Mobile Accessible Pedestrian Signals (MAPS) for the Visually Impaired

Brief Summary

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Among individuals aged 15 years and older, approximately 7.8 million people (3.4 percent) have difficulty seeing words or letters in ordinary newspaper print, and 1.8 million of these reported being completely unable to see (U.S. Census, 2008). People who are blind or individuals with vision impairment rely on walking or taking public transit as their primary modes of transportation. Due to differences in spatial perception as compared to sighted people, they often encounter physical barriers that limit their transportation accessibility and mobility.

After receiving orientation and mobility (O&M) training from O&M specialists, people with vision impairment usually can travel independently to known places along familiar routes by relying on a white cane or a guide dog. However, neither a white cane nor a guide dog provides spatial awareness (such as signalized intersection information/street names, bus stops/stations) along a path or guidance information to a destination.

In addition to a cane and guide dog, many aids based on various types of technologies have been developed in the past, and several of these are commercially available to support both indoor and outdoor wayfinding and navigation for people who are blind or visually impaired. Most have significant limitations; to our knowledge, there is currently no single technology that can offer a complete solution for both indoor and outdoor navigation and guidance for the visually impaired.

Over the past two years, we have been developing a Mobile Accessible Pedestrian Signal (MAPS) prototype to provide signal timing and geometry information to people with vision impairment at signalized intersections. Individuals with vision impairment generally have difficulty crossing intersections due to a lack of information available to them about traffic, signal timing, and intersection geometry. Among intersection crossing sub-tasks, locating the crosswalk, determining when to cross, and maintaining alignment with the crosswalk while crossing are typically the most difficult tasks for the visually impaired to execute.

As part of our ongoing effort to develop MAPS for people who are blind or visually impaired, we interviewed ten people who are blind or have low-vision to better understand what types of information they use at intersection crossings and to identify other information types that could assist them. Using these survey results, we developed a MAPS prototype that provides walk phase signal timing and intersection geometry information to smartphone users at signalized intersections. The MAPS prototype consists of a smartphone, a spatial database, wireless communication technologies, and a controller interface device that can be installed in a traffic controller cabinet to obtain signal phasing and timing information. User interaction is via simple tactile input (single or double-tap) and text-to-speech technology.

While standing at a corner of an intersection, for example, the blind user can point the smartphone in a desired direction and tap on the phone once to obtain intersection information through Text-To-Speech.
(TTS) technology. The Smartphone application then responds with an auditory message such as “Heading North to Washington Avenue, 4 lanes” as shown in Figure 1. After determining in which direction to cross, the blind user can point the phone toward the desired direction and double tap on the Smartphone screen to confirm direction of crossing. A request to get a walk signal (“pedestrian call”) is sent to the traffic signal controller through a Wi-Fi or cellular network after confirmation is made by the user. The MAPS system then requests current signal timing from the signal controller and informs the user with an auditory message such as “Wait for signal” or “Walk phase is on, 20 seconds to cross” as illustrated in Figure 2.

![Figure 1: Single Tap for Geometry Info.](image1)

![Figure 2: Double Tap for Signal Timing Info.](image2)

We currently are working on a field experiment in which 10-20 people with vision impairment will be recruited to perform crossing tasks with and without the use of the MAPS system. Objective and subjective measures are being developed to evaluate the acceptance and usability of the MAPS application by the participants.

The MAPS system can potentially take advantage of the data communication environment with DSRC to provide timely decision support and intersection information to people with vision impairment. MAPS can take advantage of the low-latency capability of DSRC to coordinate cooperative communication among pedestrians (waiting at the crossing), traffic signal controllers, and approaching vehicles, thereby providing dynamic decision-making support to all travelers, not just the visually impaired. It will not only expand the accessibility and mobility of the blind and of the elderly but will also reduce the risk of accidents at intersection crossings.