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

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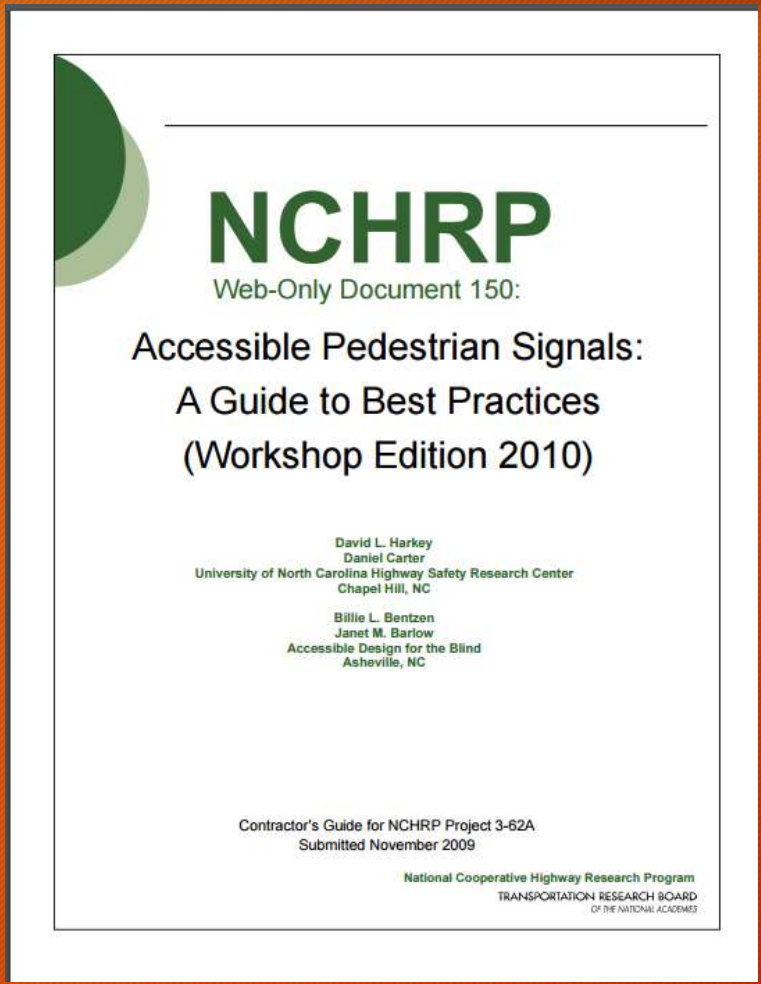
Outline

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

Motivation


NCHRP

Web-Only Document 150:

Accessible Pedestrian Signals:
A Guide to Best Practices
(Workshop Edition 2010)

David L. Harkey
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University of North Carolina Highway Safety Research Center
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Contractor's Guide for NCHRP Project 3-62A
Submitted November 2009

National Cooperative Highway Research Program
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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

Bluetooth or WiFi

Wireless Communications

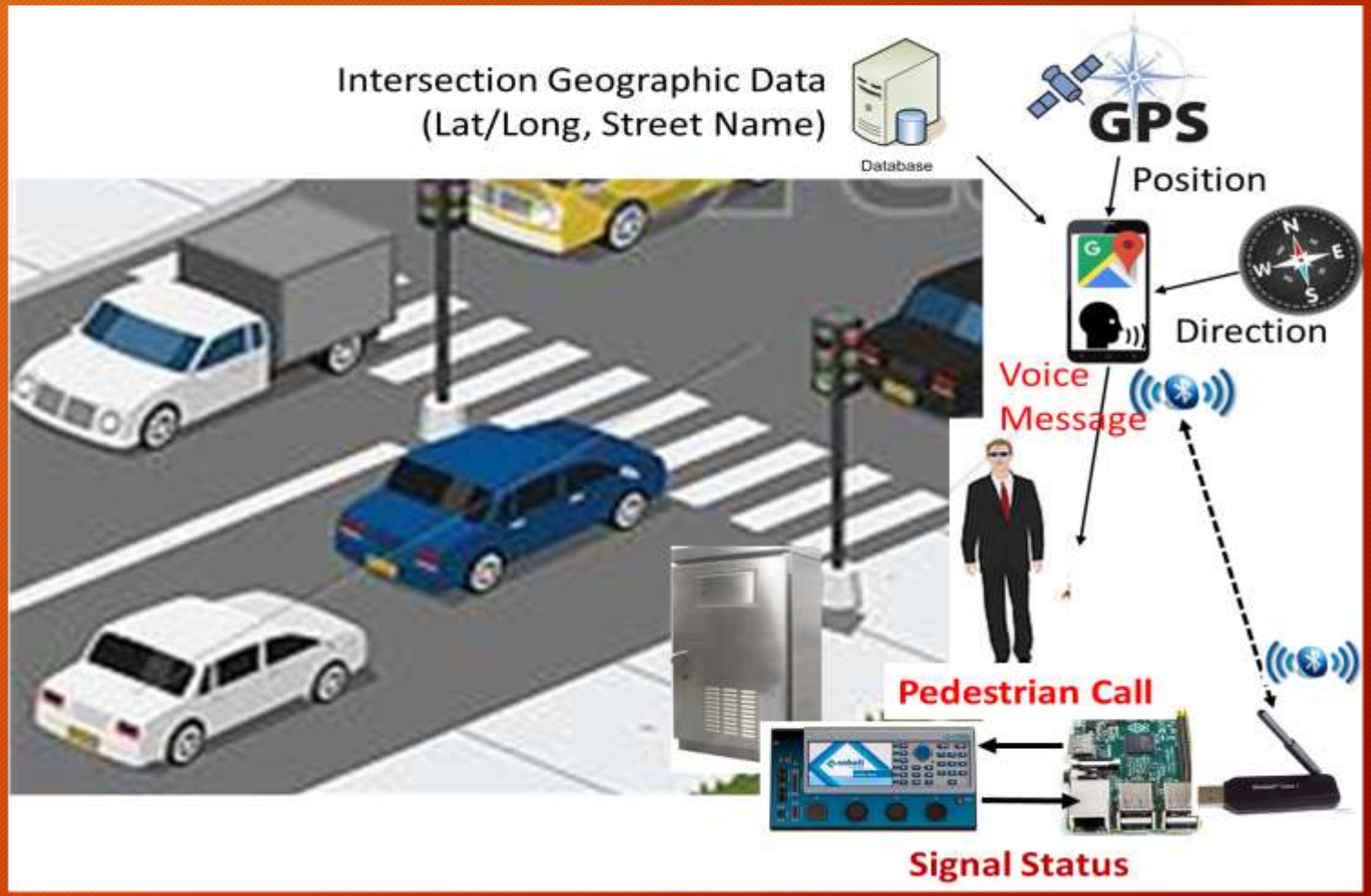
Signal Controller

Mini PC (Raspberry Pi)

Intersection

Bluetooth or WiFi

Virtual Guide Dog: Architecture

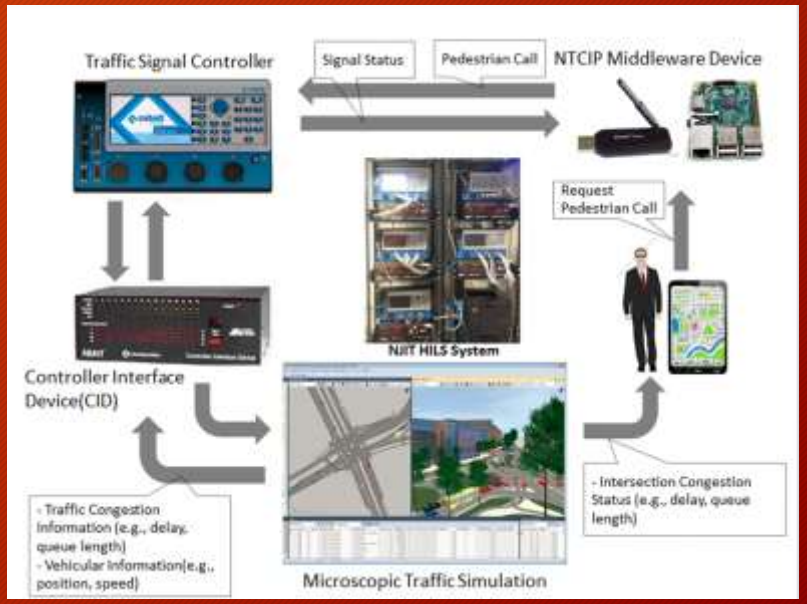


Virtual Guide Dog: Technologies Integrated

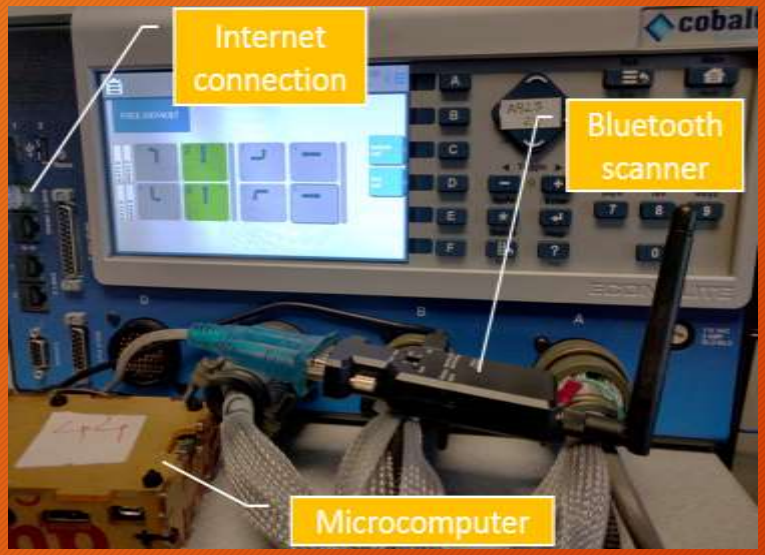
- Real-time geo-positioning using GPS, compass and Wi-fi
- Voice message/notification
- Touch control user interface
- Traffic signal control using NTCIP
- Bluetooth-based short-range communications

Proof-of-Concept Test

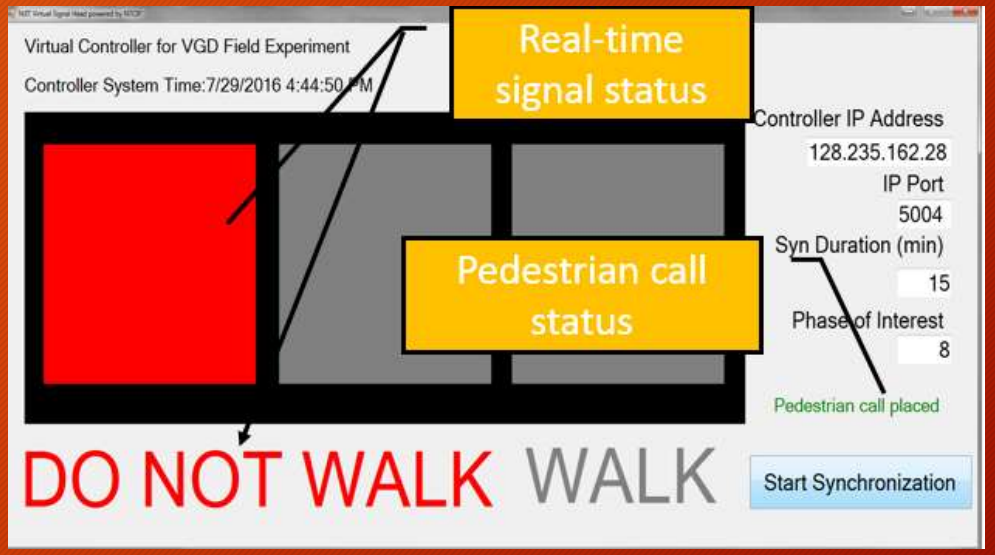
- VGD Mobile Application
- Hardware-Human-in-the-loop Simulation (HHILS)-based Test
  - Actual controller
  - Pedestrian with mobile app
  - Traffic simulation
  - Risk-free App development
  - Examine the impacts on intersection and street under various conditions



Proof-of-Concept Test



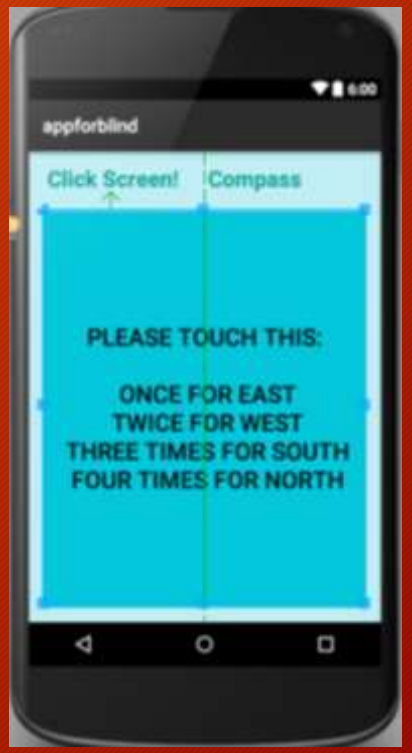
Signal Controller Retrofitting



Virtual Controller Replicated by NTCIP Protocol

- 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.

Proof-of-concept Test

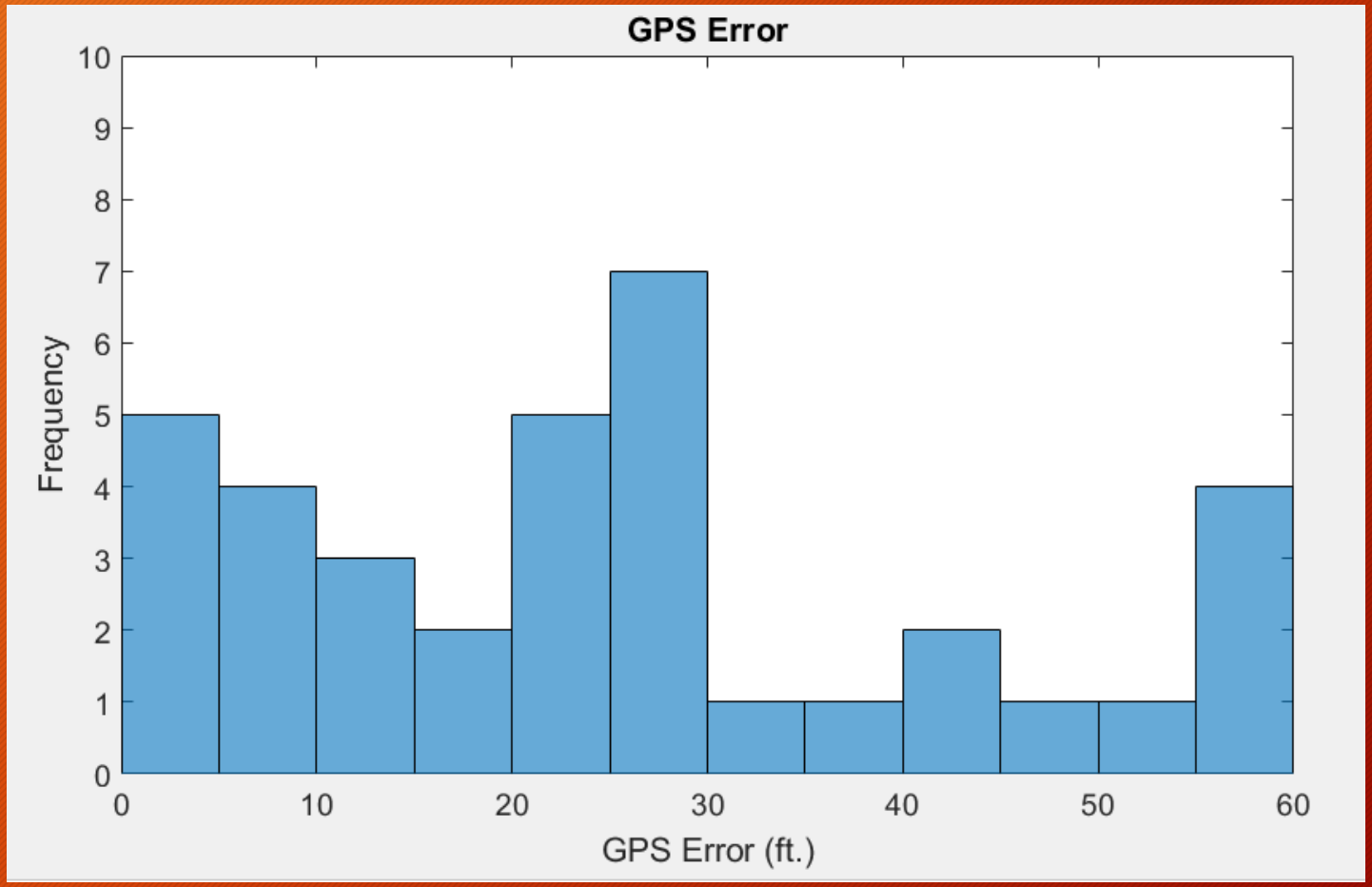


- Five reference points were selected
- Central Ave. & Lock St. in Newark, NJ
- Two non-VI test participants
- Virtual controller synchronized with controller located in ITSRC Lab

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.

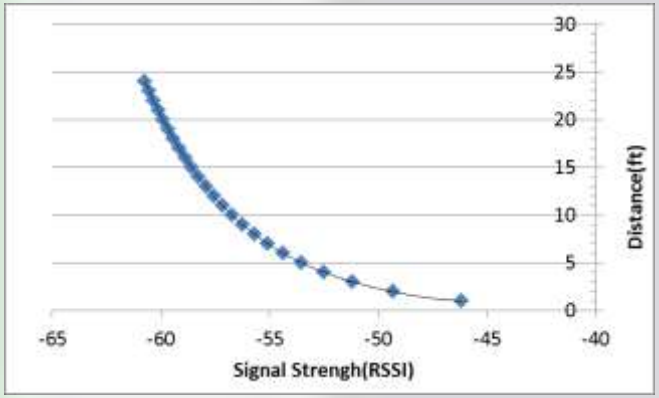
Position Accuracy



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