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Crowdsourced mapping of ambient noise levels

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ABSTRACT

Speech recognition, transcription, or translation tools work best when ambient noise levels are low. For users of such tools, e.g., hearing-challenged individuals, it is often a chore to find a quiet spot so as to have a clear conversation. This disclosure proposes the use of mobile device microphones as ambient noise sensors with user permission. Ambient noise levels are measured and reported to an online map service along with time and location of measurement. The online map displays the received real-time ambient noise levels. The crowdsourced real-time ambient noise levels are made available to users of the online map service. Besides mobile device-based noise sensing, clearly-marked noise sensors that report ambient noise levels can also be placed in a given region, e.g., city. Sensors other than sound can also be used, for example, a closed-circuit television (CCTV) camera can provide reports of real-time traffic levels, which are an indicator of current noise level in an area.

KEYWORDS

- ambient noise
- speech captioning
- speech transcription
- speech recognition
- crowdsourced mapping
- accessibility

BACKGROUND

Speech recognition or transcription is most accurate in quiet environments. Many users of speech recognition or transcription tools are hearing-challenged users, non-native speakers, etc.

For hearing-challenged users in particular, the performance of hearing aids and/or cochlear implants suffers under even a moderate level of ambient noise. For automatic speech recognition to serve as a communication tool, such users often seek quiet spaces while conducting conversations. Currently, a user of a speech recognition/captioning tool cannot easily determine nearby spaces that have low ambient noise. Users are not usually able to control the noise level in their environment; however, if a user can determine ambient noise levels in the surrounding area in advance of conversations, the user can conduct the conversation in places deemed quiet and likely better suited for speech recognition or captioning.

DESCRIPTION

Online maps have a number of layers, e.g., satellite view, terrain, traffic, business reviews, etc. More recently, online maps have started capturing dimensions that assist differently-abled users, e.g., wheelchair-accessible buildings, etc. In a similar manner, this disclosure proposes an online map of ambient noise levels.

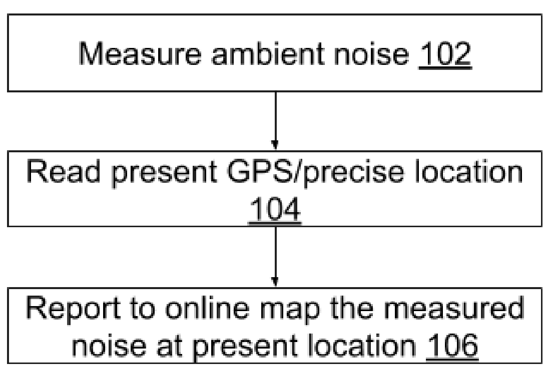

Fig. 1: Reporting ambient noise to an online map service

Fig. 1 illustrates an example process for reporting of ambient noise to an online map service in a crowdsourced manner. Contributors to the crowdsourced map are provided with options to start, stop, or limit their contributions. Further, data from on-board device sensors such as location sensors, audio sensors, etc. is utilized only upon specific permissions that are user-revocable. Data from the sensors is provided specifically for generation of the crowdsourced map and may be processed prior to such provision.

Upon user permission, when the microphone of a mobile device is not in active use, it is repurposed as an ambient noise sensor. The ambient noise level is measured (102) and the user's present location coordinates are obtained, e.g., via GPS or another sensor (104), as permitted by the user. The measured ambient noise level, and the time and location of the noise level reading is reported to an online map service.

In addition, or alternatively to crowdsourcing ambient noise levels, dedicated noise sensors can also be placed throughout a region, e.g., city. Such sensors report real-time ambient noise levels. Such noise sensors are marked with clear signage.

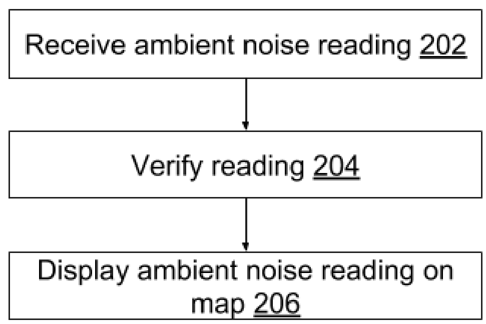

Fig. 2: Receiving and displaying ambient noise levels on an online map service

Fig. 2 illustrates an example process for receiving and displaying ambient noise levels by an online map service. An ambient noise level reading at different locations at different times is received (202) by the online map service. The reading is verified (204). Verification can involve, e.g., receipt and confirmation of the reading by other nearby independent noise sensors. It may also involve cross-verification from other, non-acoustic sensors, e.g., traffic cameras. For example, if a camera reports a high level of vehicular traffic at the time a nearby noise sensor reported a high level of ambient noise, the confidence in the noise sensor report is high. If the confidence on the reported noise level is high, it is displayed on the map (206) at the location of the reading. A low-confidence or older reading is provided and may be marked as such, for example in fading color.

Ambient noise in many locations often varies with the time of the day. A particular location can be noisy on one occasion, and quiet on another. The online map that captures ambient noise levels thus provides a dynamic, time-varying display, with displayed noise levels being the most recent. Certain locations are more likely noisy at most times, e.g., train stations, downtown cafes, etc. Other locations are quiet at most times, e.g., libraries. Therefore, a reader of the map is provided with options to see real-time as well as time-averaged noise levels at different locations.

Ambient noise is associated with identifiable characteristics of the physical world. For example, a location with many people present is more likely to be noisy than a location with fewer people. A location that is near a street with heavy traffic is likely to be noisier than one that is not. These phenomena can be detected using non-sound sensors, e.g., cameras, automatic visual detectors, motion sensors, etc. Readings from such non-sound sensors are also reported to the online map service and enable the service to provide dynamic updates of ambient noise for a particular location.

In this manner, the techniques of this disclosure make online map services more useful for accessibility needs. If users cannot determine a priori whether a particular location is quiet enough for successful speech recognition accuracy, the user can use noise-suppressing technologies, or can depend on human transcribers/captioners to convert audio to text. Human transcribers are less than ideal for a number of reasons - there is considerable cost associated with reserving professional captioners for conversations. In any case, professional human captioners are also disadvantaged by noisy environments. The human captioner has the advantage, however, of being able to advise the participants to speak closer to the microphone, or to speak more clearly, or to move to another location. He/she can also provide feedback as to whether one environment is quieter than another.

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 social network, social actions or 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

This disclosure proposes the use of mobile device microphones as ambient noise sensors with user permission. Ambient noise levels are measured and reported to an online map service along with time and location of measurement. The online map displays the received real-time ambient noise levels. The crowdsourced real-time ambient noise levels are made available to users of the online map service. Besides mobile device-based noise sensing, clearly-marked noise sensors that report ambient noise levels can also be placed in a given region, e.g., city. Sensors other than sound can also be used, for example, a closed-circuit television (CCTV) camera can provide reports of real-time traffic levels, which are an indicator of current noise level in an area.