Title
Environmental Sensing Technologies for Visual Impairment - Introduction to the Special Thematic Session

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Introduction to the Special Thematic Session

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Peoples ability to move around, interact with objects, space and people, and engage in purposeful activities hinges in large part on their visual sense. Tasks such as orienting oneself in a hallway, finding an item at the market, or recognizing a friend from a distance may become difficult or impossible for those who cannot see, or cannot see well. Simple assistive devices may play an important role in supporting activities of daily living for people with visual impairment. For example, people who are blind use simple tools such as a long cane or a dog guide to move safely along a desired path, or a screen reader to access a computer. Persons with low vision often rely on magnifying glasses, telescopes, and screen enlargers to access textual information.

In recent years, the widespread diffusion of smartphones, equipped with accessible interfaces, has spurred a number of innovative technical solutions to some of the problems faced by visually impaired persons. Some of the most successful applications rely on remote sighted helpers for visual interpretation. For example, TapTapSee allows a blind user to take a picture and receive a textual description of the scene content, such as the main visible objects. BeMyEyes uses a FaceTime-like audio/video connection to enable blind users to share the video stream taken with their iPhone or iPadwith a remote sighted volunteer, who can answer specific queries, describe what is visible in the video, and also advise the blind user about where to move the camera for a better view. Other models are currently being explored; for example, Aira provides a remote visual interpretation service by professional helpers, who are specifically trained to support blind users in tasks such as navigation, information access, and even people recognition.

These types of crowdsourcing mechanisms have been quite successful for specific tasks. However, crowdsourcing may not be the solution for all types of visual interpretation tasks. For once, video communication requires a good data connection, which is not always available, and can quickly drain the battery of a smartphone. In addition, the time to establish a connection or to receive an answer to a query may be substantial, discouraging frequent use of this technology. Automatic visual analysis by means of computer vision algorithms (executed on the smartphone itself, or on a remote cloud server) is an attractive alternative. Many blind people, for example, use currency reader smartphone apps such as LookTel. Optical character recognition (OCR), a mature technology originally developed for scanned documents, has found its way in mobile apps such as the KNFB Reader or in complete wearable systems such as OrCam. Modern OCR systems can read documents of different types with high accuracy, provided that the blind user can take a good picture (well framed and with enough resolution) of the document. In fact, using a camera without visual feedback can be quite challenging; non-visual interface mechanisms (e.g. audio) are being developed to assist blind users in this process, for example by directing the user to move the camera in a certain direction to get a better view of the document.

There are other powerful environment sensing mechanisms that harness non-visual information. Accessible navigation apps using GPS (e.g., Blindsquare) allow blind pedestrians to localize themselves, follow a route, and discover nearby points of interest. Self-localization can be enhanced by inertial sensors (contained in any modern smartphone or wearable device), which can be used to count steps and determine the users orientation. Another very promising direction is the use of an infrastructure of networked sensors (the Internet of Things). Deployed in the urban environment, these systems can enable a level of awareness that would be difficult to achieve solely with the sensors of a smartphone or other wearable device. For example, Wi-Fi access points placed inside bus vehicles or at bus stations may allow a blind person to access travel-related information, such as understanding which bus just arrived at the stop, or, during a trip, which stop to exit at. iBeacon (Low-Energy Bluetooth) technology is a low-cost approach to indoor localization, which has been deployed (among other places) at the San Francisco international airport. Passive RFID tags may also be employed for short-distance localization, provided that the user carries an RFID reader (e.g., embedded in their long cane).

This Special Thematic Session presents new advances on Environmental Sensing Technologies for Visual Impairment. It includes applications such as scene text detection and OCR with wearable devices; assisted public transportation using Bluetooth Low Energy or Wi-Fi beacons; smartphone apps for outdoorlocalization; 3-D scene analysis using depth sensors; and augmentation of GIS systems with pedestrian crossing from aerial images. The session builds on a past series of workshops[1] chaired by Coughlan and Manduchi focusing on research into the applications of Environmental Sensing Technologies and computer vision for visual impairment. Like the workshop series that preceded it, this Special Thematic Session is intended to create a forum to forge interdisciplinary links among practitioners in the fields directly related to Environmental Sensing Technologies, including computer vision, wearable sensors, ubiquitous computing, crowdsourcing, man-machine interfaces, and human factors.

[1] http://www.ski.org/project/workshop-series-computer-vision-and-sensor-enabled-assistive-technology-visual-impairment