Chapter XXXV
CRISS:
A Collaborative Route Information Sharing System for Visually Impaired Travelers

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ABSTRACT

Limited sensory information about a new environment often requires people with a visual impairment to rely on sighted guides for showing or describing routes around the environment. However, route descriptions provided by other blind independent navigators, (e.g., over a cell phone), can also be used to guide a traveler along a previously unknown route. A visually impaired guide can often describe a route as well or better than a sighted person since the guide is familiar with the issues of blind navigation. This chapter introduces a Collaborative Route Information Sharing System (CRISS). CRISS is a collaborative online environment where visually impaired and sighted people will be able to share and manage route descriptions for indoor and outdoor environments. It then describes the system’s Route Analysis Engine module which takes advantage of information extraction techniques to find landmarks in natural language route descriptions written by independent blind navigators.

1. INTRODUCTION

For a person who has a visual impairment, having the ability to be mobile without the aid of another person is a sign of personal independence. It is important enough that a lack of mobile independence can affect an individual’s mental health. Someone just beginning to adjust to a new visual impairment may find a decrease in the ability to travel independently, which can lead to depression (Blasch, Wiener, & Welsh, 1992). The ability to travel independently is also a quality of life issue. A 1991 survey in Britain of almost six hundred adults with visual impairments found
that only 51% of those surveyed under the age of 60 had left their house alone and on foot in the week prior to the interview (Bruce, Mckennell, & Walker, 1991).

In order to address the need for indoor and outdoor navigation assistance in unfamiliar environments, both commercial and research systems have been developed using various technologies such as GPS (Ran, Helal, & Moore 2004; Sendero, 2008), Wi-Fi-based localization (LaMarca, et al, 2005), and infrared beacons (Crandall, Bentzen, Myers, & Brabyn, 2001). Unfortunately, the adoption rate for these devices in the blind community remains low. There are multiple reasons for this lack of adoption. First, the commercial devices tend to be expensive. For example, the software and GPS-based guidance system Sendero GPS (Sendero, 2008), intended to be used by an individual, costs $1,495, a price which does not include the mobile computer on which to run the software. Other navigation systems do not achieve localization accuracies which would be useful for a blind person in many situations. Place Lab (LaMarca, et al, 2005), for example, achieves a median location error of 15 to 20 meters. Other systems (Crandall, Bentzen, Myers, & Brabyn, 2001; Talking Lights, 2008; Priyantha, Chakraborty, & Balakrishnan, 2000) require a device or sensor to be installed in the environment. The problems are that each device must often have a power source, or the systems must be calibrated and maintained. These systems do not scale to large-scale environments, such as college campuses, where navigational assistance would be needed over a large area. A final issue is that most systems only address either indoor or outdoor navigation, but not both. A navigational assistance device should ideally address both environments.

Almost all navigation devices take the “trust me - you are here” approach. In general, they take a reading from their sensor set, compute a location on a map, and, based on the user’s destination, instruct the user where to move next. Unfortunately, due to noise in the environment, signals can be noisy or missing resulting in incorrect location computation. Garmin (2008), for example, reports that its GPS units are accurate to within 15 meters. This amount of error may be acceptable for a sighted person who can make a visual distinction between where the device says he is standing and where he is actually standing. For a person who is visually impaired, especially those who have complete vision loss, an error of this amount reduces the usefulness of the device. If a person who is visually impaired is continually given an inaccurate location, they may at best simply stop using the navigation device or at worst become disoriented and lost.

One sensor that previous systems have not taken into account is the navigator himself. Many people who have a visual impairment receive extensive orientation and mobility (O&M) training. During training, individuals learn valuable skills which enable them to safely and successfully navigate many environments independently, both indoors and outdoors (Blasch, Wiener, & Welsh, 1997). They learn, for example, to perform actions such as following sidewalks, detecting obstacles and landmarks, and crossing streets. They also learn techniques for remaining oriented as they move around inside buildings or outside on sidewalks and streets. Experienced travelers can even handle some unfamiliar environments when given sufficient verbal assistance. There is some research evidence (Gaunet & Briffault, 2005; Kulyukin, Nicholson, Ross, Marston, & Gaunet, 2008) that people with visual impairments share route descriptions and can verbally guide each other over cell phones. In these situations, only verbal route descriptions are used to guide the traveler from one location to another location; the only technology used is the cell phone which simply maintains an audio connection between the two individuals.

Inspired by the possibility of the navigator being an active part of the navigation system, we developed ShopTalk, a wearable device for helping