Virtual Guide Dog: the Next Generation Pedestrian Signal for the Visually Impaired

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Outline

• Motivation
• VGD Component and Architecture
• Proof-of-concept Test
• Next Step
Motivation

Appendix D: Understanding How Blind Pedestrians Cross at Signalized Intersections

1. **Locating the Street**: Am I around an intersection?
2. **Street Recognition**: Which street to cross?
3. **Intersection Assessment**: How complicate the intersection?
4. **Cross the Roadway**: Am I OK to cross?
Virtual Guide Dog: Components

Pedestrian

GPS & Compass

Wireless Communications

Signal Controller

Mini PC (Raspberry Pi)

Intersection

Bluetooth or WiFi
Virtual Guide Dog: Architecture
Virtual Guide Dog: Technologies Integrated

• Real-time geo-positioning using GPS, compass and Wi-fi
• Voice message/notification
• Touch control user interface
• Traffic signal control using NTCIP
• Bluetooth-based short-range communications
Proof-of-Concept Test

- VGD Mobile Application
- Hardware-Human-in-the-loop Simulation (HHILS)-based Test
  - Actual controller
  - Pedestrian with mobile app
  - Traffic simulation
  - Risk-free App development
  - Examine the impacts on intersection and street under various conditions
Proof-of-Concept Test

- Hardware-in-the-loop simulation is used for the testing due to safety concerns.
- Microcomputer combined with Bluetooth scanner to receive calls and process requests.
- The primary function for the virtual signal head is to display what is showing on the signal controller located in ITSRC Lab.

Signal Controller Retrofitting

Virtual Controller Replicated by NTCIP Protocol

- Real-time signal status
- Pedestrian call status
Proof-of-concept Test

- Five reference points were selected
- Central Ave. & Lock St. in Newark, NJ
- Two non-VI test participants
- Virtual controller synchronized with controller located in ITSRC Lab
Conclusions

- The VGD application could be an attractive alternative for conventional Accessible Pedestrian Signal (APS) for VIs.
- The cost of implementing VGD is only a fraction of that of conventional APSs.
- Smartphone’s GPS position accuracy is often insufficient to ensure the safety of the VIs.
Position Accuracy

[Bar chart showing GPS Error distribution with frequency on the y-axis and GPS Error in feet on the x-axis. Peaks around 30 ft. and smaller values.]
Improve Position Accuracy

- Neglected
- Accepted

Distance estimation technique using Wi-Fi signal strength (Pass Loss Equation)
Next Step

• Conduct a field test at actual intersections (e.g., next to nursing homes or hospitals)
  • Deploy sensors, devices, and mobile App
  • Perform mock experiments to evaluate the effectiveness of the VGD application
  • Need a collaboration with municipality

• Incorporate pedestrian trip data to select proper test sites