Toward a collective tagging Android application for gathering accessibility-related geospatial data in European cities

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Abstract

Detailed geospatial data about the accessibility of places, buildings and transportation network features is required to improve urban planning with respect to accessibility and to assist persons with limited mobility or special needs in planning their travels. However, in official data sources or in crowdsourcing platforms such as OpenStreetMap, such information is scarce an insufficient to address the above-mentioned needs. This paper reports on an ongoing project for the development of a collective tagging Android application for gathering volunteered geographic information on accessibility at a high level of precision in selected European cities. The collective tagging application is being developed according to pre-identified needs of target user groups and will be useful to promote accessibility throughout Europe.

Keywords: Accessibility, Collective tagging, Crowdsourcing, OpenStreetMap.

1 Introduction

Improving accessibility for people with limited mobility and special needs is a core objective of urban planning policies in Europe. As highlighted in the European Union's Accessibility Policy [1], "the accessibility challenges facing society today are most visible in urban areas." To address accessibility challenges, access to detailed geospatial data, including on the accessibility of buildings, sidewalks, public transportation and roads, is crucial. However, access to such data is limited. Laakso [9] notes that no holistic geospatial data collection approach exists to describe the accessibility of geographical spaces. Crowdsourcing can be a solution to generate this missing data.

The term "crowdsourcing" emerged in 2006 to describe web-based business models that leverage a distributed network of individuals through the equivalent of open calls for proposal or information [7]. Since then, the amount of crowdsourcing applications has been increasing and their potential has been demonstrated for a large variety of purposes [5]. From a geographical point of view, crowdsourcing applications have proven to be useful to obtain detailed information at the local level and in a near real-time fashion [2]. In addition, contrary to commercial or official data sets, the data is generally available free of charge. A well-known example is OpenStreetMap (OSM), an open source and editable digital map of the world. Strunck [11], who has conducted experiments on the growth of different OSM POI categories in Germany, observed that OSM had about twice as many points-of-interest (POIs) as TomTom MultiNet data, a commercial data source. The purpose of this paper is to report on the development of a collective tagging solution that is coupled with OSM for gathering accessibility-related data in European cities. The proposed tagging Android application aims at addressing the lack of commercial or official data on accessibility of places by gathering data produced by volunteers through their mobile clients. The tagging application was developed following surveys with groups of targeted users who identified the information they needs to better plan their travels in urban areas.

2 Analysis of accessibility-related data in selected European cities

In the transportation research field, "accessibility" refers to the ability of a given category of persons to reach a given destination [4]. Accessibility is therefore a function of the spatial distribution of potential destinations, and of the facility to reach these destinations for persons with given mobility constraints; it also depends on the relative quality of the destination for the targeted social group [6]. The measurement of accessibility is an important component of urban planning, and various accessibility measures exist [3]. Measuring accessibility of the transportation network requires various geospatial data at a fine level of detail, such as the width of sidewalks, the type of road surface, the degree of road smoothness, and so on. Unfortunately, as of today, such data is not widely available and it is therefore difficult for people with limited mobility to plan their travels, or for urban planners to take appropriate measures to ensure or improve accessibility.

Still, a number of crowdsourcing initiatives have been undertaken to gather information about accessibility in some European cities. More particularly, and especially through the CAP4Access project (http://myaccessible.eu/), an active community is collecting detailed data about accessibility and making this data available to the public through OSM and other tools. We have conducted a preliminary comparative study to find out the amount of data about accessibility that has been contributed in various European cities. We have collected the number of tags that has been contributed for various (key, value) pairs that relate to accessibility of ways (sidewalk, width, smoothness, etc.). The results are reported in Table 1. The parameters listed (sidewalk, width, surface, etc.) correspond to the information items that target user groups identified as needed to assist them in planning their travel. The absolute number of way tags where the given attribute has been contributed is provided, along with the corresponding percentage. The data shows a high degree of variability across European cities, with London and Elche (Spain) being the city where, respectively, the larger and smaller numbers of tags were contributed. The table also shows the important scarcity of data on particular items, such as step height or handrail, where less than 1% of way tags also provide the attribute. The presence of a sidewalk, as well as its width and surface, are generally among the most contributed data, but even for these attributes, the data is scarce with percentage not exceeding 35 percent. Overall, the lack of data shows that it is not possible for people with limited mobility to currently rely on existing data to plan their travel.

Table 1: Amount of accessibility-related data contributed through OSM in various European cities

City	London	Vienna	Heidelberg	Elche	Geneva	Paris	Madrid	Brussels	Amsterdam
Date of observation	2014-10-13	2014-10-17	2014-10-17	2014-10-17	2014-10-21	2014-10-21	2014-10-21	2014-10-21	2014-10-21
Parameters	**Number of way tags where given attribute has been contributed (%)**								
sidewalk	15,335 (8%)	445 (5.73%)	248 (14.06%)	0 (0%)	4 (0.60%)	110 (2.51%)	687 (15.30%)	9 (1.65%)	199 (3.65%)
width	90 (0.05%)	136 (1.75%)	90 (5.10%)	1 (2.5%)	3 (0.45%)	22 (0.50%)	8 (0.18%)	0 (0%)	1,110 (20.34%)
surface	5,909 (3%)	1,355 (17.43%)	537 (30.44%)	14 (35%)	31 (4.67%)	330 (7.54%)	635 (14.14%)	24 (4.39%)	1,646 (30.17%)
smoothness	5 (0.003%)	15 (0.19%)	44 (2.49%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1,049 (19.23%)
inclination	65 (0.03%)	12 (0.15%)	30 (1.70%)	1 (2.5%)	0 (0%)	11 (0.25%)	4 (0.09%)	0 (0%)	0 (0%)
sloped_curb	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
lit	20 (0.01%)	593 (7.63%)	158 (8.95%)	0 (0%)	41 (6.17%)	233 (5.33%)	9 (0.20%)	0 (0%)	1416 (25.95%)
tactile_paving	0 (0%)	0 (0%)	10 (0.57%)	0 (0%)	0 (0%)	2 (0.05%)	0 (0%)	0 (0%)	1 (0.02%)
step_count	20 (0.01%)	5 (0.06%)	12 (0.68%)	0 (0%)	1 (0.15%)	9 (0.21%)	2 (0.04%)	0 (0%)	1 (0.02%)
step:height	40 (0.02%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
ramp	40 (0.02%)	3 (0.04%)	0 (0%)	0 (0%)	0 (0%)	1 (0.02%)	0 (0%)	0 (0%)	1 (0.02%)
handrail	1 (0.0005%)	1 (0.01%)	0 (0%)	0 (0%)	0 (0%)	1 (0.02%)	1 (0.02%)	0 (0%)	0 (0%)
crossing	6 (0.003%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (0.02%)	0 (0%)	0 (0%)	9 (0.16%)
General access (foot = yes|no, wheelchair = yes|no)	0 (0%)	81 (1.04%)	14 (0.79%)	0 (0%)	2 (0.30%)	25 (0.57%)	16 (0.36%)	0 (0%)	57 (1.04%)
total # way tags	189,941	7,776	1,764	40	664	4,375	4,490	547	5,456

3 Toward a collective tagging Android application for gathering accessibility-related data in Europe

To address the lack of accessibility-related data, we are developing a collective tagging Android application. The application enables volunteer contributors to provide useful information about the accessibility of the transportation network, whether roads, paths, sidewalks, bus station, buildings, etc. It also enables users to search the database of generated tags through different filters and to visualize these tags on OSM map.

Prior to the development of the application, a consultation phase took place to gather information about the needs and requirements of target user groups, which include disabled people, elderly people, people accompanying young children, and persons organizing events or activities for people with limited mobility. The consultation phase took place either through direct discussions with representatives of target groups, or by collecting information from forums on accessibility (including Wheelmap's user forum). The result of the consultation phase has been summarized into so-called "user stories," which are sentences written in the user's everyday language and that capture what that user wants to do. An example of user story is "As a <wheelchair user>, I want to know if the inside of a store has aisles that are wide enough to navigate with a wheelchair so that I can decide whether or not to enter the store." The user stories were the basis for defining the functions that the software application (including the collective tagging system) must provide to meet users' demands. 57 user stories were collected in the course of the consultation phase.

To implement the application, we have used Django, an open source web application framework developed in Python. The database of tags is based on PostgreSQL 9.3.5. The database connection is implemented with PsychoPG2. Instead of using XML for messages, which is a common practice, we have used JSON strings, since JSON messages' size is smaller; therefore, costs are reduced, while efficiency of message passing is improved.

The architecture of the system is depicted in Figure 1. The Locator obtains the current location of the user, which is then used to find nearby places or objects. This is done through the GPS system already incorporated into the client's Android system. The Retrieval Module provides an interface through which users can set the geographical scope within which they want to tag objects and places. Users are able to search for buildings, paths, elevators, etc., in a radius, for example, of 20 or 30 meters centered at their location. The Retrieval Module returns the matching objects from the OSM database within the user-defined geographical scope. The pool of candidate features for tagging is the set of objects and places returned by the Retrieval Module from the OSM database. The user can draw objects from this pool to tag them. The Tagging Module is the core of the tagging system. It consists of two modules. The first module is the Editing template module, which provides different data templates to be filled by the user according to the category of objects selected by the user. For example, the template for buildings has fields to indicate whether there is a ramp, whether there are accessible toilets inside, etc., while the template for roads has fields to indicate whether there is a sidewalk, the smoothness of the road, etc. The editing templates were designed according to the information needs identified by target user groups during the preliminary surveys. The Tag Recommender suggests appropriate words or phrases to describe a given type of object while the user is tagging such an object. The Tag Recommender's role is to improve the uniformity of the terms used to describe similar objects, so that the data being stored is homogeneous and easy to retrieve. It implements a collaborative tag suggestion algorithm, whereby tag suggestions are based on the tagging history of both the given type of resource and user [8] [10]. The data generated by contributors is stored into a local database, and the tagging module is also connected directly to the OSM database.

Figure 1: Architecture of the collective tagging application.

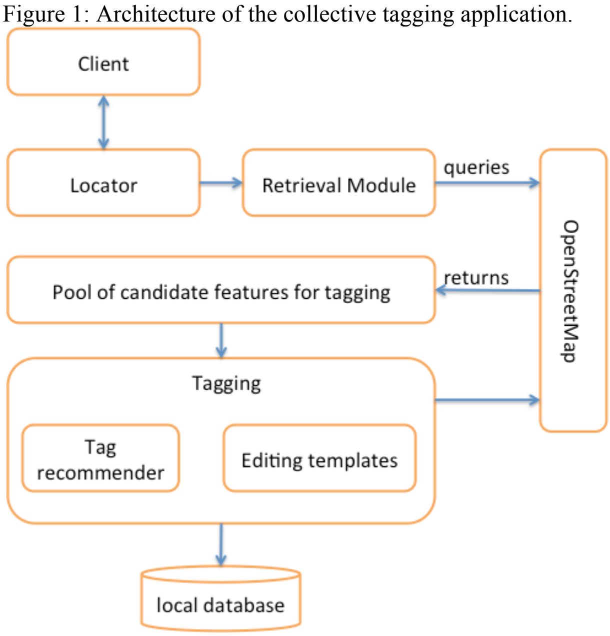


Figure 2 shows a snapshot of the collective tagging interface. Users can add tags, edit existing tags, and visualize tags according to tag categories. Figure 3 shows an example of an editing template for paths and sidewalks. It shows that in addition to specifying the desired attributes (such as way type, width, slope, surface, etc.), users can specify a rating and can indicate whether improvement of the tagged feature is recommended, needed, strongly needed, or not needed.

Figure 2: Main interface of the collective tagging application.

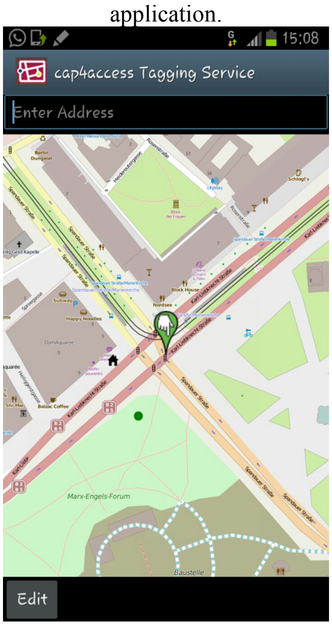
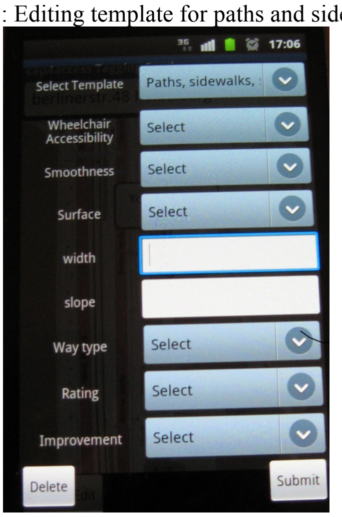


Figure 3: Editing template for paths and sidewalks.



4 Summary and future developments

A preliminary analysis of the accessibility-related information that target user groups require to improve their ability to plan their travel in urban areas revealed that such information is not currently available. Based on the identified needs of target groups, an Android collective tagging application is being developed to gather accessibility-related geospatial data at a very fine level of detail. The application is based on editing templates that ensure the required data is collected according to target user groups' needs.

Real world testing in pilot European cities is about to be conducted to verify that the application meets the information needs and contributes to improving the completeness of accessibility information. Once the pilot tests are conducted, the automatic tag recommender algorithm will be further experimented to verify that it contributes to reducing the heterogeneity of tags and therefore, to facilitate information retrieval.

Furthermore, the collective tagging application will implement a look-up service, whereby contributors will be able to detect objects within their vicinity (e.g., 30 meters) that were not tagged yet. This will encourage taggers to focus on objects where information about accessibility is missing. The look-up service will also include a notification service for active contributors who are interested in receiving notifications whenever they get close to an untagged object or place.

Finally, work needs to be done to ensure the quality of the data collected through the collective tagging application. The development of a quality assurance system is an integral part of the CAP4Access project. The quality assurance system, which is based on the OSMatrix quality tool for OSM, will be responsible for assessing the quality of data collected through the collective tagging application by measuring various quality parameters, including thematic consistency, topological consistency, and spatial accuracy.

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