Creating a worldwide 3D globe from user-generated data

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Abstract

Recent years have witnessed a paradigm shift in collaboratively created geographic data on the internet. The amount of Volunteered Geographic Information (VGI) [1] steadily increases and maps from projects like OpenStreetMap\(^1\) (OSM) are being recognised and used more and more. Investigations on its completeness and quality have shown, that in particular urban areas in Central Europe have already been mapped by volunteers with an impressive level of detail (cf. [2, 3]). In those areas, OSM is meanwhile well ahead of only mapping the street network and points of interests and a certain level of saturation is about to be reached. This progress in user-generated maps, however, is mainly limited to 2D. In order to utilise the potential of the “mapping crowd” even better, it has to be investigated, to what extent such a project like OSM could be extended into the next dimension. The idea of letting the crowd assemble not only 2D maps but also comprehensive 3D city models is very promising.

3D-related mapping in VGI projects is currently very limited. In OSM for instance, only few 3D information exists due to data structures which are inappropriate for complex 3D content as well as missing editing tools, mapping conventions and widespread 3D viewers. Nevertheless, the OSM-3D project [4-6] shows, how the data can already be used for creating 3D city and landscape models at present. Based on the 2D data and the little amount of available 3D information, 3D scenes are created and provided in a standards-based manner as a Web 3D Service (W3DS) [7]. In a regular update process, the meanwhile over 50 million building ground plans [8] in OSM are being extruded. Together with additionally available information like POIs and labels, up-to-date 3D city models are being created. The OSM-based data is enhanced with public domain terrain data from the SRTM\(^2\) mission.

Only recently, this process has been expanded to a worldwide extent. The OSM-3D W3DS now provides 3D models of arbitrary places all over the world (cf. Figure 1), whose quality and completeness mainly depend on the underlying OSM data. This can potentially have a motivating effect for people outside Europe to map their environment in 3D, because they can now see the results in our 3D globe. In general, many different applications are made possible with this user-generated 3D model of the world. Our W3DS client software, the XNavigator [9], allows for the integration of several OGC Web Services and OpenLS [10]. Therefore, applications like 3D (pedestrian) routing, analyses of disaster impacts or urban planning based on volunteered geographic data are possible (e.g. [11-13]). While changing the extent of OSM-3D from Europe to global we have made some experiences which show that the European workflow cannot in all cases be naively transferred to the rest of the world. New challenges arise which we would like to present and discuss at the workshop.

Crowdsourced 3D city modelling is still in its very early stages and the level of detail has to be improved in the future. In order to achieve this, several efforts are to be carried out, which are supposed to ease direct 3D mapping and inspire the volunteers for this new dimension. One first step towards more detailed crowdsourced city models is the OpenBuildingModels prototype [14]. This web-based platform will allow to upload entire architectural 3D building models into a free-to-use

\(^1\) http://www.openstreetmap.org
repository in the future. These models can then be referenced from within OSM and subsequently displayed in a viewer like OSM-3D (cf. Figure 2), which significantly increases the level of detail. Apart from this platform, several other challenges in the context of crowdsourced 3D city modelling have to be tackled. For instance, data structures, modelling and editing methods which are most suitable for volunteered 3D mapping have to be investigated. While a lot of research already exists about accurate 3D reconstruction of buildings (e.g. [15-17]), all this has to be examined in an altogether different light for the approach of crowdsourced data generation, where little to nothing related research exists. By pushing forward both, research and community efforts, we can make a huge step towards a user-generated “Digital Earth” [18] in the future.

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Images

Figure 1: OSM-3D is now available worldwide. This picture shows Central Tokyo with 3D buildings derived from OSM.
Figure 2: The OpenBuildingModels approach enables users to upload and share their 3D architectural building models in a free repository. The models can be displayed in OSM-3D and therefore greatly enhance 3D city models.

References


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