impaired or otherwise auditorily engaged, currently such devices listen for sounds only to detect a user utterance of a wake word to invoke their assistive capabilities. Therefore, these mechanisms are currently not useful to convey information to users based on various sounds in their environment.

Several applications permit users to provide audio input, such as speech or melodies, in order to perform specific tasks, such as identifying the songs with the audio. However, such applications are restricted to performing a limited set of specific tasks related to the input audio. Moreover, the audio processing and the tasks do not take into account various contextual aspects, such location, activity, etc.

DESCRIPTION

This disclosure describes techniques, implemented with user permission, to detect and analyze environmental sounds depending on the user context. If the sounds are determined to include information of relevance to the user, the user is alerted via tactile feedback delivered by an appropriate user device such as a smartwatch. The alert is connected to a notification on the device that includes the relevant auditory information converted to a suitable form, such as text, visuals, etc. or in the original audio form, e.g., by interrupting the user's current audio stream to provide the alert to the user.

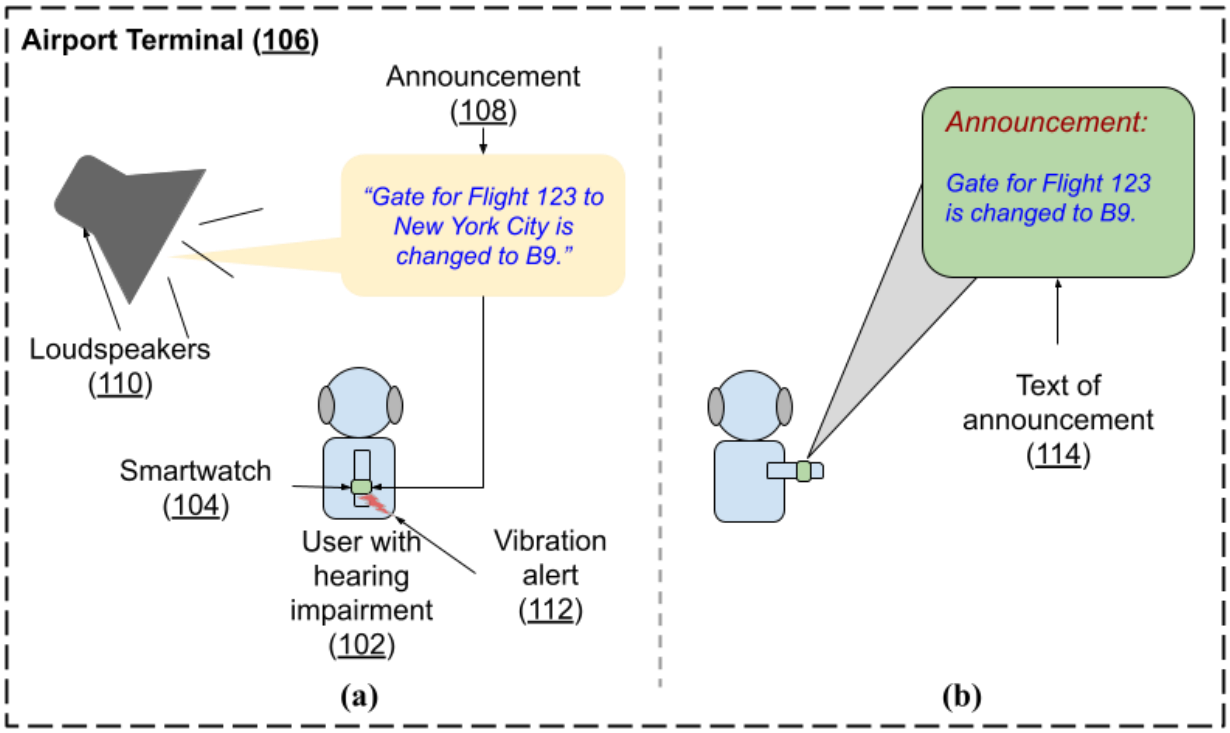

Fig. 1: Alerting a hearing-impaired user to relevant environmental audio content

Fig. 1 shows an example operational implementation of the techniques described in this disclosure. As shown in Fig. 1(a), a user (102) with hearing impairment (wearing headphones with audio playback) is at an airport terminal (106) waiting to board a flight. An announcement (108) is made through the terminal loudspeakers (110) informing passengers of a gate change for a flight. With the user's permission, the user's smartwatch (104) receives and detects the ambient sounds in the environment. When the announcement is detected and is determined to be relevant to the user, e.g., by detecting that the flight matches the user's travel details (accessed with user permission), the user is alerted with a vibration (112) that potentially relevant acoustic information is available. As shown in Fig. 1(b), upon being alerted with a vibration, the user can check the smartwatch display that shows the announcement converted to text format (114).

The techniques described above can be applied as appropriate in any suitable setting. For example, the techniques can be useful to alert those who are listening to music while waiting for

their name to be called at places such as restaurants, coffee shops, banks, stores, etc. In such situations, users can be alerted via a text notification of their name being called without requiring them to turn off or pause the music. Similarly, the techniques can be applied to ensure that those who are hearing impaired do not miss important information delivered in audio format, such as alarms, traffic alerts, etc.

Further, with user permission, user actions subsequent to the alert can also be taken into account to enhance user experience. For example, a vendor may enter a residential neighborhood and signal her arrival via a loudspeaker announcement. With user permission, a user device such as a smart home speaker can detect the arrival of the vendor based on the content of the announcement. The device can further determine that upon previous instances of arrival of the vendor, the user initiated a purchase transaction via a mobile payment application. In this case, the alert can inform the user of the vendor's arrival and initiated a pre-book flow, e.g., to inform the vendor of the user's order directly from the user's residence. By the time the vendor and the user are physically together, the vendor can pre-pack the user's order and have it ready for pickup.

If users permit, the process of obtaining and analyzing environmental sounds can begin at a relevant time as determined by various user-permitted contextual factors, such as the user's location. Alternatively, or in addition, the operation can be adjusted to detect only certain types of sounds (e.g., announcements) in specific situations (e.g., service staff at a restaurant). Specific types of sounds or speakers can be recognized with a suitably trained machine learning model that takes into account sound characteristics, such as frequencies, timbre, volume, etc.

If users permit, audio snippets obtained from various environments during operation can be used as training data for relevant machine learning models. Further, with user permission, the techniques can result in reducing environmental noise levels and improving acoustic design.

The techniques described herein can be implemented in any device, application, or platform that supports audio reception and recognition capabilities and includes tactile feedback mechanisms in addition to a visual user interface. Implementation of the techniques can enable hearing impaired users to be alerted to relevant sounds in their environments, thus enhancing accessibility, safety, and user experience.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user's device, audio at their current location, a user's activities, profession, a user's preferences, or a user's current location), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

Users with hearing impairments and those listening to audio content at high volume via headphones are unable to hear information delivered via the auditory channel. This disclosure

describes techniques, implemented with user permission, to detect and analyze environmental sounds depending on the user context. If the sounds are determined to include information of relevance to the user, the user is alerted via tactile feedback delivered by an appropriate user device such as a smartwatch. The alert is connected to a notification on the device that includes the relevant auditory information converted to a suitable form, such as text, visuals, etc.