Automatic feature extraction to support Mountains Mapping in OSM

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This abstract was accepted to the Academic Track of the State of the Map 2019 Conference in Heidelberg after peer-review.

Open access geographical databases, such as OpenStreetMap (OSM), offer a valuable alternative to proprietary solutions for the development of voluntary environment monitoring systems. However, the quantity and quality of information stored in such systems must be carefully evaluated and the contributions of volunteers must be boosted by means of effective engagement methods. We propose a hybrid approach, in which an open Digital Elevation Model (DEM) data set is processed with different techniques to find candidate mountain information and uncertainty in the automatically extracted candidates is reduced by means of voluntary crowd-sourcing. The improvement of landform information (not only about mountains, but also about orography and hydrography in general) can support the development of environment monitoring applications.

Different methods have been proposed to improve the generation of new objects in VGI, which usually rely on "in itinere" evaluation, hereby volunteers are given feedback while they are producing and annotating data. As an example, the work presented in [1] aims to improve the homogeneity of contributions by suggesting users tags while creating or editing objects, through a plug-in for Java OSM. Heterogeneity derives from the possibility that OSM provides to the users to create new tags at will. Consequently, OSM has now more than 101.000.000 different tags (https://taginfo.openstreetmap.org/reports/database_statistics), where more than one can refer to objects of the same class. As another example, the work presented in [2] aims at improving user's contributions by means of rule-guided procedures that help volunteers classify grass-related features correctly. The authors developed the Grass&Green application, which warns the users about potentially incorrect classifications at editing time. The rules employed were derived with data-mining techniques. These approaches have an important advantage: evaluations are provided as feedback to the users, who can use them to confirm or discard their contribution; this enables immediate quality control, instead of deferred quality checking after the users have left the application. Nonetheless, the above mentioned approaches rely on the users creating their contributions from scratch and do not provide hints about the gaps in the existing information that could be a target for contributors.

Nahime Torres et al. (2019). Automatic feature extraction to support Mountains Mapping in OSM
In: Minghini, M., Grinberger, A.Y., Juhász, L., Yeboah, G., Mooney, P. (Eds.). Proceedings of the Academic Track at the State of the Map 2019, 31-32. Heidelberg, Germany, September 21-23, 2019. Available at https://zenodo.org/communities/sotm-2019
DOI: 10.5281/zenodo.3387719

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To tackle this, we propose a contribution framework that consists of three main steps: (1) automatic identification of candidate objects, (2) integration of the candidate objects into a validator for the crowd to confirm or discard objects, and (3) final inspection of the results to import them into OSM.

In our case, the objects of interest are mountain peaks. In OSM, such objects require the following mandatory information: id, latitude, longitude, version and timestamp, and can optionally host additional information such as name, elevation, and alternative names. There are different methods in the literature that can support peaks extraction from DEM data, which are mainly based on heuristics algorithms that encode the "definition" of mountain. In previous works, we also investigated, with success, the feasibility of using OSM data to train a Deep Learning algorithm that learns what is a mountain from the data [3].

To populate the crowd-sourcing tool with data, objects that the algorithms detected as candidate mountain peaks, but are not present in OSM, will be published for the crowd to validate. To reduce the number of false positives and the crowd work, only candidates found by multiple detectors (a Deep Learning method and a heuristic method present in Landserf) will be published. To decide if the two methods agree on a certain object, a distance threshold of 80 meters is employed. For example, in an area in the middle of the Swiss Alps (46°N-47N° and 8°E-9°E), where OSM presents 1493 mountain peaks, the two chosen detection methods found 656 mountain peaks missing from OSM. Another example could be in the area of Albania (40°N-41N° and 20°E-21°E), where OSM presents a very high number of mountain peaks (3952), and still the two methods find 156 mountain peaks missing from OSM. These two examples show the potential of our approach to find data missing in OSM.

The proposed approach aims at improving the completeness of OSM mountain peaks information by proposing to the crowd new mountain peaks found by already validated methods. The target audience could be passionate mountain enthusiasts, such as members of worldwide mountain clubs (e.g. the CAI: Italian Alpine Club) and the 400.000 active users of PeakLens, an AR mobile application for trekkers who are the perfect candidates to join a data collection campaign at the world scale.

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