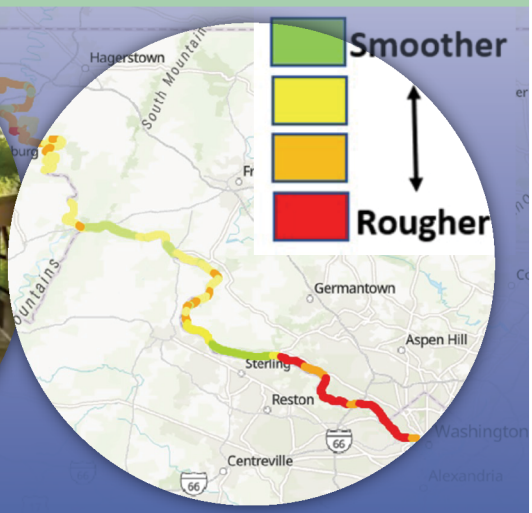
TRAILBLAZER:
Piloting a Data-Driven Trail Condition Assessment Methodology

EXECUTIVE SUMMARY



a report by the
Western Transportation Institute
Montana State University

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NATIONAL PARK SERVICE

U.S. Department of Transportation
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PUBLIC LANDS TRANSPORTATION FELLOWS PROGRAM

MONTANA STATE UNIVERSITY
Western Transportation Institute

The Trailblazer Research Project piloted an innovative, data-driven trail condition assessment methodology for the National Park Service (NPS), that uses electric bikes (ebikes) equipped with a camera and sensor system to efficiently collect photographic, accelerometer and annotative data on multi-use trails. Figure A shows the Trailblazer ebikes with critical project materials.

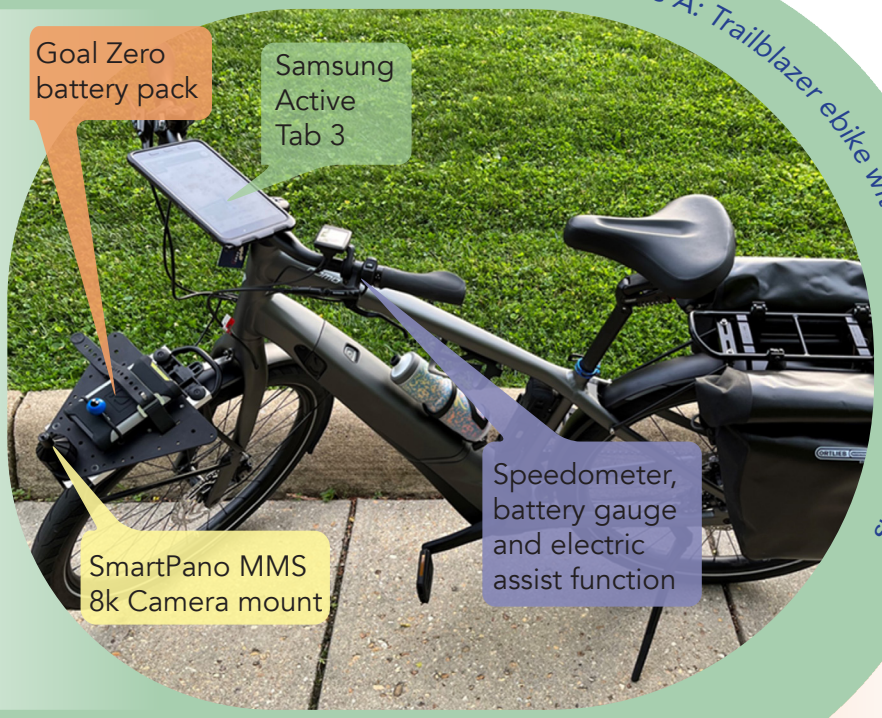


Figure A: Trailblazer ebike with critical project materials

Figure B: Trail photos captured by the SmartPano camera

The Trailblazer Project Team collected data on a total of 234 miles of NPS transportation trails (Figure B) and partner-administered trails across three National Park areas:

Chesapeake and Ohio Canal National Historical Park (CHOH),

Cuyahoga Valley National Park (CUVA), and

George Washington Memorial Parkways (GWMP).

Figure C: Example of trail 'roughness' data averaged by half mile at CUVA

These data were used to create geodatabases in geographic information systems (GIS) that can be interpreted by NPS staff and administration to inform trail management priorities and decisions. Figures C and D display examples of the maps produced by the project team.

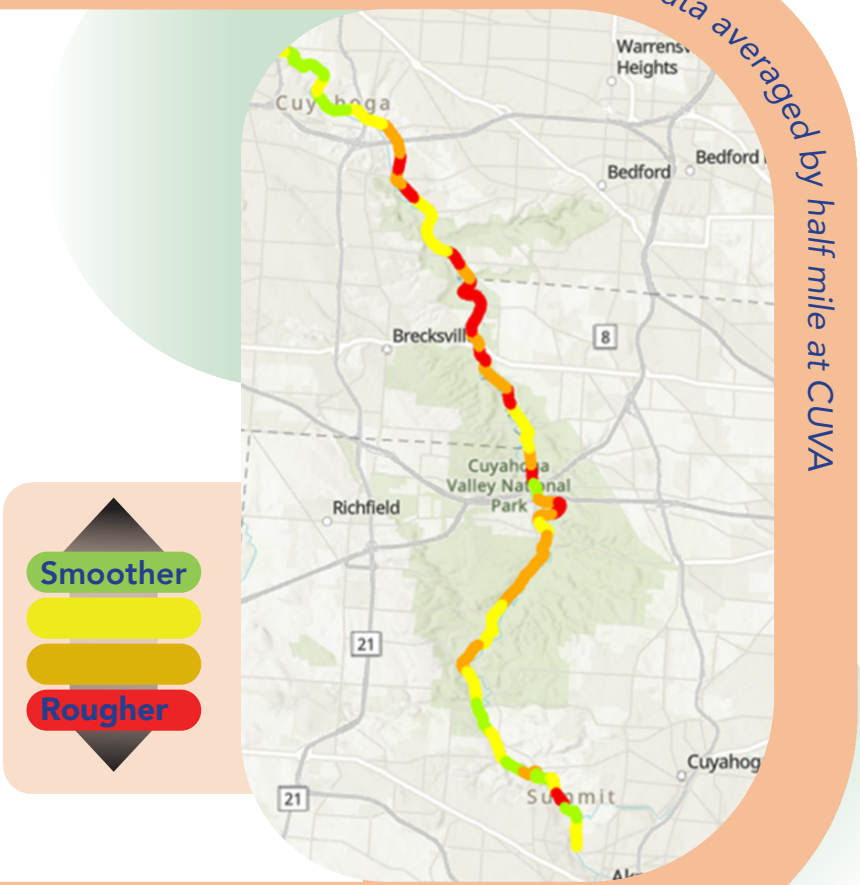
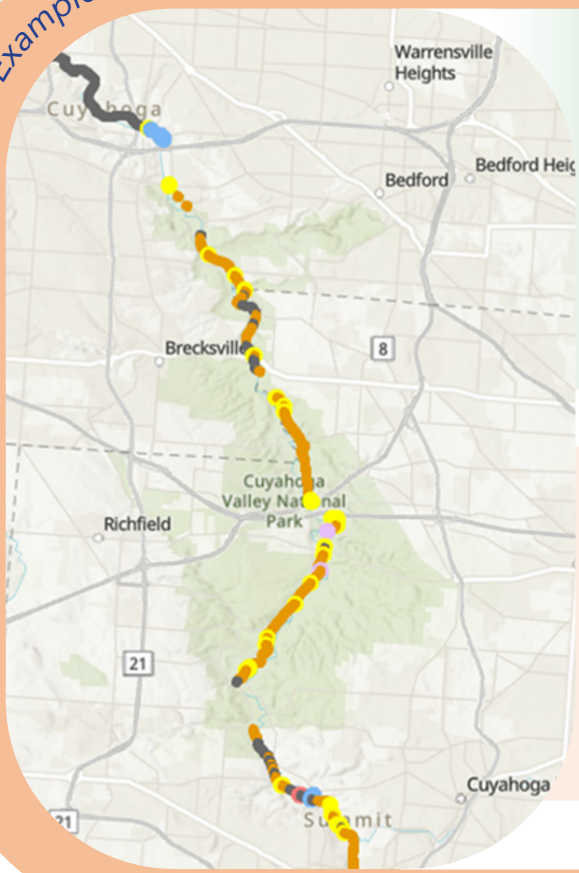


Figure D: Example of trail surface material mapped at CUVA



At a high level, trailblazer roughness data identifies the roughest and smoothest sections of trail, which can inform trail maintenance and rehabilitation priority areas. This information may also be used as a condition baseline, which can then be compared to subsequent Trailblazer assessments to track changes in trail condition over time. Mapping the surface material of the trail is also extremely useful when scoping trail maintenance or rehabilitation projects.

At a more granular level, trailblazer data can pinpoint specific damage such as potholes, cracks, rutting, etc. in a trail using photographic and annotative data. Furthermore, annotative and photographic data may be used to inventory specific trail features such as bridges, street crossings, mileposts and vegetation overgrowth, which was demonstrated by the project team over the pilot research period. This same custom annotation feature could be used in the future to inventory other trail features such as signage, access points, water resources and bathrooms, benches, etc.

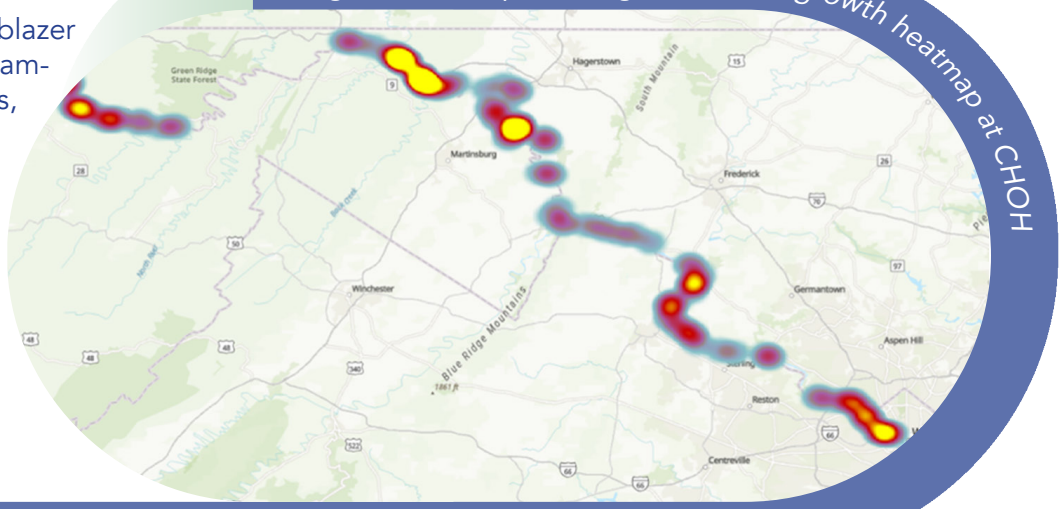


Figure E: Example of vegetation overgrowth heatmap at CHOH

Figure F: Annotaion examples 1. Bridge 2. Congestion 3. Crosswalk 4. Hazard 5. Trail Surface Material Change 6. Milepost 7. Slow/Stop 8. Vegetation

The Trailblazer system could be scaled up to assess trail networks at a national level, as well as serve an array of other future uses. Ebikes outfitted with sensors and cameras may be able to collect data on user patterns and trends that inform planning decisions regarding connectivity and community development (Rico, A., Sakai, Y., & Larson, K., 2020), as well as to produce 'virtual experiences' of trails, roads, etc. The Trailblazer methodology could also be used to assess infrastructure damage after natural disasters and stream real-time 360-degree photographic or video data to multiple remote locations, such as emergency response units. Additionally, future Trailblazer projects could employ LiDAR sensors to improve data granularity and facilitate "virtual site visits" by project engineers. LiDAR use could also be expanded to create 3D maps of trail environments, which could be further fleshed out using photogrammetry. Finally, future advances in Artificial Intelligence algorithms may be able to examine large data files and identify useful patterns. This would allow analysts to label patterns, such as bridge locations, without the need for in-person annotations, and isolate them during analysis.

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