Utilizing Viennese Geographic Open Government Data For Better Inclusion Of Mobility-Impaired Persons

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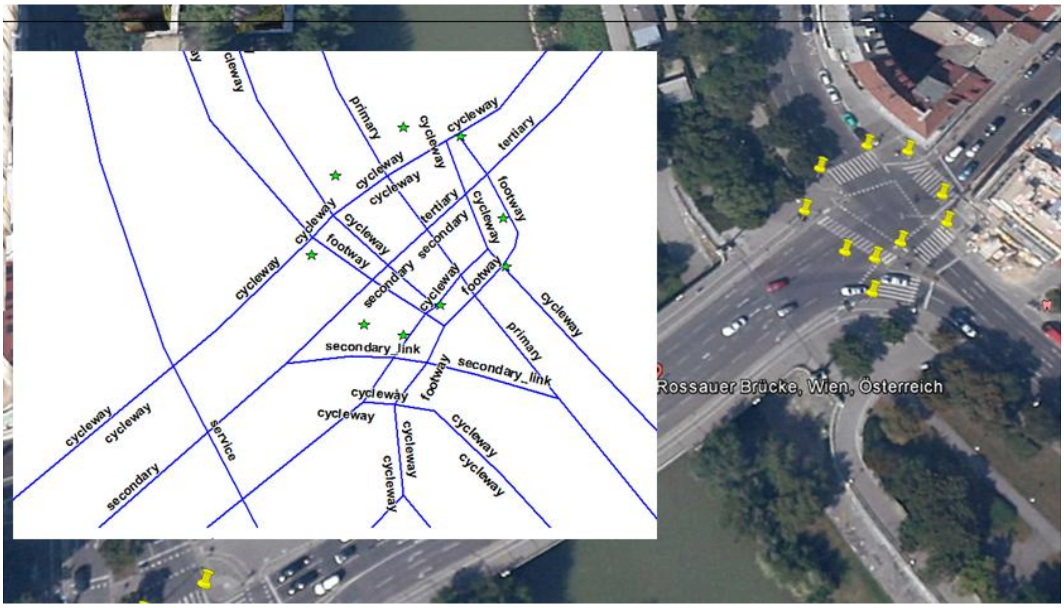
Summary

Mobility-impaired pedestrians, such as wheelchair users or people with walking frames or rolling walkers, have significantly different demands regarding routing and navigation support than car drivers and non-impaired pedestrians. This paper reports about work in the European funded project CAP4Access (www.MyAccessible.EU) of adapting routing and navigation algorithms to better facilitate mobility impaired pedestrians by integrating point data about kerbs in the City of Vienna into OSM street and sidewalk information. We show how the data integration from point data onto lines in OSM can work, and how the new routing and navigation algorithms have to be based on a sidewalk network instead of the street network.

Context. CAP4Access (Collective Awareness Platforms for Improving Accessibility in European & Regions) is a three year research project funded by the European Union (2014-2016). The project consists of a diverse consortium of eight European partners, who are researching tools and methods that can improve accessibility for people with mobility impairments. All outcomes of the project in terms of data and software are made available under an open licence. Results of the project are sourced from and exploited in four European pilot cities: London, Heidelberg, Vienna and Elche (Spain).

Viennese Kerb Data. One important task of the project is to enhance routing and navigation functionality based on OSM (Open Street map) to respect specific accessibility-sensitive information. Vienna, as a pilot site of the project, has one of the most advanced open data policies of any European city. OGD Vienna offers several accessibility-related data sets such as road and sidewalk surfaces, the position and height of dropped kerbs, acoustic and tactile signals, elevators in stations, handicapped parking, and a precise elevation model. In the course of the CAP4Access project and as an awareness raising demonstrator of its potential, these data, most of which are not yet available in OSM, will be utilised in a variety of ways.

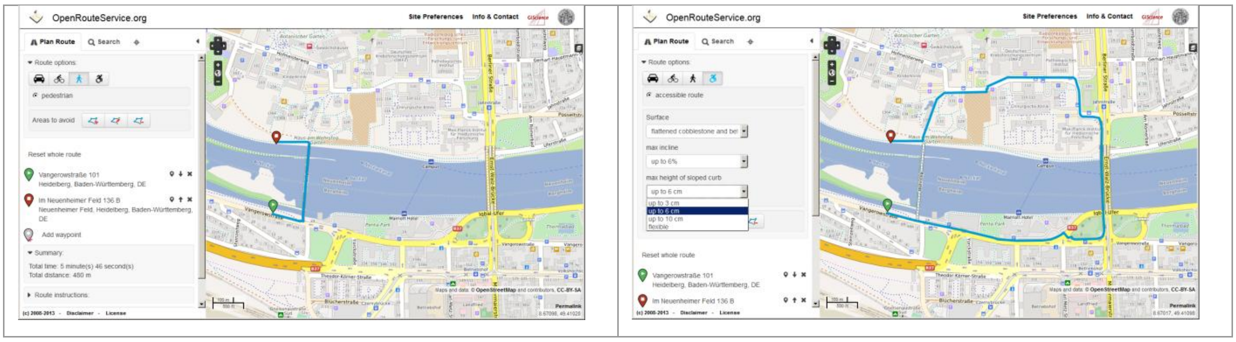


As a first activity, project partner Fraunhofer IAIS has started integrating Vienna's dropped kerb data set into the mapping platform OpenStreetMap (OSM), soon to be made available to the entire OSM community. Dropped kerbs are the points which enable wheelchair users crossing a street to re-enter the sidewalk. Every record of the dropped kerb data set provides two pieces of information: the position of a dropped kerb defined by its geographic coordinates and the height of the kerb at that point, measured in one of three values: 0, 3, or 5 cm. It is simple enough to just import these records as new points into the OSM data base, and in this way the dropped kerbs could be shown on the map as points. But because the location of a dropped kerb shall be used in wheelchair routing, it must thus be uniquely associated with the correct street, and now things become more complicated.

The complication that arises is illustrated in the figure above. On the aerial image, several pins represent the dropped kerbs at a crossing. Looking at this photo, the locations of the pins seem to make sense in terms of which sidewalk they allow entry to. They usually come "in pairs" facing each other at opposite sides of a street. Now have a look at the overlaid graphic showing the situation in OSM where streets and ways are modelled only as thin lines in the map's internal database, shown by the blue lines in the graphic. The green stars in the graphic represent the dropped kerb points with the same coordinates as those in the aerial image. Now, forget what you know from the aerial image and try to match the green stars to the "their" skinny blue lines, or streets. That is not easy anymore! You will probably find several points hard to assign to one single street.

Resolving these ambiguities proved to be surprisingly challenging. We started introducing a set of heuristics based on what is known about the location of dropped kerbs on real streets. This set of heuristics then was incrementally applied reducing the set of possible assignments until the most plausible overall solution was found. Fortunately, after manual checks at dozens of complex crossings – the heuristics of the automated kerb assignment algorithm delivered almost 100% accurate results.

Utilization of Kerb Data for Optimized Routing and Navigation. Only few of the available routing algorithms address routing profiles for mobility impaired people[1]. CAP4Access partner University of Heidelberg previously developed the OpenLS-based[2] routing system OpenRouteService.org[3] (ORS), which may easily be integrated in other applications. This routing system uses the OSM database as its source for the underlying road and footpath network. Within that system, multiple routing profiles are provided (car fastest, car shortest, pedestrian, wheelchair etc.). The figure shows an example of a route plan where a difference between the pedestrian profile and the wheelchair profile occurs due to a pedestrian bridge that is only accessible via steps. Obviously, a wheelchair user should not be directed on a route that requires the traversal of such step features.



The height of the kerbs at streets is an important parameter for wheelchair route planning. Since different wheelchair users have different abilities (e.g. electric wheelchair vs. manual wheelchair) they may self-select their maximum feasible height of a kerb. The routing algorithm may then interpret a given too high kerb on a possible route as a barrier and search for an alternative route. The computed route plan may then be used to provide navigation instruction tailored to the individual needs

Future Work. As mentioned above, OGD Vienna has some more relevant data sets in their offering. We plan next to utilize the elevation data and assign a level of slope to every section of a sidewalk. The manageable slope will become part of every individual's profile. Surface texture of the sidewalk (e.g. sand, asphalt, etc.) will then follow. The project will also address means for crowd-sourcing or otherwise create new data where they are not yet available.

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[1] Neis, P. & Zielstra, D. (2014). Generation of a tailored routing network for disabled people based on collaboratively collected geodata. *Applied Geography*. Vol. 47, pp. 70–77.

[2] Open Geospatial Consortium Inc., 2008. *OpenGIS Location Services (OpenLS): Core Services*. Available from: http://portal.opengeospatial.org/files/?artifact_id=22122

[3] Neis, P. & Zipf, A. (2008). OpenRouteService.org is three times "Open": Combining OpenSource, OpenLS and OpenStreetMaps. *GIS Research UK (GISRUK 08)*. Manchester, UK.