



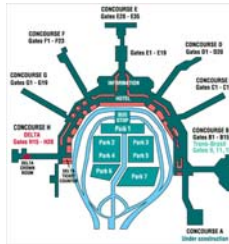
# BlindAid: An Electronic Travel Aid for the Blind

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## Motivation

- 1.8 million are unable to see [US census]
- Travel can be difficult for the blind: 90% of blind people cannot travel independently
- Indoor navigation rarely addressed and often more confusing than outdoors
- Signs and maps for sighted are unavailable to the blind
- Impossible to tell one hallway from another, let alone find a route to a particular destination
- Examples: hospitals, airports, hotels
- Facilitating unaided travel promotes independence and dignity



## Problems to Address

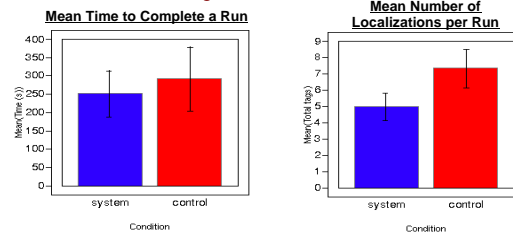
- To design an indoor navigation aid that:
  - Assists indoor navigation
  - Informs user about current location
  - Does not replace conventional mobility aids, such as a cane
  - Audible, tactile or haptic interfaces
  - Does not occupy the user's free hand
  - Control over the amount of chatter
  - Does not obstruct user's sense of hearing
  - Does not draw undue attention
- Also, overcome the challenges faced by the navigation assisting devices in the past:
  - Cost
  - Lack of landmarks
  - Lack of Braille tags
  - Inconsistent placement of Braille tags
  - Not all users can read Braille

## User Study

### Experiment

Blind users were asked to navigate through an unfamiliar office building with and without the BlindAid device. They were asked to find a particular room using either the navigation aid or the braille door plaques. Even after limited training, users with the device were able to find their destination more quickly, and with fewer stops for reorientation, than without it.

### Results & Analysis



- Average time per run decreased by 45 seconds (15%)
- Number of pauses to localize decreased by 2.5 times per run (35%)
- Large variances in averages due to small data set

### Feedback

- "I would love to have a device like that."
- "I just needed to get used to the system"
- "I could focus on conversation instead of keeping track of where I am."

•Possible improvements:

- Numbered steps
- Orientation guidance ("turn around" problem)
- Specify whether user should trail left or right wall
- Distinguish between 3-way and 4-way intersections

## Cost Estimate

### RFID Tags

\$0.60/Tag \* 200 Tags/Floor  
 = \$120/Floor (Based on CMU's Newell-Simon Hall)

### RFID Reader

\$480 for IDBlue in proof-of-concept experiment  
 Others available vary from \$240 (Socket CF RFID Reader) to \$1200 (specialized PDA+RFID – Minec or Magnatec)

### PDA or Mobile Phone

\$340 for Dell Axim PDA in proof-of-concept experiment  
 Mobile phones can vary from \$100 to \$1000

## Conclusions

- Results are not yet statistically significant, but they show promise
- The user's mental model of system's state and operation is important, and should be explicitly guided

## Future Work

- Changes to the format of directions based on feedback
- Further user trials
- Test on mobile phones
- Voice recognition for input
- Integration with an outdoor navigation system

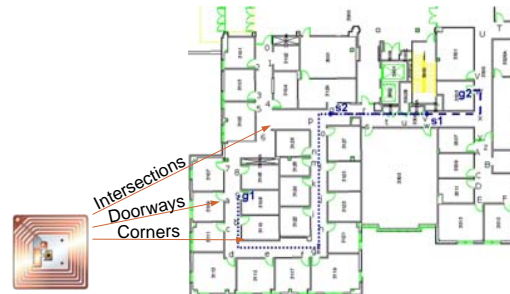
## BlindAid System



Handheld Device



RFID



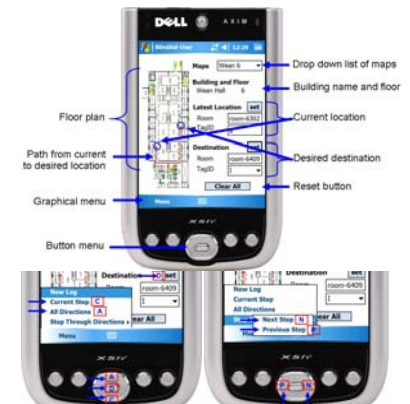
Map Data & Path Planning

Set destination:  
 "Heading to Room 6409"

Localization (i.e. start):  
 "Room 6403"

- Walk to the 1st corner. Turn left."
- "Walk to the 1st intersection. Turn left."
- "Walk to the 4th doorway on your left."
- "You have arrived at your destination"

Audible Instructions



Tactile & Graphical Interface