

Atlanta: Crowdsourced Data Collection with Apps for Sidewalk Quality

Alice Grossman, Alper Akanser,
Hanyan Li, Randall Guensler

Smart Cities Day World Conference in Marseille

September 3, 2015

STRIDE

Southeastern Transportation Research,
Innovation, Development and Education Center



SMART CITIES DAY



U.S. Context: Sidewalks and the ADA

- **The Americans with Disabilities Act was introduced in Congress in 1989 and signed into law July 26, 1990**
- **The ADA constitutes wide-ranging legislation intended to make American Society accessible to people with disabilities**
- **One goal is to reduce the frequency of unemployment and isolation suffered by persons with disabilities**

ADA Requirements for Sidewalks

- Clear width of 60" (36" minimum w/passing zones)
- Running slope 5% maximum
- Cross-slope 2% maximum
- No obstructions in pedestrian access route
- Firm, stable, slip-resistant surface
- Changes in level (surface disjoints):
 - 1/2" maximum
 - Bevel 1:2 between 1/4" and 1/2"
- Vertical clearance 80" minimum
- Curb ramp design specifications

Examples of Sidewalk Problems



Obstructions within the pedestrian route



Uneven sidewalk surfaces due to tree encroachment

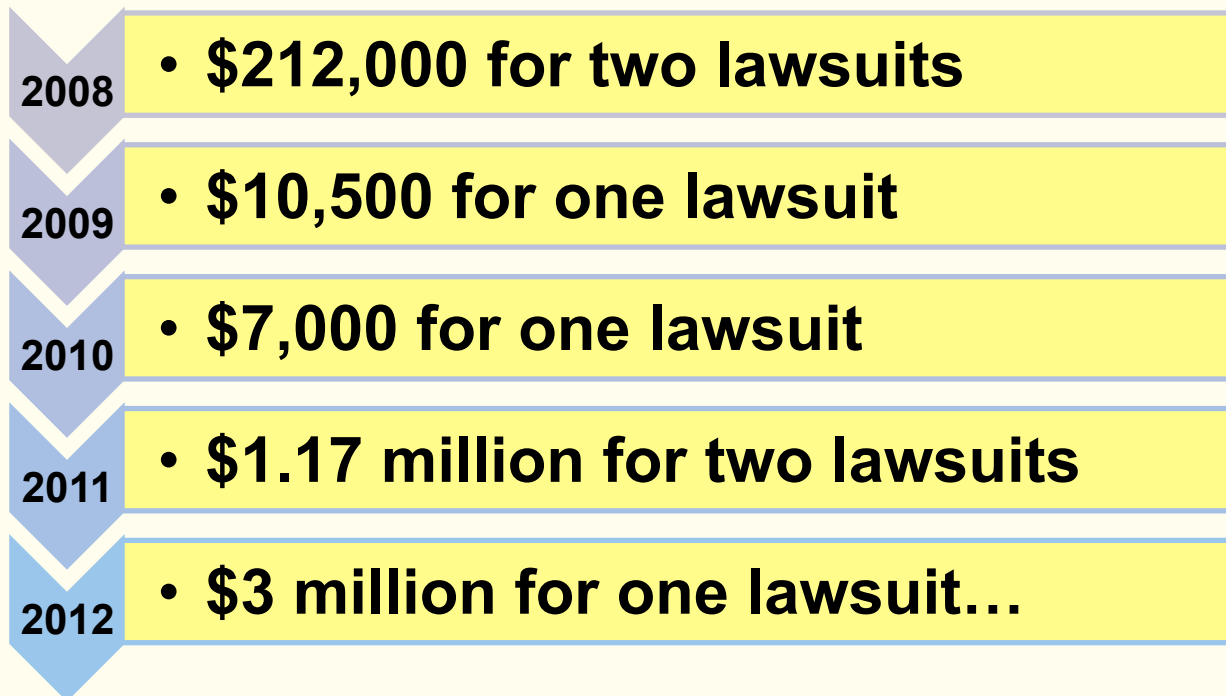


Insufficient vertical clearance

Atlanta's Sidewalks

- **More than 2,200 miles of sidewalks in City of Atlanta**
- **State of the Infrastructure Report (DPW 2010)**
 - **18% (395 miles) of sidewalks are in disrepair**
 - **10% (216 miles) of curbs are in disrepair**
- **System Maintenance Costs (DPW 2010)**
 - **\$152 million to eliminate backlog of disrepair**
 - **\$15 million annual maintenance budget needed**
- **FY 2010 budget was only \$42,000**

Sidewalk Liability: City of Atlanta Settlements



Young, Caroline. "City sidewalks need new money source." *Neighborhood Newspapers*, July 27, 2012. Web. Nov. 13, 2012.
McWilliams, Jeremiah. "Atlanta loses its footing on sidewalks: Decaying pathways cost millions in repairs, lawsuits." *Atlanta Journal Constitution*, June 24, 2012. Web. Nov. 13 2012.

Project Background

Goal: To develop data collection and analysis method for communities to prioritize sidewalk project needs based on multiple criteria, including accessibility needs for persons with limited mobility

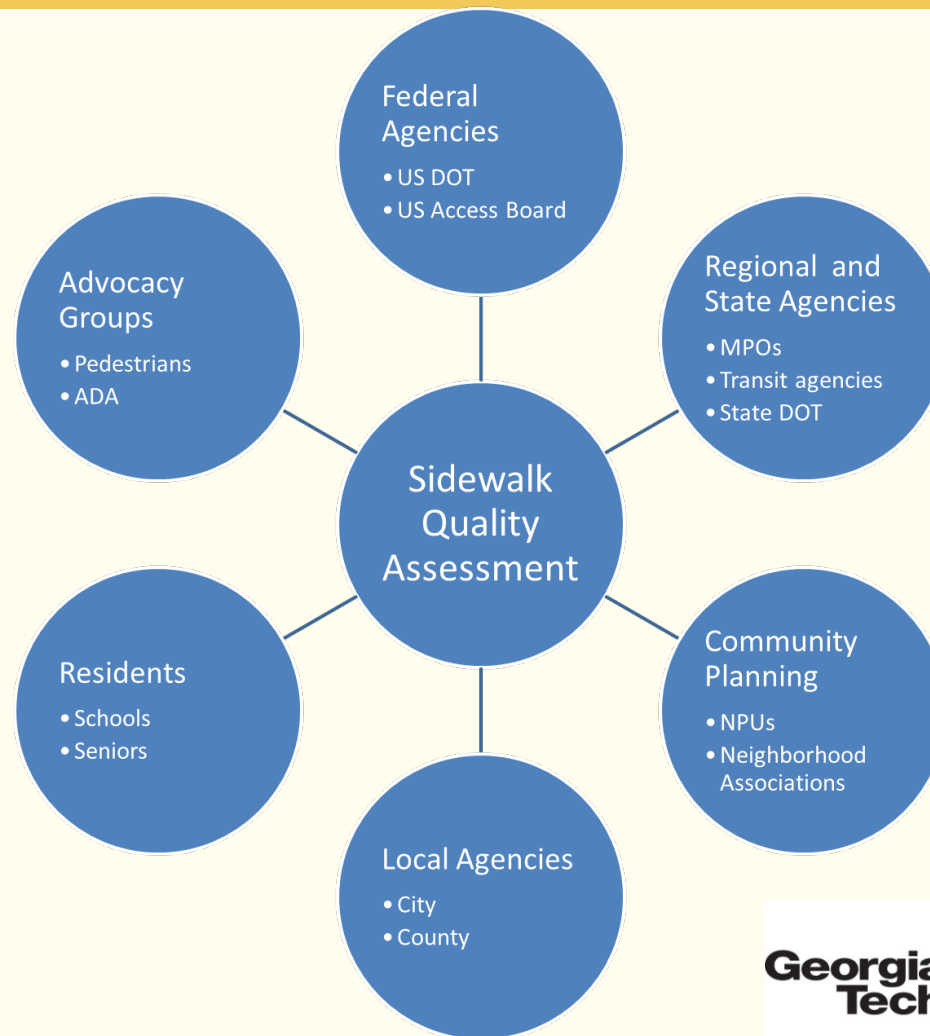
Data collection:

- User-friendly comprehensive, objective sidewalk data-collection app for tablets
- Crowdsourced sidewalk problem reports from smartphones
- Pedestrian planner and engineer Sidewalk Quality Survey

Data Analysis:

- Measured data
- Publicly available data
- Develop prioritization schemes with adjustable weighting of available variables

Stakeholder Engagement Targets



Outreach Initiatives

- **Agencies and City Organizations**
 - GDOT/FDOT
 - ARC and City of Atlanta
 - NPU
- **General public**
 - Neighborhoods
 - High schools
 - Persons with disabilities
- **Academia**
 - Papers and conferences
- **Present research to public agencies, community organizations, and local professionals**
- **Implement outreach plan to solicit volunteers for widespread deployment**
 - Neighborhood planning units (NPUs)
 - High schools
 - Other community groups

Technologies Employed

- Data collected through multiple technologies and techniques depending on the level of expertise needed
- All data contains GPS locations

Hardware	Software	Data Collected	Users
Tablet	Sidewalk Sentry	Rolling video, vibration	Researchers, Targeted volunteers
Smartphone	Sidewalk Scout	Sidewalk Problem Reports	General Public
Smartphone	Sidewalk Scout	Ramp Inspections	Trained data collectors/ researchers

Sidewalk Quality Survey

SMART CITIES DAY

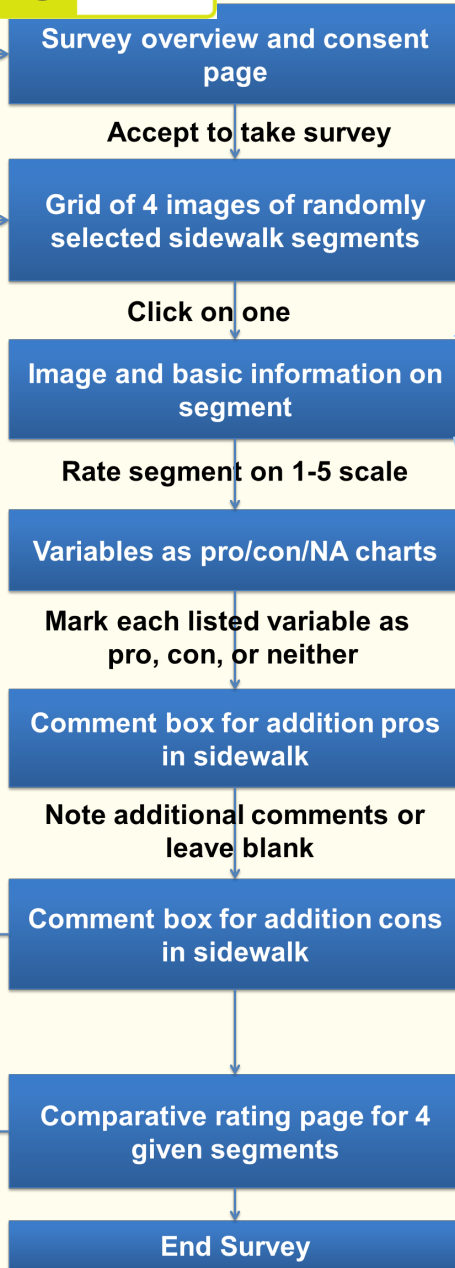
Survey Overview

- **Main objective: to inform sidewalk quality research using opinions of experts in pedestrian transportation and infrastructure**
- **The survey**
 - 1) **Provided respondent with information about four sidewalk segments in the database (out of a set of 40 available)**
 - 2) **Asked respondent to evaluate each segment**
 - 3) **Asked which variables mattered to the respondent in their evaluation**
 - 4) **Asked respondent to rank the four segments against each other**

Survey Flow

May complete survey with 1 repeat segment and 3 new segments up to 13 times

Loop repeats 4 times



Click links **video and context maps**

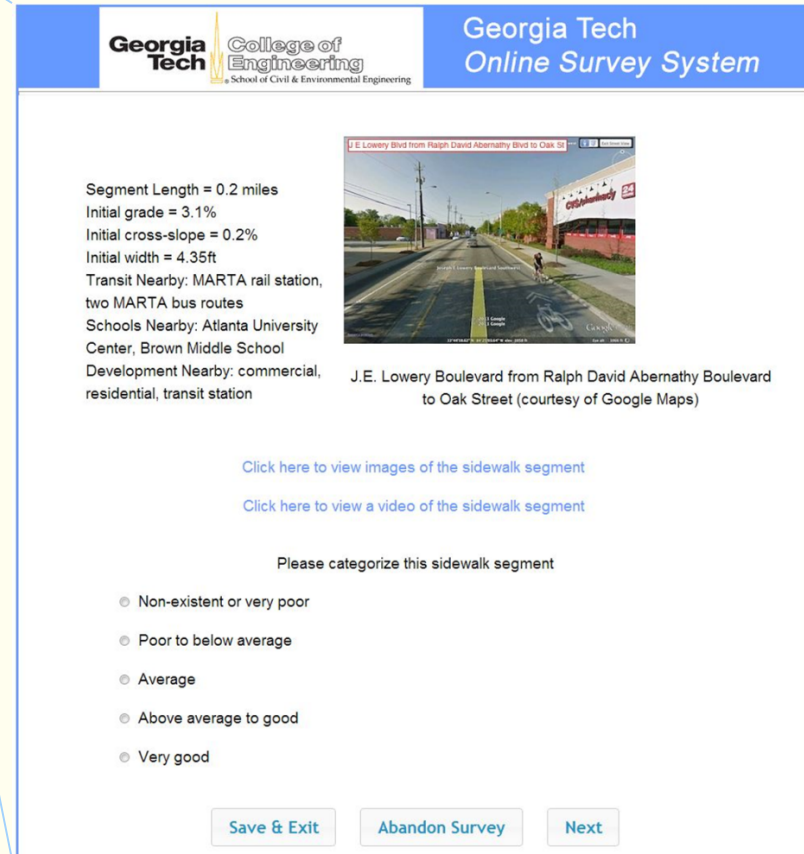
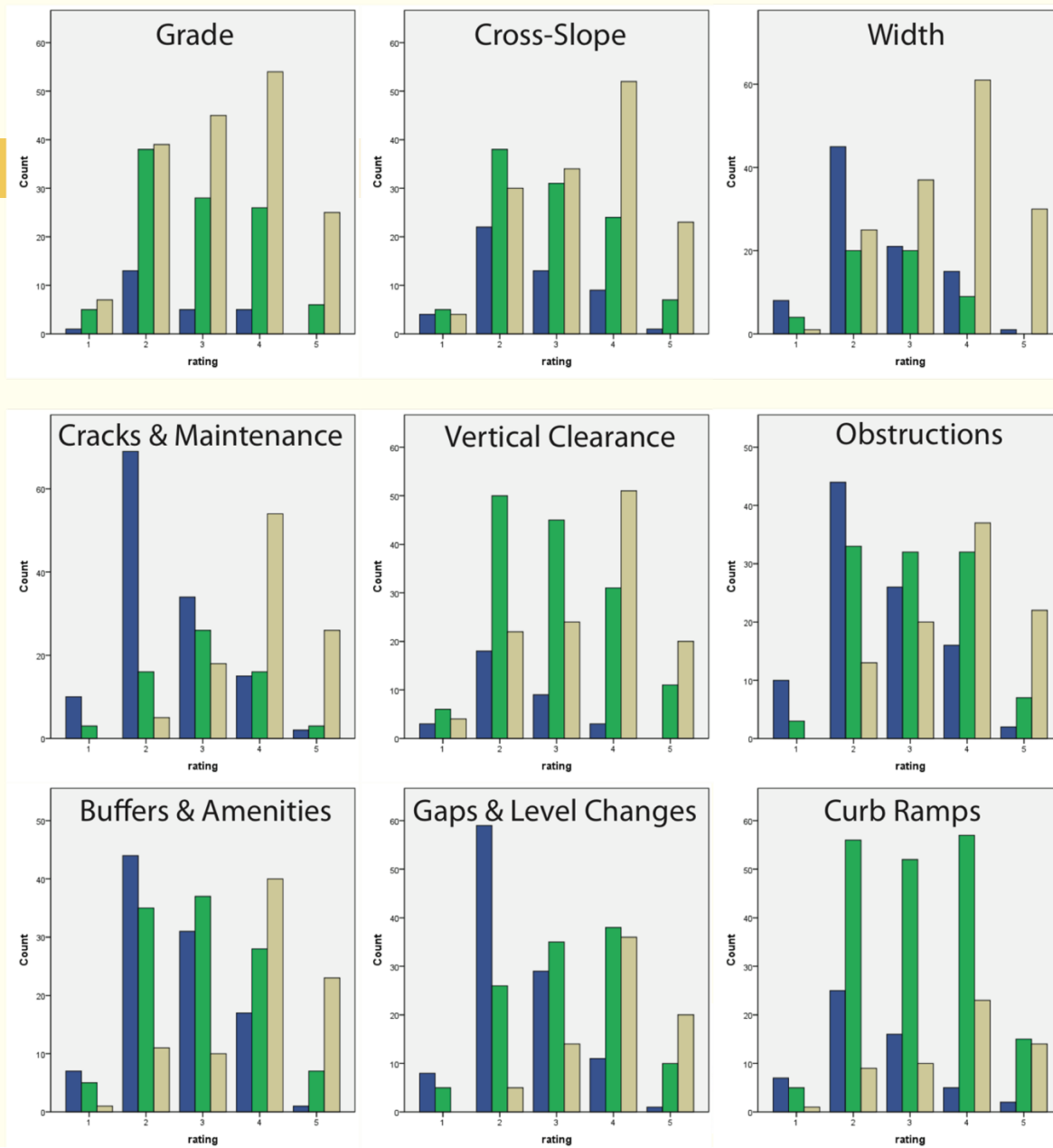


Image and basic info page of survey

Survey Results

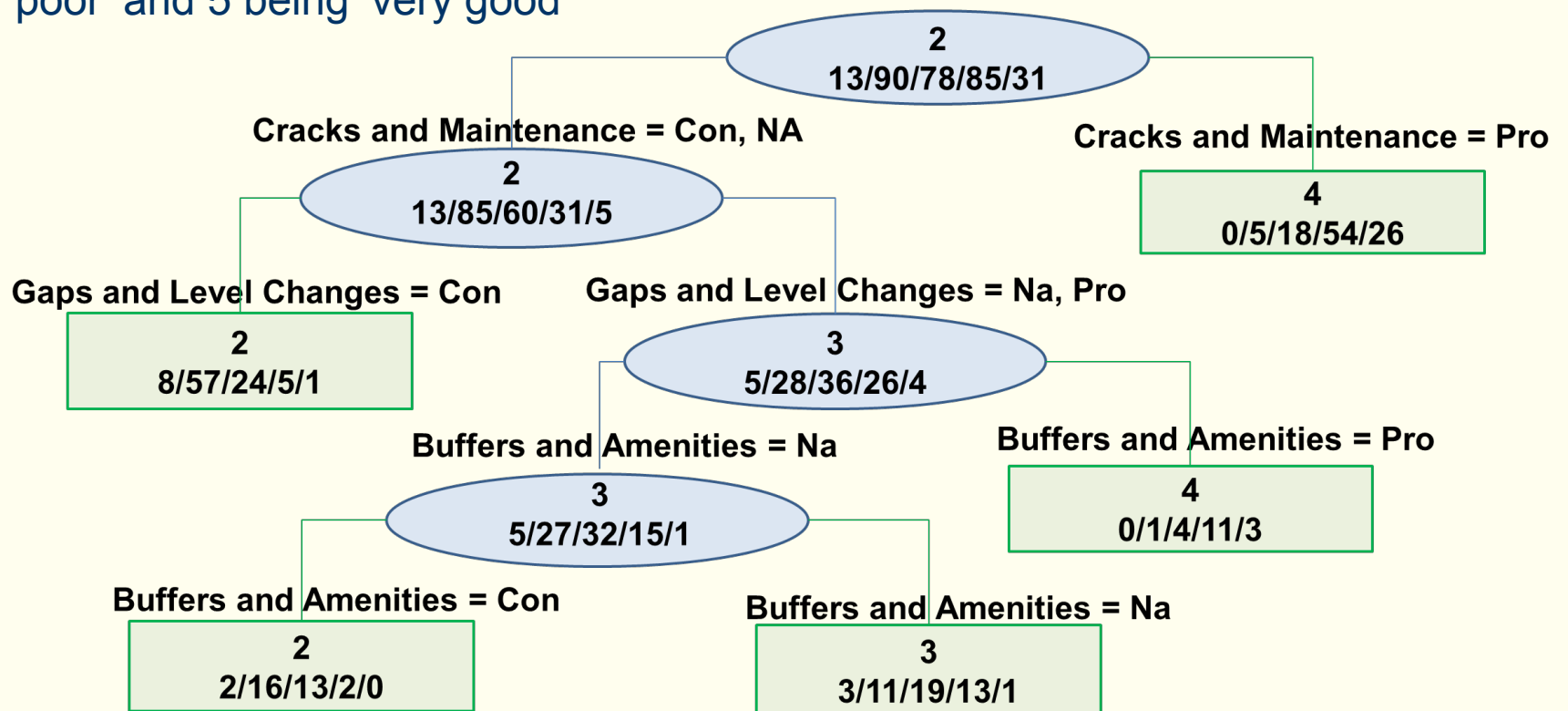
Response Rates for Con, NA, and Pro Effects of Variables on Overall Ratings

■ Con
■ NA
■ Pro



Survey Results: Classification Tree

The classification tree analysis indicates the importance of each sidewalk quality variable in experts' overall rating of a sidewalk. The tree identifies the mode rating for each classification on a 1 to 5 scale of 1 being 'non-existent to poor' and 5 being 'very good'.



Sidewalk Sentry

SMART CITIES DAY

Data collection

- Android tablet app collects rolling video, accelerometer, gyroscope, and GPS data
- Easy to use:
 - 1) Put tablet on wheelchair
 - 2) Push start button
 - 3) Walk along designated route
 - 4) Push stop button



Public Engagement

- Neighborhood Planning Unit meetings
- Volunteer training sessions
- Volunteer data collection days

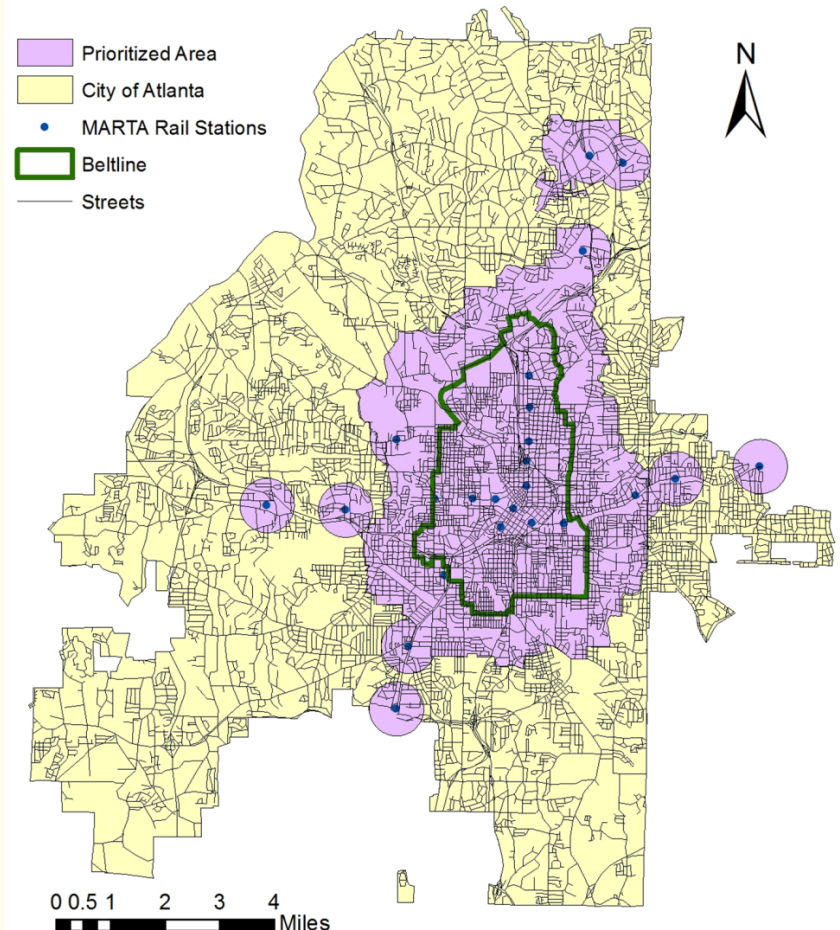


Data Collection Scope

The research team prioritized data collection within:

- The urban core areas
- Community Improvement Districts
- Half-mile buffer around rail stations
- High pedestrian crash frequency locations

Priority Area for City of Atlanta Sidewalk Data

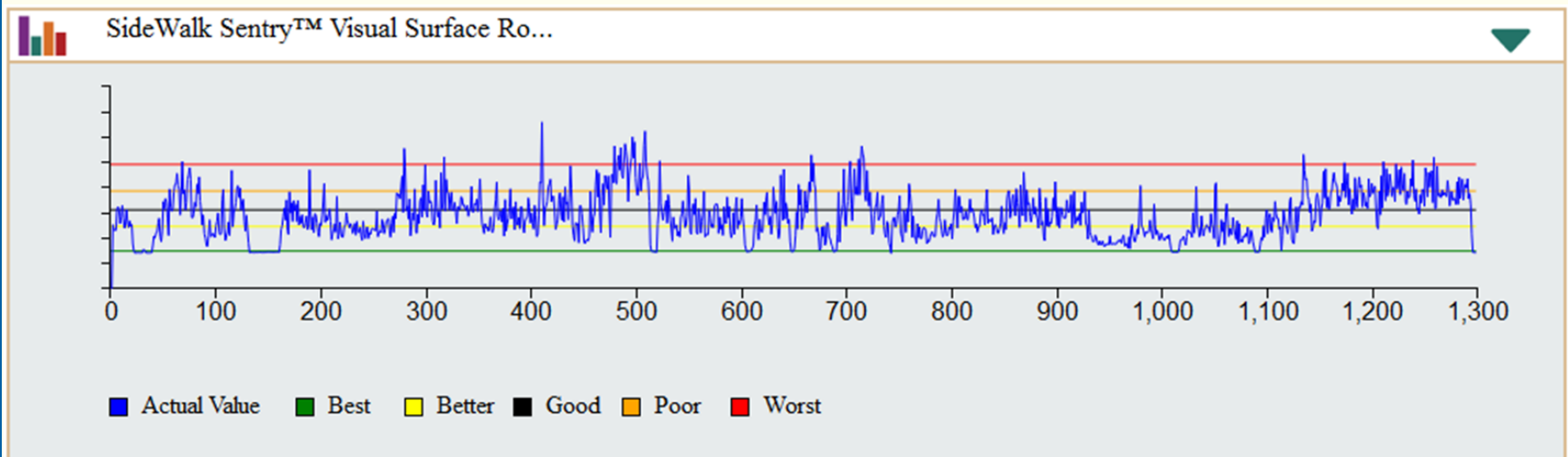


Post Processing

- **Post-processing goals:**
 - **Sidewalk width**
 - **Surface roughness**
 - **Presence of obstructions**
 - **Surface discontinuities**
 - **Crack density**
 - **Grade and cross-slope**
 - **Absence of ramps**

Vibration Data

- X, Y, and Z direction vibration readings
- Second by second aggregated data points
- Cluster analysis for 1-5 vibration rating



Vibration output for one route from interactive data viewing site

Width Data

- Semi-automated process
- Width readings every 50 feet
- Research assistants drag blue dots to align orange lines to sidewalk edges
- Automated conversion from pixel distance to real-world width



Screenshot of interactive width measuring

Object Identification

- Rolling video review
- Target and click problem on screen
- Record issue
 - Width
 - Obstruction
 - Pothole
 - Cracking
 - Uplifting

The screenshot displays the Georgia Tech SideWalk Sentry™ web interface. At the top, there is a navigation bar with 'Georgia Tech', 'Dashboard | Map | Logout', and an error message: 'Error: No expired login time was updated'. Below this is a 'SideWalk Sentry™ Map Legend' section. The main content area is split into two panels: 'SideWalk Sentry™ Video' on the left and 'SideWalk Sentry™ Route Map' on the right. The video panel shows a street view with a yellow target marker overlaid on a crack in the pavement. The map panel shows a street map of the Candler Park neighborhood with a highlighted route and various colored markers. At the bottom, there is a 'SideWalk Sentry™ Controls' section with a video player and a 'Report video issues' button. A text box provides instructions: 'To report a sidewalk issue, mouseover in the lower section of the video. Once the cursor changes into a target marker, then click the left mouse button and fill out the form that pops up. If the form was successful submitted, a marker will show up on the map.' There is also a 'Download User Trip File' button.


Data Viewing

Different levels

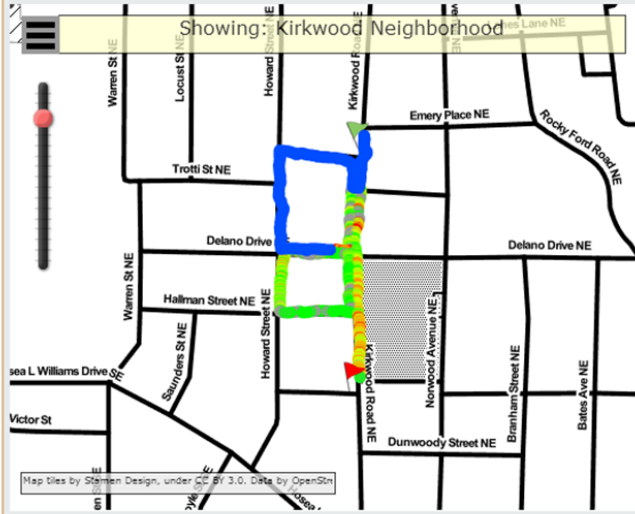
- Publicly available color coded mapped points
- Advanced user rolling video and data downloads
- Super user editing capabilities

Georgia Tech Dashboard | Map | Logout

Video Status: Loaded



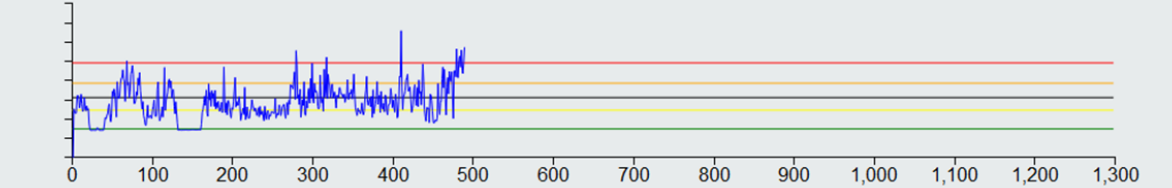
Showing Kirkwood Neighborhood



▶ || ◻ ◀ -3sec +3sec ▶ 📷

Report Video Issues Download Data for this Video

SideWalk Sentry™ Visual Surface Ro...



■ Actual Value ■ Best ■ Better ■ Good ■ Poor ■ Worst

Sidewalk Scout

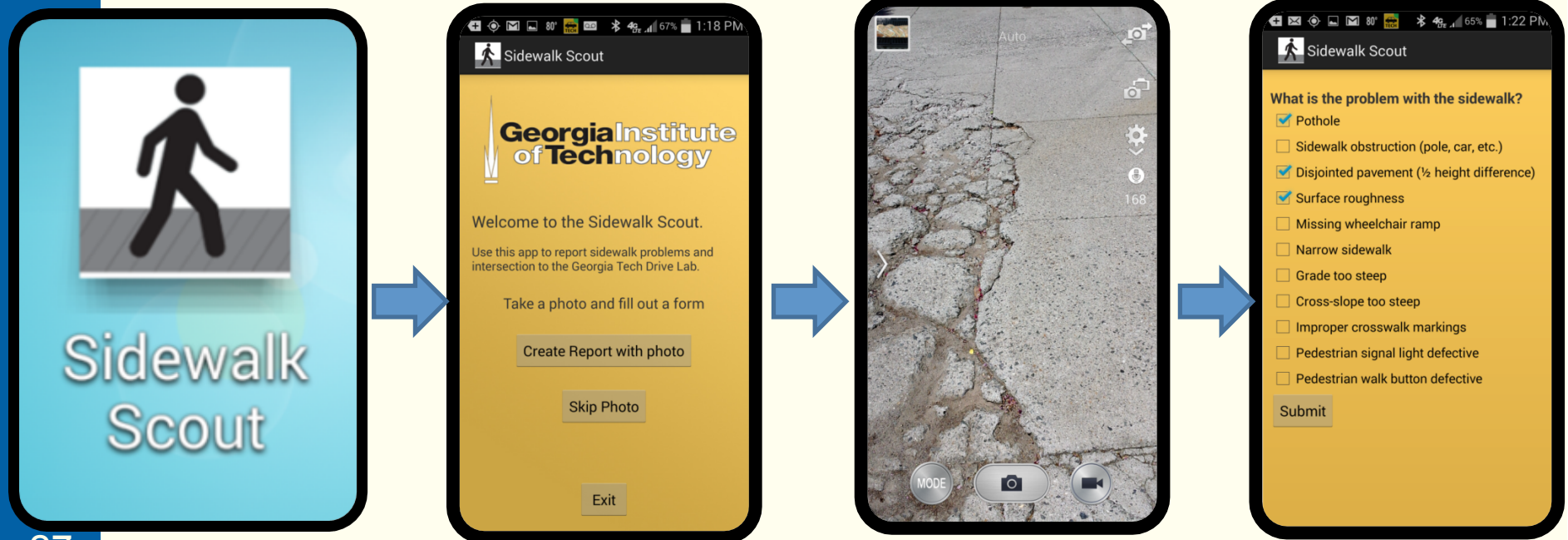
SMART CITIES DAY

Smartphone app for Pedestrian Infrastructure Problem Reports

- **Smartphone App for sidewalk problem reporting**
 - Android and iPhone versions
 - No cost, no advertisement
 - Crowdsource problem reporting feature
 - Ramp data entry feature for trained/authorized users
- **Publicly available online data viewing**
 - All reports are shown on a map
 - Open Street Maps background

Problem Reports

- Each report has options for a photo of the problem and identification of the type of problem
- App automatically GPS tags the report



Smartphone page progression for problem reporting

Trained User Measurements

- Ramp measurement feature is only available for approved users to ensure correct measurement techniques
- Enter field measurements into Sidewalk Scout interface
 - Slopes and cross slopes from smart level
 - Widths from measuring tape
 - Direction from compass



Publicly Available Data

All crowdsourced sidewalk problem reports are uploaded in real time to a publicly viewable interactive Open Streets Map interface



Screenshot from Sidewalkscout.ce.gatech.edu

Individual Report Information

Clicking on a report marker on the map gives details on the problem type, date reported, location, and an image for the issue

The image shows a map interface with numerous blue report markers. A popup window titled "Sidewalk Scout Info" is open, displaying a photograph of a sidewalk and the following details:

Name:	N/A
Date:	5/5/2015 03:02 PM
Cross Street:	33.77343 and -84.3642
Location:	33.773433640, -84.364292390
Note:	N/A
Problem:	

Close

(Social) Media

Engagement and increased awareness with the public through:

- **Twitter**
 - Policy issues
 - Calls for action
 - Events
- **Email blasts**
 - Advocacy orgs
 - Neighborhood lists
- **Postcard handouts**



Planned Activities

- Integrate Sidewalk Sentry and Sidewalk Scout views
- Personalize routing/accessibility information for pedestrian trips
- Increase visibility to stakeholders
- Undertake additional comparative surveys

Conclusions

Using technology to connect with communities about pedestrian and accessibility issues can:

- **Collect more data and increase research impact via crowdsourcing**
- **Build awareness around pedestrian accessibility**
- **Encourage communities to identify pedestrian accessibility as a legal and social responsibility**