SEAMLESS OUTDOOR/INDOOR NAVIGATION FOR BLIND AND VISUALLY IMPAIRED INDIVIDUALS

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Abstract: Sendero Group, pioneer of accessible Global Positioning Systems (GPS) for outdoor navigation, explores the indoor navigation frontier.

The Global Positioning System (GPS) and related indoor navigation technologies, combined with ever-growing location databases, present the opportunity for those who cannot see signs to have an audible representation of the environment. Hear about and see demonstrations of the BrailleNote GPS and state-of-the-art wayfinding technologies like GPS cell phones and indoor navigation.

Outdoor Navigation Background

Over the past few years, the GPS commercial market has exploded. People are using GPS in rental cars, on hiking trips, and in many other recreational activities. Mapping companies have built massive databases with street names, addresses, business names, points of interest, restaurants, underwater wrecks, and the list goes on. Anything, which is stationary, is likely to be electronically labeled.

With this boom in electronic data, blind people no longer need be limited to the 1% location information to be glean from sighted people. The maps and points of interest are no longer just a drawing on an inaccessible print map. They are loaded on compact flash cards within portable Braille and speech devices.

Accessible GPS for blind and visually impaired people has been developed based upon this data and the latest GPS hardware. By combining the BrailleNote PDA with the latest GPS Technology one has the ultimate tool for expanding and exploring the environment while being able to switch at any time to the other BrailleNote applications like the Internet, Email, Word Processor, MP3 player, Address Book, Planner and more. Two other accessible GPS systems have emerged, Trekker and StreetTalk for the Pac Mate. The blind traveler can now be a co-pilot in a car, not just a passive passenger. He or she can keep the taxi driver honest and can enjoy hearing about the sites and businesses being passed while in a car, bus, or even on foot. There is nothing more empowering for a blind person than getting around effectively and location information makes this possible.

GPS Accuracy

GPS receivers have on average 30 foot accuracy. So, instead of picturing GPS position as a pinpoint, picture it as a bubble of radius 30 feet around your position. If the GPS receiver is Wide Area Augmentation System (WAAS) enabled, meaning that there are complimentary satellites and ground stations to correct for some of the standard GPS error, the user can receive as good as 10 foot accuracy.

Tall buildings or cliffs can obstruct GPS satellites, potentially degrading accuracy. The latest receivers are sensitive enough to even pick up satellites inside buildings but the accuracy and direction of travel are further degraded.

The limitations of GPS could translate into a situation where an individual has arrived at the building for a job interview on time but spends 30 minutes trying to navigate the hallways to find an office. Clearly, independent indoor navigation is as important as accessible outdoor navigation.

Indoor Navigation Developments

For the last four years, Sendero Group has been working with a Swiss company, Vectronix, which makes high end compasses for military equipment. They have designed a navigation module with various motion sensors that allow a person's movement to be tracked when wearing this device independent of GPS or other sensors. They have incorporated GPS into this module and we have connected it to the BrailleNote. We refer to this as the Personal Navigation Module, PNM.

This type of technology is generically called dead reckoning. One of the challenges with dead reckoning is that an error accumulates over a distance, unlike GPS which has a fixed error. So, the PNM will accumulate about 15% error, not so bad after 100 feet but pretty bad, 150 feet error after walking a thousand feet.

There are various ways to reduce this error by coupling the PNM with other sensors and Vectronix is trying to reduce the error as well in the core module. For one, the GPS can correct the error as soon as you go outside. We put a command on the BrailleNote that allows the user to correct the error manually when you are in a known place like the entrance to a shop. If the PNM says you are 30 feet away from the shop and you are in the doorway, you just press the Control 0 to zero out the error. This means the next doorway is more likely to be where you expect it.

Another option is to correct the error automatically using position sensors in the environment like RFID tags, Talking Signs or even WiFi points. There is a technology called Talking Lights whereby a florescent light has its ballast changed so the light has a unique position ID. Sendero has teamed up with Talking Lights to test how this combination of BrailleNote GPS, the PNM and Talking Lights will work for indoor/outdoor navigation. A very early stage test was conducted at Benetech in July. It worked reasonably well most of the time and it showed us what needed improvement.

With the introduction of seamless indoor/outdoor navigation, it is possible to achieve an environment which is totally accessible. One would be able to plan a street route to get to a destination. Once at the destination, one would be able to walk down a hallway inside a building and hear the elevator announced, or the heading and distance to the rest rooms.

Sendero Group is collaborating on indoor and outdoor wayfinding with 5 organizations under a 5-year NIDRR grant as well as working with mainstream navigation companies. A prototype of the indoor component is expected to be demonstrated at CSUN 2006 where the first 10-pound accessible GPS system was shown by Sendero in March 2000. The smallest accessible BrailleNote GPS, 1-pound, will be demonstrated as well as accessible GPS on a cell phone. The actual process of getting somewhere can now be fun and not a chore. We like the adage that, “It is better to travel hopefully than to arrive.”