Technology/Data Projects

- MySidewalk
- Developing National Bicycle Facility Inventory Data
- Smartphone Based Mid-Block Pedestrian Crossing Application
- Connected Bicycle Technology
- Understanding Traffic Systems with Innovative Pedestrian and Cyclist Detection
- ATTRI Products
- UTCs
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My Sidewalk - Smartphone App

• Benefits
  – Community Inputs and Involvement: Report Issue, New Sidewalk Requests/Inputs, Priorities
  – Sidewalk GIS Data Collection
  – Sidewalk Condition Assessment and Reporting
  – Identifying ADA Compliance / Accessibility Issues
  – Auditing, Maintaining, Sharing, and Overlaying Data to aid TIP and STIP / Sidewalk Prioritizing and Planning Support
  – Data Mining Results: Use Patterns, Demand Drivers, Network Gaps

• Phase II B proposal submitted
  – Will focus on expanding tool use beyond asset management to include more attributes that contribute to safety and low stress walking environment
Mobile App – Track Interface

- Track My Walk
  - Start Tracking
  - Track Missing Sidewalk

- Sidewalk Attributes
  - Width
    - 4 Feet or Less
  - Location
    - Both Side
  - Buffer Width
    - Less than 4 Feet
  - Material
    - Asphalt or Concrete

- View Sidewalks
Mobile App – Accessibility and Maintenance Issues

Address

✔ Use My Current Location

Forest Drive, College Station, Texas, 77840

Details

Issue Category
Obstructions - Utility Pole, Mailbox, signs

Description
Utility pole on the way

Photo

Surface Defects - Cracks, Holes, Gaps

Description: The intersection of Forest drive and University drive is severely damaged. It’s directly across the water line marker.
Address: Forest Dr., College Station, Texas, 77840.
Crowd Incentive Scheme and Local Community Involvement
Installation and Quick Functionality Overview

App Download

- Available as Android and iOS app.
- Search for “mysidewalk”
- Download Link
  - Android / Google Play
  - IOS / iPhone
Installation and Overview Videos

- https://www.youtube.com/watch?v=X_3pDWUH5zM
- https://www.youtube.com/watch?v=NVZCpuJn2yw
Developing National Bicycle Facility Inventory Data

• Gather national bicycle facility geospatial data
  • Routes
  • Trails
  • Shared Use Roadways

• Develop a web portal for bicycle geospatial data information from:
  • Agencies
  • Public and crowdsources
  • Various organizations
  • Commercial data sources
Developing National Bicycle Facility Inventory Data

• Recommend facility type classifications and data attributes
  • Incorporate into existing Federal data systems
  • Highway Performance Monitoring System (HPMS)
  • All Roads Network Of Linear Data (ARNOLD)

• Reuse codes from 2016 Traffic Monitoring Guide + HPMS Field Manual

• Generate Illustrated Handbook (Field Guide) on collecting and uploading

• Project Completion in June 2019
Developing National Bicycle Facility Inventory Data
Developing National Bicycle Facility Inventory Data
Developing National Bicycle Facility Inventory Data

Colorado Bike Box Location Map (CODOT)
Developing National Bicycle Facility Inventory Data

Bicycle Network Data Project Next Steps

- Data Request Webinar July 2018
- Obtain data and perform validation Aug. 2018
- Create pilot master geospatial database Oct. 2018
- Web Portal for receiving data Dec. 2018
- Field Guide Feb. 2019
- Final Report June 2019
Developing National Bicycle Facility Inventory Data

TMAS Nonmotorized Data Upload – Upload will be coming online within the next few months

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Connected Bicycle Technology

Multimodal Alerting Interface with Networked Short-range Transmissions (MAIN-ST)

- USDOT FHWA-Funded Phase II SBIR Effort
- **Objective:** Develop the technology to bring bicycles onto connected vehicle (V2X) networks via a Basic Safety Message for Bicycles (BSM-B)

![Diagram showing the process of Tech Upgrade, Broadcast BSM-B, Process Other Vehicles’ BSM, Predict Hazards, and Warn Cyclists]
Multimodal Alerting Interface with Networked Short-range Transmissions (MAIN-ST)

- Simulation testing underway on VR bicycle simulator at FHWA’s Turner-Fairbank Highway Research Center
- On-road testing in the Smart City environment of Las Vegas, NV
- Completion: March 2019
Connected Bicycle Technology

Images for MAIN-ST Connected Bicycle

- Collision
  - Imminent
  - Cautionary
- Hazard
  - Heightened Caution
  - Avoidance
- Action Required
  - Heightened Caution
Connected Bicycle Technology

Virtual Bike Simulator
Smartphone Based Mid-Block Pedestrian Crossing Application

USER RECOGNITION AT MIDBLOCK CROSSINGS VIA SMARTPHONE TECHNOLOGY

This fact sheet introduces users to research that analyzes drivers' reactions to advanced in-vehicle warning messages for pedestrians at midblock crossings.

INTRODUCTION

With new technologies being released to the public, the number of incidents involving vehicles and vulnerable road users can be minimized. Pedestrian-to-vehicle (P2V) communication can be deployed through smartphone technologies, allowing pedestrians to send in-vehicle warning messages directly to drivers. This fact sheet discusses a study that involved deploying a cyber-physical P2V communication system at a midblock crosswalk to analyze drivers' reactions to mobile and visual in-vehicle messages, the safety impacts of the in-vehicle messages, and the performance of a P2V communication network. The cellular P2V network was utilized in this study, using mobile applications that pedestrians and motorists can install on connected smartphones or tablets.

METHODOLOGY

Pedestrians and drivers are connected using a smartphone application that operates using a cellular network and they interface when they are both in the predefined proximately area. When a pedestrian is in the pedestrian presence delineating the midblock crosswalk, the pedestrian is given an option within the application to notify other drivers within the designated vehicle presence of the pedestrian's presence at the midblock crosswalk (see Figure 1).

EXPERIMENTAL DESIGN

Eighty test subjects operated a test vehicle equipped with a tablet computer with the capability of displaying visual cues and playing an auditory warning to the driver. The 80 test subjects were divided into two groups, Group A and Group B. Test subjects in Group A drove four laps around the test track. In the first lap, no pedestrians were present (no test). In the second lap, a pedestrian attempted to cross the street without sending an advanced warning message. In the third lap, no pedestrians were present (no test). In the fourth lap, a pedestrian attempted to cross the street without sending an advanced warning message. Group B also drove four laps around the test track. In the first lap, no pedestrians were present (no test). In the second lap, a pedestrian attempted to cross the street with an advanced warning message. Group B also drove four laps around the test track. In the first lap, no pedestrians were present (no test). In the second lap, a pedestrian attempted to cross the street with an advanced warning message. In the third lap, no pedestrians were present (no test). In the fourth lap, a pedestrian attempted to cross the street without sending an advanced warning message.

RESULTS AND DISCUSSION

Preliminary results show that drivers who receive advanced warning messages are more likely to slow for pedestrians compared to drivers who do not receive advanced warning messages (see Figure 2).

PRELIMINARY RESULTS SHOW THAT DRIVERS WHO RECEIVE ADVANCED WARNING MESSAGES ARE MORE LIKELY TO SLOW FOR PEDESTRIANS COMPARED TO DRIVERS WHO DO NOT RECEIVE ADVANCED WARNING MESSAGES (SEE FIGURE 2).

For more information, please contact: George.McFadden@dot.gov

Office of Operations Research and Development

User Recognition at Midblock Crossings via Smartphone Technology

Preliminary results also show that drivers behave in a similar manner when no pedestrian is present, as in Lap 1, shown in Figure 3. As shown in Figure 4, the subjects in Group A (with no warning) had an average speed of 15 miles per hour, with a standard deviation of 5 miles per hour. As shown in Figure 5, the subjects in Group B (with warning), during their first exposure to the pedestrian (in Lap 2), approached the pedestrian at an average speed of 15 miles per hour, with a standard deviation of 5 miles per hour. This test statistically shows that drivers receiving advanced warnings, compared to drivers not receiving advanced warnings, approach crosswalks at a slower speed and with less speed variation.
Smartphone Based Mid-Block Pedestrian Crossing Application

The Problem

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<tr>
<th>Light Condition</th>
<th>Person Type</th>
<th>Total</th>
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<tbody>
<tr>
<td></td>
<td>Pedestrian</td>
<td>Bicyclist</td>
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<tr>
<td>Daylight</td>
<td>24%</td>
<td>49%</td>
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<tr>
<td>Dark</td>
<td>72%</td>
<td>44%</td>
</tr>
<tr>
<td>Dawn/Dusk</td>
<td>4%</td>
<td>6%</td>
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<tr>
<td>TOTAL</td>
<td>100%</td>
<td>100%</td>
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</table>

<table>
<thead>
<tr>
<th>Traffic Control Type</th>
<th>Percent of Pedestrian Collisions</th>
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</thead>
<tbody>
<tr>
<td>No Traffic Control</td>
<td>74.4%</td>
</tr>
<tr>
<td>Stop Sign</td>
<td>7.0%</td>
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<tr>
<td>Traffic Signal</td>
<td>17.3%</td>
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<tr>
<td>Other</td>
<td>71.4%</td>
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<tr>
<td>TOTAL</td>
<td>100%</td>
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</table>
Smartphone Based Mid-Block Pedestrian Crossing Application

Pedestrian-to-Vehicle (P2V) Cyber-Physical Environment
Smartphone Based Mid-Block Pedestrian Crossing Application

Application User Interface
Experimental Design

Critical Distance of 220’ from crosswalk is when the message is targeted to send.
## Smartphone Based Mid-Block Pedestrian Crossing Application

### Research Test Plan

<table>
<thead>
<tr>
<th>Track Lap</th>
<th>Group A (40)</th>
<th>Group B (40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lap 1</td>
<td>No Test</td>
<td>No Test</td>
</tr>
<tr>
<td>Lap 2</td>
<td>No Warning</td>
<td>Warning</td>
</tr>
<tr>
<td>Lap 3</td>
<td>No Test</td>
<td>No Test</td>
</tr>
<tr>
<td>Lap 4</td>
<td>Warning</td>
<td>No Warning</td>
</tr>
</tbody>
</table>
Smartphone Based Mid-Block Pedestrian Crossing Application

Data Collected

- **Driver Reaction** – % of drivers stopping for pedestrian with and without advanced warning message.
- **Driver Questionnaire** – test subject stated preference and acceptance of advanced warning message.
- **Cell Phone Event Data** – timestamped data of when messages were sent and delivered and when drivers entered and exited the designated geofences.
- **Eye Tracking Data** – eye gaze tracking of test environment.
- **Cellular Device Tracking Data** – driver speed and position data.
- **Vehicle Control Area Network (CAN) Data** – driver speed, position, and vehicle diagnostic information.
Smartphone Based Mid-Block Pedestrian Crossing Application

Driver Reaction – Lap 2

<table>
<thead>
<tr>
<th>Track Lap</th>
<th>Group A (40)</th>
<th>Group B (40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lap 1</td>
<td>No Test</td>
<td>No Test</td>
</tr>
<tr>
<td>Lap 2</td>
<td>No Warning</td>
<td>Warning</td>
</tr>
<tr>
<td>Lap 3</td>
<td>No Test</td>
<td>No Test</td>
</tr>
<tr>
<td>Lap 4</td>
<td>Warning</td>
<td>No Warning</td>
</tr>
</tbody>
</table>

Driver Reaction

Without App: 48%
With App: 68%
Questionnaire Results

Question 1: The pedestrian warning application increased my awareness of present pedestrians at the mid-block crosswalk.

Question 2: The pedestrian warning application is a feature I would like to see incorporated into GPS technologies.

Question 3: I found the pedestrian warning application to be more distracting than helpful.
Conclusions

• Drivers stopped more frequently for the pedestrian with the advanced warning message.

• Drivers stated in the questionnaire that they were more aware of the pedestrian with the advanced warning message.

• With the advanced warning message, Group B’s drivers spent less percent time looking at pedestrian, and nearly never at the display.

• Drivers also stated they felt the application was not a distraction.
Available material

• Overview video: https://www.youtube.com/watch?v=JMdwizSABwl
• Phase 1 application software is open source, download at: https://itsforge.net/index.php/community/explore-applications#/35/149
• Two graduate thesis reports:
  • Sean Laffey, UVa: https://libraetd.lib.virginia.edu/public_view/j96021035
  • Austin Angulo, UVa: https://libraetd.lib.virginia.edu/public_view/j96021035
Next Steps

• Limited (40 subjects) nighttime testing being conducted at TFHRC this summer

• Phase 2 of this project will commence in the fall
  • Tests at midblock crosswalks on real roads
  • Additional functionality of the application
Understanding Traffic Systems with Innovative Pedestrian and Cyclist Detection

Enabling the Sharing and Using of Data Between Connected Mobile Devices, Connected Vehicles, ITS Devices, and Traffic Management Systems
Sending & Receiving Electronic Messages With Mobile Devices:

Develop, test & evaluate ability of prototype system with mobile devices to:

- Transmit & receive messages via multiple communications media (cellular, Wi-Fi, DSRC)
- Coordinate &/or group mobile devices sending & receiving messages for transit trips
  - Transmit & receive personal safety (PSM) & mobility messages (PMM)

- Personal Safety Message (PSM):
  - Allows messages to be transmitted at configurable frequency when mobile device is not in vehicle
  - Data format specified in SAE J2735.2016 standard w/ following fields:
    - Data and time
    - Speed
    - Latitude
    - PSM Number
    - Longitude
    - Latitude
    - Elevation
    - PSM Radius of Protection
    - Position Accuracy
    - PSM Path History
    - Path Protection
    - Group information (e.g., ad-hoc group) if applicable
Personal Mobility Message (PMM):

- Transmitted at configurable frequency when sending travel arrangement information
- Once activated, continually transmitted until response obtained (e.g., vehicle, traveler)
- Option for connected travelers w/ same travel arrangements to join group for purposes of only sending 1 message representing entire group vs each device sending messages
- Data format specified following SAE J2735.2016 standard w/ following fields:
  - Group ID – remains unchanged from first request until final boarding of vehicle
  - Requested ID – ID established within group of iterations with each update to message
  - Status – new or updated
  - Request date
  - Pick up date
  - Position – Lat/long of where traveler is waiting for pickup
  - Destination – Lat/long of where travelers want to travel
  - Mobility needs – number of travelers with special needs (e.g., wheel chair)
  - Mode of transport – preferred mode
  - Path Protection (e.g., transit route selected)
Mobile Devices Sharing Data with Other Devices, Vehicles, Traffic Signals, & ITS Devices:

Device-to-Everything (D2X) Hub Prototype Software Posted on OSADP:

https://www.itsforge.net/index.php/community/explore-applications#/45/135
D2X Hub Software: Messages & Telecommunication Methods Tested:
D2X Hub & Resources Available:

D2X Hub Software FREE TO DOWNLOAD on OSADP
https://www.itsforge.net/index.php/community/explore-applications#/45/135

Documents Available to Support Use of Software:
• Technology and Standards Assessment
• Concept of Operations and System Requirements
• Architecture and Design Document
• Proof-of-Concept Acceptance and Test Plans
• Prototype Proof-of-Concept Acceptance and Field Test Plan
• Prototype Field Test Evaluation Plan and Report
• Outreach Material
The Mobility Challenge for Americans with Disabilities

As many PWDs say it is important to their daily living needs

76% say it is important to their job search

29% consider it a significant problem in accessing jobs

Current ATTRI Applications In Development

Wayfinding and Navigation:
- CITY COLLEGE OF NEW YORK
- ABLELINK
- PATHWAYS SOLUTIONS
- TRX SYSTEMS

Pre-Trip Concierge and Virtualization:
- ABLELINK

Safe Intersection Crossing:
- CARNEGIE MELLON UNIVERSITY

Robotics and Automation:
- CARNEGIE MELLON UNIVERSITY
Enabling the Complete 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.

2. Travel to Transit Station
An automated shuttle (rideshare service) is dispatched.

3. Ride the Bus/Take a TNC
While on the bus, Andy receives direction on when to pull the Stop Request cord from his wayfinding and navigation application.

4. Cross the Street
As Andy approaches an intersection, his safe intersection crossing application communicates with the traffic signal.
Current Efforts in Automated Vehicles (AVs) & Disability

- **ATTRI**: Seven technology teams working on Complete Trip solutions
- **NIDILRR**: Information robots for wayfinding in transportation hubs
- **ATCMTD Greenville**: Deployment of Automated Taxi-Shuttles to improve transportation for disadvantaged and people with mobility disabilities
- **STAR**: Proposed FMLM and automated ADA demos
- **ODEP/ICDR**: Work with key federal partners to realize this vision
Challenges and Opportunities in Universal Access to AV’s Potential

• Accessible AVs, Current Efforts and Challenges:
  • **AV 3.0 Summit:** Provide clear guidance on accessibility requirements for vehicles that support a range of disabilities
  • **UACT:** Demonstrations without understanding of key accessibility issues
  • **Low Speed Shuttle vs AV:** Lack of understanding of needs and impact

• Opportunities to Advance:
  • Identify partnerships/opportunities to integrate ATTRI research into ongoing and planned AV efforts across the government
  • Partner with transit agencies, mobility service providers, manufacturers, etc., to demonstrate the value of the complete trip and universal design in automation
FHWA Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts

**ATTRe Big Picture Opportunities**

**Societal Savings**
$1.3 trillion in savings from productivity gains, fuel costs, and accident prevention, among other sources

**Affordable Healthcare**
$19 billion in savings annually in healthcare

**Employment Opportunities**
New employment opportunities for an estimated 2 million individuals with disabilities

**Reduced Transit Costs**
Use of fixed-route transit by people with disabilities could save municipal transit systems an estimated $9 million annually for the country’s largest transit providers

**Reduced Barriers**
Reduced barriers to the mobility of people with disabilities could result in a positive impact to GDP of 0.6%, valued at around $460 billion.
# WHILL NEXT

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<td>• Runs autonomously after users give it a destination via a smartphone application.</td>
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<tr>
<td>• Allows multiple units to travel in a single file line.</td>
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<tr>
<td>• It can link to sensor-equipped luggage carts that automatically follow the wheelchair without getting lost.</td>
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<td>Panasonic: Sensors, Systemization</td>
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<td>• Singapore Changi Airport [SIN]</td>
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<td>• Amsterdam Schiphol Airport [AMS] - Demonstration Only</td>
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<tbody>
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<td>Panasonic: B to B market (Airports and others)</td>
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<tr>
<td>Model Ci: <a href="https://whill.jp/model-c">https://whill.jp/model-c</a></td>
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WHILL NEXT Functionality

Automatic Stop Function
- Equipped with sensors which detect obstacles in surrounding environment.
- Stops automatically as it determines there is a fear of collision.
- Easy to operate even for those who are not fluent in navigating.

Autonomous Mobile Function
- Recognizes exact location based on prestored map information.
- Selects a route and travels when destination is specified.
- Takes you to the boarding gates or selected shops without getting lost.

Platooning Function
- Recognizes own position based on autonomous mobile technology.
- For families and groups, wheelchairs can navigate to travel together.
- Reduces job load for airport staff as wheelchairs can be collected all at once after use.
Presentations by the 9 UTCs (48 universities), Industry representatives and US DOT leadership.

The UTCs presented the research they were undertaking to highlight potential areas of collaboration.

ITE, TRB ATRI, and other Industry representatives discussed the research needed to match technology with the needs of users.

Leadership from FHWA, ITS-JPO, and FTA discussed the research efforts underway in their offices to address mobility.