Inventorying Bus Stop Amenities across the United States Using Google Street View Images and Computer Vision

Recipient/Grant (Contract) Number: University of New Orleans; University of Florida; University of Utah/69A3552348337

Center Name: Center for Transit Oriented Communities (CETOC)

Research Priority: Preserving the Environment

Principal Investigator(s):
Xiang 'Jacob' Yan; University of Florida; xiangyan@ufl.edu; ORCiD: 0000-0002-8619-0065
Guang Tian; University of New Orleans; gtian@uno.edu; ORCiD: 0000-0002-4023-3912
Reid Ewing; University of Utah; ewing@arch.utah.edu; ORCiD: 0000-0002-4117-3456

Project Partners: Gainesville Regional Transit System; Miami-Dade Transit; Jacksonville Transportation Authority; New Orleans Regional Transit Authority; Utah Transit Authority; Luyu Liu (Auburn)

Project Funding: $207,000 (USDOT) + $103,500 (matching funds) = $310,500

Project Start and End Date: 10/1/2024 – 5/31/2026

Project Description: Bus stops play a crucial role as primary points of interaction between the public and transit systems, facilitating access to essential services and opportunities. However, comprehensive data on bus stop amenities are scarce across U.S. cities, hindering efficient resource allocation to improve bus stops and research efforts within the transportation community. To address this critical data gap, this project proposes the development of a national database of bus stop amenities utilizing Google Street View (GSV) images and advanced computer vision algorithms. Specifically, this project aims to automate the detection and cataloging of bus stop amenities such as shelters, seating, signage, lighting, and accessibility features. To achieve this aim, we will start with the development of computer vision algorithms to detect bus shelters in Florida cities. Subsequently, a national-scale model will be trained using data from diverse regions to ensure applicability across U.S. cities. Furthermore, the project will explore the detection of additional amenities beyond shelters, including seating, bicycle parking, crosswalks, signage, and accessibility features. The main product of this project will be a comprehensive national bus stop census database, which will be made publicly accessible through a user-friendly web interface. This database will be a valuable resource for transit agencies to prioritize investments and enhance rider experience. Additionally, it will serve as an essential piece of research and education infrastructure for the transportation community. By democratizing access to bus stop data, this project will foster innovations in transit research and promote transit-oriented communities. This database can open a wide range of research and application opportunities for transit agencies across the United States and beyond. The PIs will develop a web-based interface to allow public access to the database. Also, they use technology transfer funds available from CETOC and potentially seek other funding opportunities to maintain and update this database to reflect bus stop changes. Since Google Street View images

are updated every 1 to 3 years (more frequent in dense areas where bus stops are located), together with the computer vision algorithm being developed from the project, maintaining this database up to date will be feasible with relatively low costs (estimated annual cost is $3,000 - $5,000).

USDOT Priorities: This project aims to develop a national inventory of bus stop amenities using Google Street View images and Computer Vision. It fills an essential data gap in public transit systems, which can inform the implementation of the Bipartisan Infrastructure Law and in turn advances the *Economic Strength* and *Safety* goals established by the USDOT RD&T Strategic Plan. By creating an inventory of bus stop amenities, the project can help identify areas where improvements are needed to make public transportation more accessible for everyone. This includes identifying stops that lack basic amenities like seating, lighting, or shelter, which can impact rider safety. Moreover, the application of cutting-edge computer vision algorithms for transportation infrastructure data collection aligns with USDOT's *Transformation* emphasis on fostering innovation and transformative research.

Outputs: We expect to produce 1-2 publications from Year 1 of this project. We will present the work at international/national conferences such as ACSP and TRB annual meetings. The project will lead to new computer vision algorithms and bus stop amenity detection methods widely applicable across US cities and beyond. In addition, by working together towards the goal of developing a national database of bus stop amenities (which is expected to be accomplished in Year 3 of the project), it will establish close relationships between CETOC and various transit agencies.

Outcomes/Impacts: We will develop automatic bus shelter and bench detection models that are scalable across U.S. communities. This will provide cities and transit agencies an efficient and cost-effectively approach to evaluate bus stop conditions. By the end of this proposed four-year project (two R&D years and two technology-transfer years), the output will be a national bus stop census database freely available to the public. The database may also be used by public agencies and community groups to develop a clear picture of bus stop conditions across their transit networks, which will allow them to identify and prioritize opportunities for improvement. This database can also open a wide range of research and application opportunities, such as understanding potential disparities in bus stop amenity distributions across cities, developing enhanced ridership prediction models, and investigating the role of bus stop shared mobility and alternative vehicle parking in promoting transit use.

Final Research Report: (Link to be provided after project completion).