



ACCESSIBLE TRANSPORTATION TECHNOLOGIES
RESEARCH INITIATIVE

ATTRI Project Update Webinar 2 – Wayfinding and Navigation

City College of New York
TRX Systems

December 13, 2017



U.S. Department of Transportation
Federal Transit Administration



U.S. Department of Transportation
Federal Highway Administration



Agenda

- **Welcome and Introductions**
 - Kevin Viita, ITS America
- **ATTRI Program Overview and Status**
 - Rik Opstelten, FTA
- **Wayfinding and Navigation**
 - Jizhong Xiao, CCNY
 - Carol Politi, TRX Systems
- **Q&A**
 - Kevin Viita, ITS America

ATTRI Vision and Mission



Vision

*ATTRI seeks to remove barriers to transportation by leveraging advanced technology to enable people to travel **independently, anytime of the day to any destination**, regardless of their individual abilities.*

Mission

*To transform the mobility of travelers with disabilities by providing the capability to reliably, safely and independently plan and execute their travel **by leveraging principles of universal design and inclusive information and communication technology (ICT)**. ATTRI identifies, **collaborates**, coordinates, develops, and implements **transformative** solutions in advancing accessible transportation and **independent** mobility.*



The Challenge



Persons with Disabilities

- 56.7 million; 19% US population
- Unemployment Rate – 13.2 %; Income: \$38,400 (\$61,000)
- Poverty: 24.7% (9.0%)
- Rise in Autism: 1 in 150 (2000) to 1 in 68 (2010)
- Fed expenditures: \$226 B (2002); \$357 B (2008)



Veterans with Disabilities

- 21.4 million Americans are Veterans
- Disability claims: 104,819 (2006) vs. 634,743 (2012)
- 2.6 million deployed in 2012, 45% of eligible Veterans file claims for disability
- Spending: \$0.93 billion (2006) vs. \$5.95 billion (2012)



Older Adults

- Disability rates rise as people get older
- 43.1 million age 65 + in 2012 or 1 in 7 people
- 28% live alone
- Expected to reach 72.1 million by 2030

Challenges and Opportunities



- 76% people with disabilities say adequate transportation is important to their job search
- 29% consider it a significant problem in accessing jobs [1]

Targeted Populations



Persons with Disabilities



Veterans with Disabilities



Older Adults

Types of Disabilities



Vision



Mobility



Hearing



Cognitive

Enabling Technologies

ITS,
Wireless &
Sensors

Connected
Vehicles

Automated Vehicles/
Personal Mobility

Robotics,
Artificial
Intelligence

Accessible
Data

Application Development

- Stakeholder Engagement and User Needs Assessment
- Technology State of Practice and Innovation Scan
- ICDR Roundtable
- RFI
- Applications Workshop

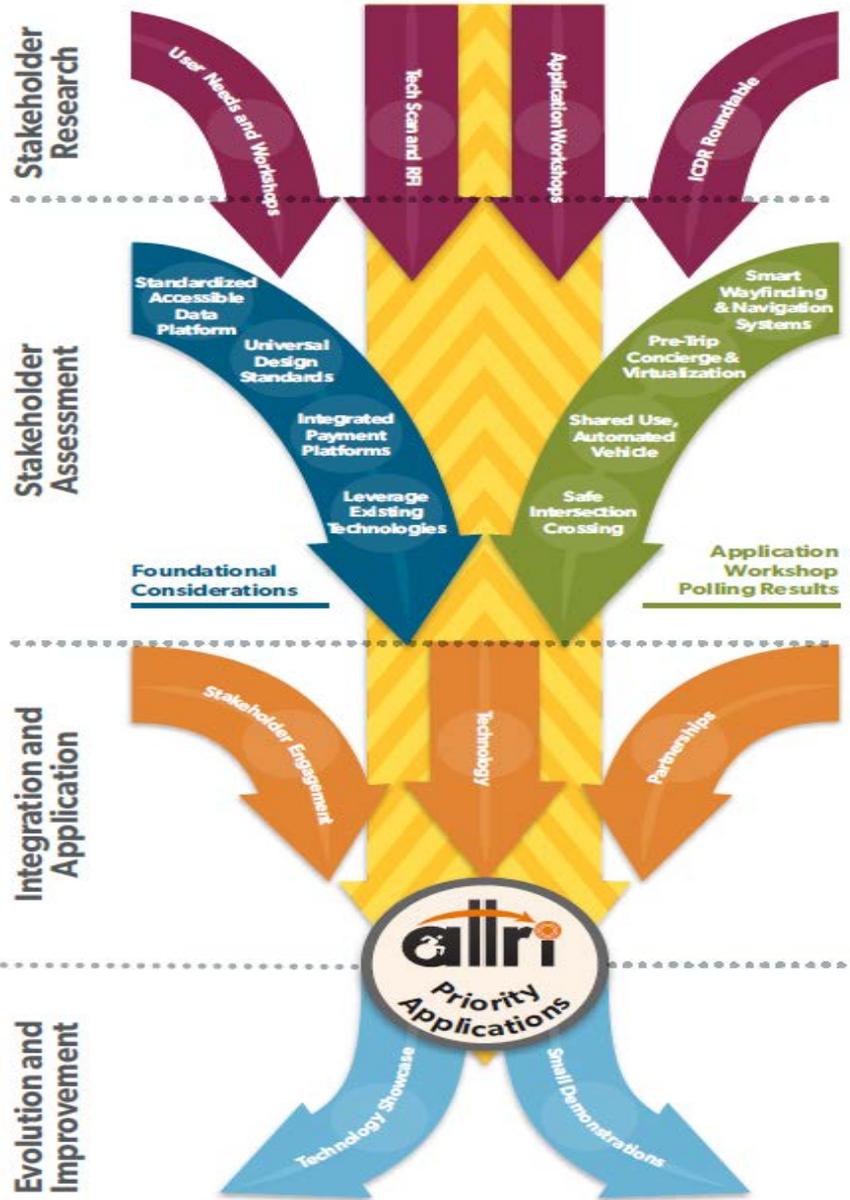


- Foundational Considerations
- Priority Application Areas
- Partnerships
- USDOT BAA & NIDILRR FOA



- Application Development
- Prototyping & Testing
- Technology Showcases and Demonstrations

Searching for ATTRI Applications



Documenting User Needs



Top Identified Barriers

75

Lack of / or inaccessible signage/ maps/ landmark identifiers/ announcements

71

Navigation difficulties (do not know when arrive, transfer time, distance)

67

Inconsistent accessible pathway infrastructure

Top Identified User Needs

102

Amenity information (e.g. restroom, shelter)

88

Real-time transportation information

76

Safety, security and emergency information



User Needs

Final Report Available on the ATTRI Website:
http://www.its.dot.gov/research_archives/attri/index.htm

Top Identified Issues with Technology

46%

Training to use and awareness of new technology

21%

Affordability

16%

Performance quality (especially long-distance travel, rural areas)

Technology Recommendations



Wayfinding & Navigation Solutions

- Focus on integration of map data and standardized infrastructure descriptions from various sources
- New data unique and specific to ATTRI users should be developed



ITS & Assistive Technologies

- Focus on remote assistance for stakeholders and opportunities to inform and aid barrier traversal
- Modernizing assistive technology maintenance and asset management (area for advanced research)



Automation & Robotics

- Shared neighborhood autonomous vehicles which are cost effective and aid at traversing distances between transit stops, homes, and places of employment.
- Assist service models, electric vehicles, and autonomous vehicles create opportunities for novel accessible designs



Data Integration

- Reduce complexity and identify coordination in service matchmaking through open data and services
- Develop environment for community generated data



Enhanced Human Services Transportation

- Support initiatives by ridersharing services to involve ATTRI stakeholders and develop accessible versions of these services.
- Support mode shift through private on-demand ride services



[Links to Final Reports](#)

Application Priorities



Foundational Considerations

**Standard
Accessible
Data Platform**

**Universal
Design
Standards**

**Integrated
Payment**

**Leverage
Existing
Technologies**



Smart Wayfinding & Navigation Systems

- Wayfinding and navigation systems for indoor and outdoor use
- Wearable technologies
- Community navigators



Pre-Trip Concierge & Virtualization

- Pre-trip and in-route traveler information
- Connected travelers
- Virtual caregiver help for pre-trip planning and on route support



Robotics & Automation

- Assistive and collaborative robotics to enhance mobility
- Ability to plan and execute trips, associated services
- Transformative transportation alternatives



Safe Intersection Crossing

- Intersection crossing assistance for all travelers
- Pedestrians interface with traffic signals, vehicles and nomadic devices
- Guidance, notifications and alerts for optimization

ATTRI Complete Trip



ATTRI - THE COMPLETE TRIP

After his doctor's appointment, Andy decides to take a spontaneous trip to meet a friend at a coffee shop in an unfamiliar part of town. Using ATTRI's **pre-trip concierge**, **wayfinding and navigation**, **robotics and automation**, and **safe intersection crossing** applications, Andy can travel with confidence throughout his trip.

5. Arrival at Destination

Andy safely arrives at his destination, while the **pre-trip concierge application** plans his return trip home.



1. Plan and Book a Trip

Andy uses a **pre-trip concierge application** to plan and book his trip from the doctor's office to the coffee shop.



2. Travel to Transit Station

An **automated shuttle** (rideshare service) is dispatched to take Andy to the transit station based on his booked trip. Once there, an **assistive robot** helps Andy to his bus platform.



3. Ride the Bus

While on the bus, Andy receives direction on when to pull the Stop Request cord from his **wayfinding and navigation application**. After he departs the bus, the application provides Andy with turn-by-turn walking directions to the coffee shop.



4. Cross the Street

As Andy approaches an intersection, his **safe intersection crossing application** communicates with the traffic signal to ensure sufficient time for him to safely cross the street, and notifies him when it is safe to begin crossing. The application also communicates with nearby cars to notify them of Andy's presence in the intersection.



Broad Agency Announcement (BAA)



The objective of ATTRI BAA is to put contracts in place that will:

- Develop applications in three of the ATTRI priority application areas:
 - Aimed to advance the current knowledge and state-of-the-art in the sciences and technologies employed in the planning, design, construction, operation, maintenance and management of accessible transportation
 - Application development will include prototyping, demonstration and evaluation
- Collaborate with other application development areas under the ATTRI program

Acquisition Approach



- USDOT BAA:
 - Application development for:
 - Wayfinding and Navigation
 - Pre-Trip Concierge and Virtualization
 - Safe Intersection Crossing
- NIDILRR/HHS FOA
 - Application Development for:
 - Robotics and Automation for Accessible Transportation

Prototype Awards



Application Area	Contractors	Description
Pre-Trip Concierge and Virtualization	AbleLink	Create a suite of assessment, self-directed learning, and trip execution technologies to support pre-trip planning needs
Wayfinding & Navigation	AbleLink	Open wayfinding media standard and the infrastructure for creation of geographically specific cloud-based libraries of routes
Wayfinding & Navigation	City College of New York	Smart Cane for Assistive Navigation (SCAN) integrated with a Smart Phone application
Wayfinding & Navigation	Pathway Accessibility Solutions, Inc.	Wayfinding tool for wheelchair users and people with visual impairment, providing routes tailored to the preferences of the user.
Wayfinding & Navigation	TRX	Smart Wayfinding and Navigation system to obtain real-time location, en-route assistance and situational awareness
Safe Intersection Crossing	Carnegie Mellon University	Connect pedestrian travelers with disabilities to the traffic signal infrastructure to develop assistive services for safe intersection crossing and increased traveler mobility.



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Application Development Projects:

City College of New York (CCNY)

Smart Cane for Assistive Navigation (SCAN) to Help Blind Persons



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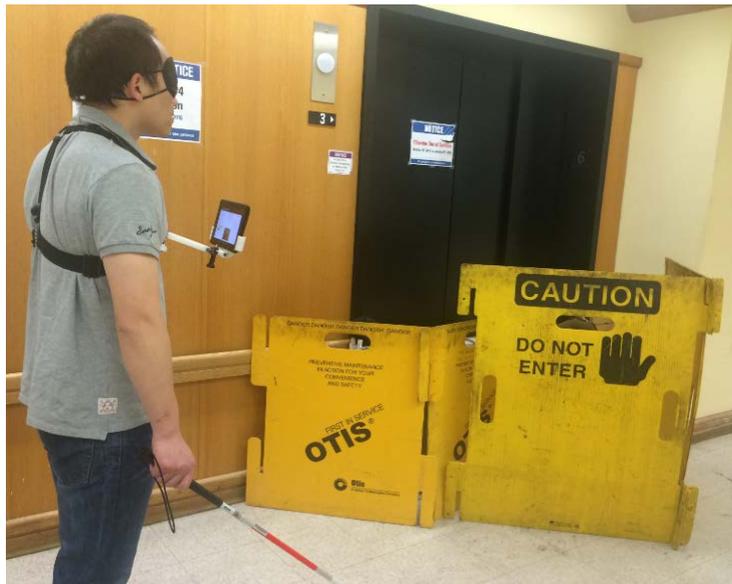


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Indoor Wayfinding & Navigation – Smart Cane



- The SCAN project will develop a smart-cane hardware and integrate new algorithms into ISANA system to mitigate the problems caused by non-perfect user interface, and tackle technical challenges in complex indoor environments, and expand the ISANA capabilities to provide blind users with independent travel in transportation terminals and outdoor pedestrian environments.



Partnerships



- The City College of New York (CCNY) is the technical lead organization on this project and is developing the software that provides the object detection, path planning and effective human-machine interaction.
- Virginia Commonwealth University (VCU) is working with CCNY to develop the smart cane hardware with passive free swing mode and robocane mode.

The City College
of New York



Additional Information

The SCAN project is based on our previous ISANA project (Intelligent Situation Awareness and Navigation Aid for Visually Impaired Persons) funded by FHWA's Exploratory Advanced Research Program (EARP).

SANA is the first Tango-enabled wearable system that achieved great success in assisting blind navigation in multi-floor office buildings. The demonstration video at DOT headquarter building can be found: <http://www.assistiverobot.org/ain/>

Innovative Claims



- Develop next generation wearable wayfinding and navigation system that:
 - Includes a smart-cane device and software app running on a Google Tango-enabled smartphone
 - Provides semantic localization, path planning, SLAM-based navigation in complex indoor environments, and GPS-guided waypoint navigation in outdoor pedestrian environments.
- Design a smart-cane with rolling tip that will automatically detect human intent allowing the blind travellers to feel and follow turn-by-turn instructions more accurately.
- Create an effective user interface between smart-cane and smartphone to eliminate the problems caused by non-perfect voice recognition and text-to-speech software.

Technical Approach and Rationale



Project SCAN is developing a holistic solution and an effective tool to improve independent mobility of blind persons in both indoor and outdoor environments.

- The smart-cane provides proximity sensing for obstacle avoidance and effective user interface for communicating with navigation app on a smartphone, which will help to reduce problems such as malfunctioning of voice recognition in noisy environments and significant delay in queuing verbal instructions.
- The assistive navigation software app will also parse the building maps and interact with GIS to provide blind travellers with semantic localization, obstacle avoidance, route planning, waypoint navigation, and advanced warning of events.
- The software app can also be used by normal sighted persons to help them navigate in complex indoor environments such as transportation terminals, airports, shopping malls, etc.

Expected Impacts



- Enable and provide a MapEditor software tool to generate navigation map customized for blind users
- Provide an assistive navigation App to help blind users to access and improve mobility within complex public buildings and transit structures.
- Expand the ISANA software functionalities to provide semantic information for scene understanding
- We expect to see a greater user satisfaction after implementing SCAN hardware and software system (compared to the previous ISANA prototype).

Outreach Activities



- Project team attended IEEE Cyber2017 conference to present two papers. The first paper is on Intelligent Situation Awareness and Navigation Aid (ISANA) which won the best conference paper award, and the second paper introduced our first prototype of CCNY Smart-Cane.
- City College of New York has established good working relationship with the blind rehabilitation community in New York City, such as the New York State Commission for the Blind (NYSCB) and Lighthouse International.
- Virginia Commonwealth University is building a relationship with the Virginia Center for the Visually Impaired to get user feedback on the prototype hardware design.



LOCATE. MAP. TRACK. INDOORS.



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Application Development Projects:

TRX Systems: Smart Wayfinding and Navigation (SWaN) Using High Accuracy 3D Location Technology



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Smart Wayfinding and Navigation (SWaN) with High Accuracy 3D Location Technology



- ### NEON Smart Wayfinding & Navigation
- Integrated with Android device
 - Centralized 3D control and visualization
 - Scalable, cloud based architecture
 - Optional small, mounted tracking accessory for improved accuracy

NEON Equipped Individual



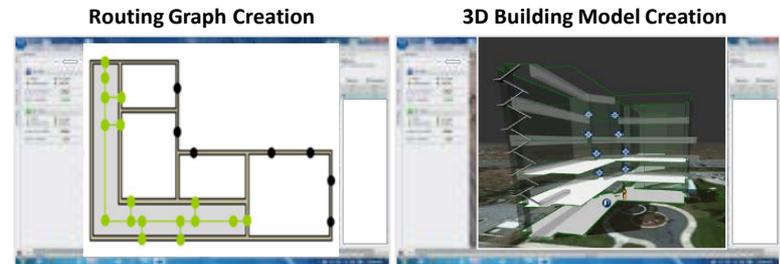
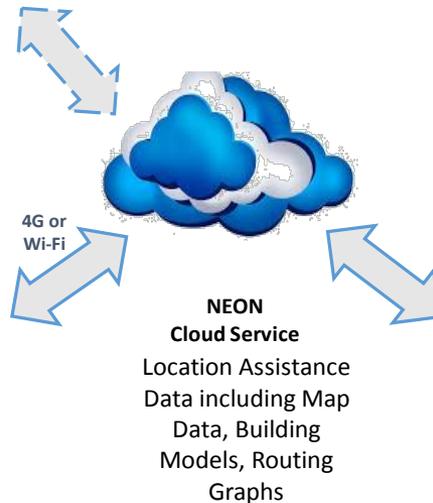
Accessible Navigation and Wayfinding App (with open API)



Bluetooth



NEON Tracking Unit (mounted)



NEON Command Software

Partnerships



- TRX Systems is the lead organization on this project, with support from the University of Maryland and National Federation of the Blind.
- TRX is partnering with University of Maryland to gain insight on functionality and usability requirements for diverse user groups.
- TRX is partnering with National Federation of the Blind to gain insight on requirements for and access to application developers supporting applications for the visually impaired.
- TRX Systems is doing the technical development of the platform/application.



Innovative Claims

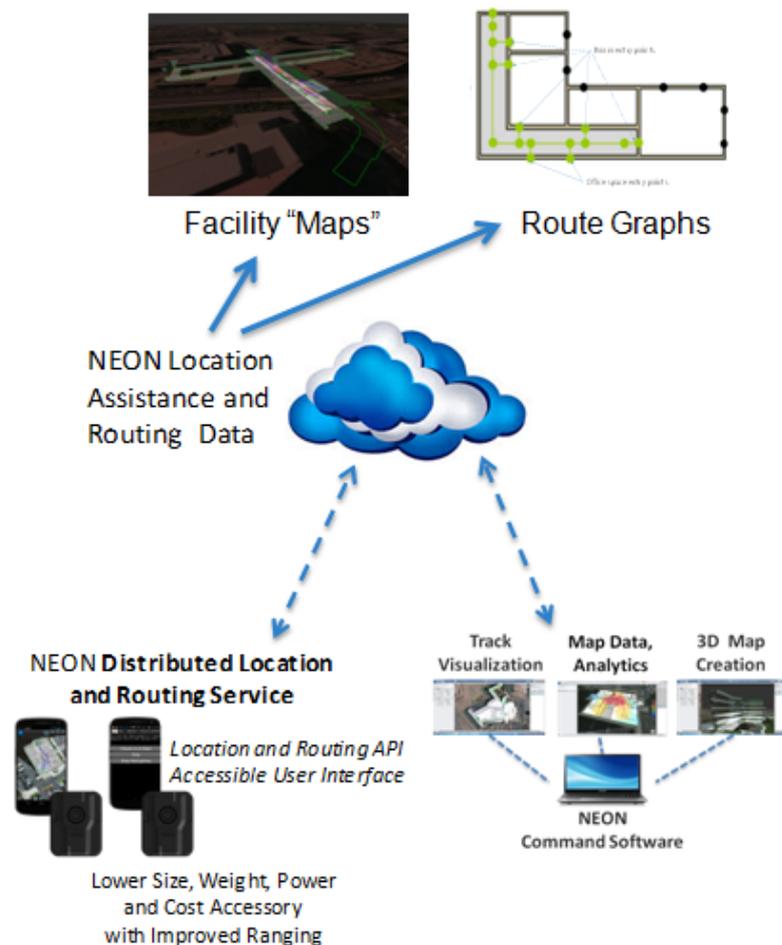


- Develop navigation and wayfinding mobile service with open APIs delivering localization, orientation, waypoint navigation, route guidance and advanced warning of events.
- Provide tools for path planning and routing, design to support applications that can deliver wayfinding for travelers with diverse needs.
- Run on standard smartphones and smartphones paired with a wearable accessory, allowing users to select the platform and accuracy tailored for their needs.
- Support standardization efforts to incorporate learning and best practices regarding user routing priorities, location technology and configuration, and API features and capabilities.

Technical Approach and Rationale



- Support navigation and routing in complex, overlapping above and underground structures.
- Implement crowdsourcing of navigation maps and community contributed route data.
- Deliver venue mapping and route creation tools (for venue owners, user communities, volunteers).
- Develop Open APIs for ATTRI program and commercial application partners.
- Deliver early baseline service and iterative service enhancements.



Expected Impacts



- Enable and expedite innovative accessible location/ wayfinding/ navigation app development.
- Deliver the required core accessible location and wayfinding capabilities within complex public buildings and transit structures.
- Greatly improve mobility options for people with disabilities and expand access to independent and accessible transportation.
- Support developing ecosystem of application developers focused on expanding independent travel for people with disabilities.

Outreach Activity



- Reach out to application developers to inform them about the program and developing capabilities.
- Launch developer program to deliver information, tools, and support required by accessible application developers.
- Participate in accessibility focused hackathons to make available the APIs and encourage application development.
- Reach out to Wayfinder and other standardization efforts to ensure best practices are shared among the community.

Questions?



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