Extraction of Building Heights from Volunteered Photographs for LoD1 OpenStreetMap (OSM) Building Models

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SUMMARY

3D city models are valuable and useful information for a wide range of applications, including: guidance and navigation, environmental simulations and facility management, emergency response and rescue operations, architecture, city planning and digital tourism – to name a few. Due to the large impact of 3D city models on the one side, and the high cost of generating these infrastructures manually on the other, automatic procedures for the generation of different grained 3D city models are required. This notion is also consistent with Sarjakoski's suggestion that "three-dimensional modeling and photorealistic visualization and animation should be included in public participation GIS for the sake of space-to-feel level experience in urban plans". Perhaps the most important features in 3D city models are building features, since they serve as a major geospatial element in many applications. As such, this research paper demonstrates a methodology for reliable constructing of 3D building model that is based on user-generated content that is available on the internet.

Although 2D footprints of building features in OSM are mapped with increasing accuracy and detail, mostly from satellite imagery, building heights are almost impossible to determine, and thus only sporadically edited to the maps (only 1.4% of the buildings in OSM have height information, frequently inserted manually by users). Although efforts are done to generate and visualize 3D models of OSM data, e.g., OSM-3D project, these are mostly limited to several major cities, while there is no standardized usage for exchanging and sharing urban city and building models integrated within the user-generated OSM domain.

To this end, this research paper will use contributed sources of information containing building footprints (OSM) database, and building photographs (e.g., Flickr and panoramio) that store implicitly and explicitly building heights. The extraction of building heights from a single image

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that was taken using smartphones or tablets is achieved by the calculation of the vanishing points in the photographs to extract the real world height of the building presented. Geospatial matching and integration are then implemented to fuse the retrieved height information with the corresponding building information (footprint) existing in the OSM database.

Preliminary analysis shows promising results of automatic building height retrieval when compared to other available methods used today to measure building heights. Overall, this research paper presents a framework for an automatic user generated-based creation of 3D building of LoD1, thus enriching the already established 2D OSM map infrastructure to the 3D domain.