Smartphone-Based System Improves Safety and Mobility for Visually Impaired Pedestrians

Crossing a street isn’t risk free for any pedestrian, but it’s especially challenging for those who are blind or visually impaired. To help these pedestrians safely cross signalized intersections, researchers at the University of Minnesota have developed a smartphone-based system that uses GPS, Bluetooth, and other technologies.

Pedestrians who are blind or visually impaired face a number of unique challenges, such as difficulty locating the edge of the street or crosswalk and interpreting signal and traffic patterns. These issues can be especially daunting when traveling in unfamiliar locations or through work zones.

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As part of their work, the researchers interviewed several blind and low-vision people to better understand what types of information they use at intersection crossings and what additional information would be most helpful to them. To maximize the system’s effectiveness, the researchers wanted to be sure that it would build on—but not replace—the orientation and mobility skills that these pedestrians have already learned. “Engineers can design great, fancy stuff, but if nobody wants to use it, it’s not useful at all,” Liao says.

The smartphone-based system goes above and beyond existing crosswalk aids by placing the assistive technology directly in the hand of the user. Unlike traditional systems—which require visually impaired pedestrians to deviate from their preferred path in search of push-button signals—the smartphone-based system provides relevant audio information at the tap of a touchscreen.

When using the system, a visually impaired pedestrian can point a smartphone in the direction he or she wants to cross when standing at an intersection. By tapping the smartphone’s touchscreen once, the user can call up information about the intersection geometry and the signal phase. Tapping twice confirms the desired crossing direction and sends a request for a crossing signal to the traffic signal controller. Throughout the process, the user gets audio messages from a text-to-speech interface.

To expand the system for use in work zones, the research team incorporated Bluetooth beacons that communicate with the GPS receiver on a user’s smartphone. These beacons can be temporarily attached to signs, posts, or construction barriers in a work zone. When a user’s smartphone detects a beacon, the phone vibrates and provides a corresponding audio message.

The audio message includes the pedestrian’s current location information, the location of the work zone, and suggested routing instructions. The user can tap the smartphone to repeat the message, if needed.

The researchers integrated the work-zone component with the intersection crossing information provided by the previously developed smartphone app. If a Bluetooth

http://utc.dot.gov/
beacon contains both work-zone and intersection information, the app provides the work-zone message followed by the intersection information, based on the direction the smartphone is pointing.

Moving forward, the researchers would like to work with MnDOT and local cities to access real-time traffic signal information and work-zone construction information on a larger scale. Prior to the release of the app, additional human-subject testing will also be conducted.

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In addition, the research team has received funding from the Roadway Safety Institute, the current Region 5 UTC, to expand the project by creating a “condition aware” infrastructure that can be integrated with the smartphone app. The goal is a system that can self-monitor and keep the information it broadcasts to app users as up-to-date as possible.

“...audio information is provided to app users at the right location,” Liao says. “It could be used anywhere—at traffic intersections, skyways, or underground tunnels—to provide directions for travelers.”

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