

Smart Building
Project:
System
Specifications

October 6

2008

This document outlines the demands and needs of the SMP as they are understood by the customer. This is not a technical specification document, but a “problem space” view of the project, and the minimum demands of what the customer expects.

*S.M.P. Phase 1:
System Specs*

Steven Salerno
Ian Small
Hochan Son
Aravindraj Sriram
Justin Strawther

Contents

Introductory Problem Statement.....	3
Analysis of current and previous solutions	3
Current Solutions	3
Electronic Travel Aids (ETAs) and Electronic Orientation Aids (EOAs).....	4
Drishti: an integrated indoor/outdoor blind navigation system and service.....	4
Sources:	5
Functional Requirements.....	5
Objectives and Goals	6
User Profile	7
Deployment Environment	7
Constraints	7
Deliverables	8
Future Plans/ Expandability	8

Introductory Problem Statement

Consider the unique conditions experienced by the blind when entering a foreign environment for the first time. The visually impaired person does not have the advantage of sight necessary to obtain a sense of building layout, detect obstacles, and navigate toward points of interest. This would be the equivalent of a sighted person walking into a dark room and attempting to accomplish the same tasks.

The objective of our efforts will be to produce or improve upon an existing system that provides indoor navigation for the visually impaired. This system should have the ability to guide the visually impaired person throughout the “Smart Building”, avoiding obstacles and guiding them to their chosen destination safely. Additionally, the system should be scalable and portable, so that installation in any building is possible.

Analysis of current and previous solutions

Current Solutions

As modern technology continues to transform more and more aspects of daily life, great advances continue to be made in the development of assistive technology for the blind and visually impaired. Greater emphasis is being placed on the creation of technologies that are accessible to those with visual impairment and other disabilities. Print media is being digitized, and software is filled with accessibility features. Orientation and mobility are two areas where assistive technology remains somewhat lacking, however, and there is room for improvement in these fields.

The problem of developing assistive orientation and mobility technologies has, surprisingly, only been taken seriously within the past century or so. Orientation and mobility training, as a profession, had its origins as recently as World War II, and since that time, progress has been made in the development of better mobility training practices, such as the training of guide dogs and the employment of specialized mobility trainers at places like college campuses (Kelley).

Little ground has been covered, however, in the advancement of navigation and orientation technologies for the visually impaired. Several assistive orientation devices have been developed with good intentions, but the level practicality and effectiveness of these devices is still not where it needs to be. There has been a wealth of development effort put into technologies that can provide location and navigation assistance, but relatively little progress has been made toward providing an accessible interface to these technologies for the visually impaired. The following are some current solutions to the orientation and navigation problem.

Electronic Travel Aids (ETAs) and Electronic Orientation Aids (EOAs)

ETAs are devices that operate by emitting energy waves in order to detect objects and provide feedback to the user. The devices range from laser-equipped canes to sonar emitting spectacles to path-finding wheelchairs.

As opposed to ETAs, which are meant to provide information about the user's immediate surroundings, EOAs provide orientation and navigational assistance. These systems are typically incorporated into stationary objects, and provide points of reference, and other key information such as auditory cues, to the user. A common example of an EOA is an auditory crosswalk signal, which beeps to alert the visually impaired when it is safe to cross the street.

The two types of devices can be combined to provide a theoretically useful service to the visually impaired. The crux of the problem seems to lie in the development of a simple, effective interface for the user. While ETAs and EOAs can be helpful, these devices are often too cumbersome, difficult to use (or find), or are not economical solutions. The user is often required to carry or wear heavy or even dangerous equipment that can get in the way of performing common tasks, thereby defeating much of the purpose of a mobility aide (Blasch, Wiener, and Welsh).

Drishti: an integrated indoor/outdoor blind navigation system and service

Developed in 2004 in the Computer & Information Science & Engineering Department at the University of Florida, Drishti is a wearable computer system aimed at being an indoor/outdoor navigation aide. While similar systems have been devised to solve these problems individually, Drishti was designed to be a single solution that would help its users to navigate in familiar and unfamiliar environments independently and safely. In addition to the computer, the system consists of a GPS receiver, a number of ultrasound positioning devices (referred to as "pilots"), and a GIS database full of maps, sent over a wireless network. The system aims to provide adequate contextual information about the surrounding environment through the use of an interactive voice recognition and response setup.

While the device has potential, it also possesses several drawbacks, perhaps the most significant of which being that it remains in the prototype stage and hasn't yet undergone real world testing. The developers cite two main limitations with the system. First, the algorithm used to determine the user's location is inaccurate, and needs improvement. Second, the number of "pilot" sensors used in the prototype was insufficient to provide adequate data reads, resulting in "dead zones". These do not seem like insurmountable obstacles, nor do they seem to disqualify the device from receiving attention for future development. But when coupled with cumbersome equipment that must be worn by the user,

and it is a system that still needs considerable improvement before it can be put to real world use (Ran, Helal, and Moore).

Sources:

BLASCH, BRUCE B., WILLIAM R. WIENER, AND RICHARD L. WELSH. FOUNDATIONS OF ORIENTATION AND MOBILITY. NEW YORK: AMERICAN FOUNDATION FOR THE BLIND P, 1997.

KELLEY, PAT. ED. D. TEXAS TECH UNIVERSITY, 1999. HISTORICAL DEVELOPMENT OF ORIENTATION AND MOBILITY AS A PROFESSION: AN OVERVIEW OF THE DEVELOPMENT OF EDUCATION, SPECIAL EDUCATION AND THE EDUCATION OF INDIVIDUALS WITH VISUAL IMPAIRMENTS. HISTORY OF O&M.

RAN, LISA, SUMI HELAL, AND STEVE MOORE. THE SECOND IEEE ANNUAL CONFERENCE ON PERVASIVE COMPUTING AND COMMUNICATIONS, 2004. DRISHTI: AN INTEGRATED INDOOR/OUTDOOR BLIND NAVIGATION SYSTEM AND SERVICE. IEEE COMPUTER SOCIETY.

Functional Requirements

The Smart Building device is engineered specifically to help all visually impaired people. In this regard we are already restricted to the methods as to how information is presented to the user. Because of this handicap the interface between the user and device is extremely important. The entire interface must rely explicitly on audio cues and voice recognition to convey information and commands. The interface must also be simple to use and be rid of and excessive complexity in order to make it easy to use.

The device should be cheap for the user, allowing all that would benefit from this device to obtain one. It should be small, portable, durable and discrete. Everyday life should carry on normally with the device making navigation through buildings easier for the visually impaired. There is also a need for the device to have a relatively long battery life. The device should also not be in any manner harmful to the user.

The software within the hand held device should be relatively easy to pick up and use and should not take any or little training in order to learn how to use it. The ideal case would be to have a

visually impaired person obtain the device, turn it on, pick a location and the navigation starts. Path selection should be handled by the software but there should be cases for user selection of the path, as well as specialized paths for emergencies. The end destination that the person is being navigated towards should be able to be updated at any time. While en route to the users destination choice key points of interest can/should be pointed out. There should also be the possibility of making the points of interest user specific. Navigation routes should avoid all obstacles unless they are completely necessary to pass through, in which case the person should be notified as to what the obstacle is and how to pass by it.

The device and software should have the ability to work with any building that has the Smart Building system installed in. When entering a building with the system the map for that building should automatically be downloaded into the device. The device should also have the functionality of allowing the user to select how the audio cues and directions are conveyed. These cues and directions must also be highly descriptive of the environment as to help create a layout of what surrounds the user. The device should also have the possibility of having an emergency location device button in the case of an urgent situation.

The system itself should be relatively cheap for building owners. There should be no discrimination between public or private buildings. The entire system should be easy to install and should not require extensive time to do. The points of interest should be easy to program and update by the building owner or consultant. The points of interest and other components should be discrete and should not interfere with other building systems. The cost of the system after setup should also be low, i.e. low maintenance cost, low power cost, etc. The mapping of the building should be done by the installation company and uploaded into the database of building maps when completed. The entire system should be updatable at any desired moment and should be scalable to fit any building.

Objectives and Goals

- Navigation goals
 - Lead the visually impaired by audio cues.
 - Reliable tracking of the users' position and direction.
 - Must work indoors.
 - Must accept vocal instructions.
 - Point of interest system
- Physical system goals:
 - Make the system unobtrusive and not socially awkward.
 - Light weight, portable and unobtrusive user side system.
 - Simple to install.
- Information System Goals
 - Downloadable maps.
 - Creation of maps should be relatively simple and fast.
 - Editing of maps and POIs should be possible by building owner/staff with little to no training.

User Profile

The user is a visually impaired person seeking guidance to goals and buildings. Their impairment could range from total to partial blindness. This system should also be functional for a person with no such handicap. The user should have an average range of all other senses, most notably hearing. The user may not have been born with their specific form of blindness, and thus may not be accustomed to navigating with no visual guidance and hence may feel unsafe navigating around objects. Users will want to enjoy the same mobility that they do around familiar places, in places they have had little to no familiarity with.

The user will not wish to feel “marked” by the system, as they may feel self-conscious of their disability. They will want a system that does not appear to be out of the ordinary to the casual observer.

Deployment Environment

The system is planned to initially be installed in major academic environments, such as schools for the blind and college universities. From there, other nearby businesses will equip their building with the system to facilitate the local customers’ needs and increase income. The system will need to work indoors, and dynamically load the local environment into the handheld system that the user may purchase OR have provided to them by the original customer.

Constraints

a. Budget

- Each user device should have a financial cost of no more than 1500 dollars.
- Total system financial cost shall not exceed \$50,000 for a 10,000 sq. ft. 3 floor building. (dollar amount is the estimate of financial gain produced by the system over its use, and this amount should be adjusted if that estimate changes).
- All costs of installation, training and maintenance for the system should not exceed the costs of not having the system. (Benefits should not outweigh the costs)
- In effect, the system has to justify the cost of development and deployment against the services that are rendered by it.

b. Schedule

- The system should be deployable in a reasonable time based on the building size. (The system will not be outdated before the system has been enough of a benefit to outweigh its cost).

c. Technical

- The System should not violate any FCC regulations and also be non-intrusive to the environment of deployment.
- The system should have security mechanisms in place to prevent unauthorized access to the system.

- The size of the user system should not be impractical for daily use.
- The system should require minimal daily maintenance.

Deliverables

- User Manual
- Online Help
- Tutorials
- Troubleshooting Guide
- Installation/Configuration Guide
- Maintenance Guide
- Smart Building Software
- Supporting Software
- Disability Device
- Supporting Devices

Future Plans/ Expandability

- ✚ The system should be easily expandable, by uploading new maps to a central server for dynamic download onto the user system upon entering any equipped building.
- ✚ The modular POI system should allow for easy addition of new information in a building.
- ✚ A simple editing environment should allow the customer to change building information at any time.