Collecting and visualizing accessibility information are always challenging problems within the realm of Human-Computer Interaction (HCI). A team of researchers at the University of Maryland have proposed innovative approaches that combine crowdsourcing, computer vision and machine learning to detect and visualize how accessible a particular street or sidewalk is. Tohme is one such approach for finding curb ramps remotely in Google Street View scenes. Based on experiments conducted by the team, the system demonstrates a performance comparable to a conventional manual approach but with a dramatic reduction in time and cost.

Why street-level accessibility?

The U.S. Census Bureau in Americans with Disabilities: 2010 reports [1] that 30.6 million adults in the U.S. have physical disabilities that impair their ambulatory activities and nearly half of them use assistive aids such as wheelchairs. For these populations, Street-level accessibility is an important factor in securing their mobility outdoors. Especially, mechanisms that provide information about accessible routes are necessary to enhance their mobility (e.g., Figure 1). Assessing street-level accessibility information, however, has been labor intensive and costly, and no such aiding tools have existed.

New scalable data collection method and assistive map tools

A team of researchers from the University of Maryland, College Park led by Prof. Jon Froehlich has developed new data collection techniques to gather street-level accessibility information and new assistive navigation/map tools based on the collected accessibility data. They combine crowdsourcing, computer vision (CV), and machine learning techniques along with Google Street View (GSV) scenes to efficiently and accurately gather road-accessibility information, such as curb ramps (Figure 2), which existing public databases have failed to sufficiently provide [3]. Combining and exploiting the three techniques helps in overcoming the scalability challenges affecting existing approaches that rely solely on only one of them (i.e., crowd sourcing, computer vision, or machine learning [4] [5]).

Tohme: detecting curb ramps in Google Street View

As a part of their ongoing efforts, the team has presented Tohme (pronounced toe-may) [3], a semi-automatic scalable system that finds curb ramps in GSV panoramic scenes (Figure 2). Tohme is operated by four subsystems:

1. A web scraper that downloads street intersection data using Google Maps API;
2. State-of-the-art computer vision algorithms that automatically detect curb ramps in a given GSV scene;
3. A machine-learning-based controller that predicts the quality of the CV-based detection and then forwards the GSV scene to either a human labeling pipeline or a human verification pipeline according to the prediction result;
4. **Human workers:** if the prediction is a false negative, the GSV scene is forwarded to the human labeling pipeline where human workers label a curb ramp from the scene. Otherwise, the GSV scene is forwarded to the human verification pipeline where human workers just verify the detection made by the CV-based algorithms.

The Tohme system has been extensively tested using over 1000 intersections of GSV image data in both dense urban cores and semi-urban residential areas across four cities in the U.S. With around 240 labeling and 160 verifying by crowd-sourced human workers, Tohme was able to provide comparable accuracy to a pure human-powered labeling approach with huge enhancements in run-time. A demo of the Tohme system in action can be accessed here [6].

**Future of road accessibility studies**

Tohme has proved the efficiency and the accuracy of the semi-automated framework for assessing road accessibility. To foster the work in this area, the researchers plan to make their collected accessibility information available and provide an access to their API. They hope that this initiative will drive the development of a new broad range of accessibility-aware applications and interdisciplinary research areas. For instance, public health researchers and urban planners can study the relationship between neighborhood accessibility and local residents health, using the data publicized by the researchers. Further, Prof. Froehlich and his team also envision the integration of their results into available services, e.g., searching for restaurants on Yelp based on their level of accessibility, finding the most accessible routes in Google Maps etc.

**References**


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