DRISI
Caltrans Division of Research,
Innovation and System Information

Research Results

Sidewalk System Digitalization

Creating a sidewalk inventory/categorization program that will support active traveling and foster sustainable transportation

Planning/Policy/
Programming

MAY 2019

Project Title:
Sidewalk System Digitalization

Task Number: 3097

Start Date: November 21, 2016

Completion Date: November 15, 2017

Task Manager:
Patrick Tyner
Associate Transportation Planner
patrick.tyner@dot.ca.gov

WHAT IS THE NEED?

As a key ingredient for sustainable transportation, active traveling, in particular walking, is advocated as a great way to promote physical fitness, mitigate local street congestion, and foster community livability. To favor active mobility, extensive work has been focused on planning, maintaining and enhancing the infrastructure, such as sidewalks. A significant amount of these efforts are focused on the setup and maintenance of the sidewalk inventory on a certain geographic scale (e.g., citywide, statewide). Conventionally, researchers rely on laborious field surveys to conduct sidewalk inventory. To date, only a few studies attempt to digitize sidewalks as a part of geographic information system (GIS) training, and create the sidewalk inventory under restricted conditions. However, the current methods of sidewalk system digitization are not comprehensive or cost-effective.

WHAT WAS OUR GOAL?

The goal of this work was to provide a database that both local entities and the state can use in assessing pedestrian transportation systems and future infrastructure needs concerning Active Transportation.

WHAT DID WE DO?

To address the stated problem, the project developed an interactive machine learning based approach that can: 1) initialize the features of sidewalks; 2) classify sidewalks into two major categories, i.e., paved sidewalk, and missing sidewalks; and 3) construct a connected sidewalk network in a time-efficient and cost-effective manner. The proposed method took full advantage of available data sources (e.g., aerial and satellite images)

and built on top of existing roadway networks to digitize sidewalks. The mapping approach laid the foundation for a sidewalk inventory, as well as improved active traveler navigation and related research. The final deliverables are: 1) a final research report; 2) the digitization prototype written in Python and MATLAB; and 3) copies of reports produced with this funding. This research also presented a case study that helps to evaluate the performance of the mapping approach. Researchers chose several neighborhoods in Riverside City as the case study area. Upon request, we can present our study in an interactive webinar with Caltrans.

WHAT WAS THE OUTCOME?

This project's mapping approach will provide a basis for a comprehensive sidewalk inventory, which lays the foundation for a variety of active-mobility-focused applications.
The applications include:

- Enhance the inventory of sidewalk infrastructure
- Improving the pedestrian navigation accuracy
- Modeling the pedestrian volume and identifying sidewalk sections which need improvement

Several future directions can be explored:

- Automate the preprocessing steps
- Enhance the level of details when categorizing sidewalk features, e.g. separate driveways from regular sidewalk
- Explore more advanced machine learning algorithms such as a convolutional neural network for classifying images into detailed sidewalk features.
- Apply the similar image sweeping methods to obtain other road attributes, for example, road width, bicycle lane location, and freeway condition.

WHAT IS THE BENEFIT?

This project's mapping approach will provide a basis for a comprehensive sidewalk inventory that will improve active traveler navigation, a key factor in the enhancement of sustainable transportation. For Caltrans, this project will support the Department's goals for sustainable transportation and Caltrans' Complete Streets implementation efforts, which leads to a seamless, interconnected transportation system utilizing a variety of modal options for travelers.

LEARN MORE

Review the complete report.

https://ncst.ucdavis.edu/project/developing-an-interactive-machine-learning-based-approach-for-sidewalk-digitalization/

IMAGES

a. a section of paved sidewalk (blue line) is paved and wheelchair accessible. It is the safest and most friendly for pedestrians and other active travelers.

b. a section of landscape/lawn sidewalk (green line) has no pavement, but it is still walkable.

c. a crosswalk (coral line) is the walkable section at intersections of motor vehicle roadways. Even though most busy intersections are controlled by signal lights, most pedestrian crashes occur on crosswalks. Moreover, there is additional waiting time at crosswalks because pedestrians need to wait for the crossing signals.

e. a missing sidewalk (red line) means there is a potential need for sidewalk, but no space is available for walking at all.

d. section of driveway/parking-lot sidewalk (purple line) is usually the outlet of parking lots or garages. Vehicles pass these sections without signal regulation. Hence there are potential safety hazards and yielding delay for active travelers when they cross these sections.