OSM indoor: moving forward

Authors

- **Jorge Rocha**, University of Minho, *Portugal*
- **Nair Alves**, University of Minho, *Portugal*

KEYWORDS : OSM, Indoor navigation, Indoor routing, VGI, 3D

Introduction

The OpenStreetMap (OSM) project started focused on mapping streets. But as many other successful innovations, it created new possibilities. Beyond streets, the community started to captured other information, to create more than just street maps. For example, initiatives like wheelmap.org enhance the OSM with tools and specific data for wheel drivers.

The OSM proved that Volunteered Geographic Information (VGI) [3] can be used in large scale projects. OSM become a school for neogeographers, where they learn how to produce high value user-generated geographic content. Many techniques and technologies were developed specifically to improve the quality of OSM, and to support the OSM mappers.

In this paper we aim to present a proposal to map indoor spaces in OSM. The goal is to map public indoor spaces, like universities, malls and airports. A public hospital, for example, can have many more people moving around than a small city. This is not the first or the only proposal around. Many people already suggested and developed some support to indoor spaces in OSM. This proposal tries to get the best of former initiatives to establish a common path to move forward.

We start by reviewing some important concepts, obviously starting by defining the meaning and the scope of indoor space and its representation. There are representations based on floor footprints and representations more based on the building model. Either can be more syntactical or semantic oriented. The distinction between indoor spaces and 3D models is necessarily discussed, since the distinction between them is somewhat blurred. We also revisit the commercial notion of 3D maps, used by companies like Google, Microsoft or Nokia in their web mapping solutions. These applications are 3D in the sense that they provide terrain elevation plus the 3D building volumes. There are no building models involved. Just the volume (the shell) of the building is modelled and portrayed with textures. For OSM, there are proposals to add this volumetric information to OSM [12], and Heidelberg OSM 3D [7, 13] is a good example of such proposal. More sophisticated approaches are also emerging [1, 2], using the entire building information model (BIM), instead of just its volume. In this scenario, the indoor space can be completely represented in the building information model. Although we strong believe that is feasible to have BIM shared on OSM in the short time, we argue that OSM indoor mapping still make sense, and it will take some time to OSM indoor be completely computed from shared BIM. It is worth to remember that OSM indoor has some advantages: it works pretty well on 2D, people are already trained to read floor plants, the existent editors like Potlatch and JOSM can be used to draw floor plants with minimal changes and the existent portrayal technology does not require any changes, since multiple floors can be draw on top of the building bounds. 3D building models are more powerful and better represent the building, since they have more information. But the complexity of 3D BIM is its major disadvantage. All the increased complexity in modelling, representation and manipulation can not be easily transformed in a incredible better visualization. 3D navigation is complex for ordinary users.

Users are not trained to navigate and understand 3D models. For that reason, we argue that 2D visualizations of indoor spaces are necessary and are a major enhancement over the existent ODM data. It will take more time to change to overall OSM work flow to support 3D BIM. We also argue that both models can coexist, and we can have indoor support and 3D BIM data simultaneously. The indoor can be handful to improve the 3D models. Finally, indoor routing and indoor navigation are also reviewed, to highlight the differences and the relations between them. Any kind of routing can always be reduced to a graph representation, but current available algorithms rely on the distance to populate the graph. For indoor spaces, the same location can be used for an elevator that travels through several floors, for example. The graph resulting from the indoor space must be aware of the distance between nodes on different floors, but on almost the same location. Indoor navigation techniques are also reviewed. All techniques are grouped in Pedestrian Dead Reckoning (PDR), Radio Frequency based (WiFi, GPS+beacon, UWB, RFID, Bluetooth and NFC) and Image Analysis based [4].

OSM Indoor related initiatives

After reviewing the main concepts related to indoor spaces, we analyse three known proposals for OSM Indoor. The scientific literature is scarce about the subject. The only publications we know about are [5, 6]. Besides these publications, the best starting point for our research was the OSM Wiki, where mostly of the discussions take place, and where pointers to examples are posted.

The methodology adopted for our analysis was to review and compare each proposal against a list of characteristics, group in four categories:

- space representation
- supporting tools
- generation of the routing network (graph) and routing calculation
- interaction, visualization and exploration

We also surveyed some commercial solutions, mostly to evaluate some HCI issues, since we don't have access to the underlying implementation.

All the three initiatives are related to university buildings or campus: Heidelberg University, Germany [8, 9]; Alpen Adria Campus of the University of Klagenfurt, Austria [11]; and Gløshaugen campus of the Norwegian University of Science and Technology [10].

Proposal

The proposal presented for the OSM indoor support take advantage of experiments already mentioned. The goal is to point way a common way to handle indoor spaces in OSM. If we are able to generate some consensus about a common approach, many more mappers will help to improve the tools and share their knowledge about indoor space representation. The proposal covers the space representation, all necessary tools, and a new web interface, able to explore the indoor space and to provide the necessary controls to enable route calculation.

Space representation

This proposal is for indoor spaces, and not for 3D BIM. The indoor initiatives reviewed proved us that the current OSM data model is able to represent the indoor space. So, the impact on the overall OSM architecture and work flow is minimal, since the data is stored on the same database. There are no modifications needed on the current API. By the contrary, if we want to represent 3D BIM on OSM, we should move these to another database, with another data model and API. The OSM data model is so simple (nodes, ways and relations), that theoretically we can represent any building with that primitives. But the abstraction level of that representation is not suited. 3D BIM requires a separated database, with models and API that manipulate concepts more closed to the building semantics. The recent proposal [1] goes in that direction, since they propose a new parallel project, OpenBuildingModels for 3D BIM data.

Tagging

For OSM Indoor two major proposals are being discussed on the OSM wiki. One, from the University of Heidelberg, tries to represent more than the indoor space, and has more tags to represent the building details#. This proposal almost tries to represent the 3D building model using OSM tags. The other proposal, by User:Saerdnaer, is more simple#. We propose that this last proposal be used as the starting point. Some tags from the first proposal can be used, not for OSM indoor, but for OSM 3D. By other words, we should distinguished the minimal tags necessary for indoor from tags than can be used to better extrude 3D buildings (just the shell) from the OSM data.

Tools

Editors can be slightly improved to enhance the representation of indoor spaces. Basically, the existent editors can provide an interface where users can edit each level independently. Additionally, an OpenLayers based editor can be developed, using the simple editing primitives of OpenLayers. While this might not be the best solution, it can be an alternative.

Routing

The routing solution is as simple as possible, and only includes routes by foot or by wheel chairs. As we already said, the only specific requirement is related with the distance weight of distinct nodes at the same location. From our initial tests, the precision of locations is relevant, since locations are more closed. When generating the network graph, the entire precision of the locations must be considered, without any kind of rounding.

Web map

A new web interface is necessary to fully explore the indoor additional information. The new interface should be aware of existing indoor data. At certain zoom levels, if indoor data is available, an additional control is displayed. The number of floors will be used to display the floor switch. To calculate routes, two possibilities are provided. The origin and destination can be pointed on the map, or the user can select the explicit rooms or stores, if they were tagged on the data. The result route is calculated on the server side, and it is returned as WFS feature. Since the sources of this alternative site are open source, users can improve these features. One additional feature is to use such interface within other web sites, for example, in mall or airport web sites, where they can take advantage of the crowded source data and tools.

Conclusions and outlook

This discussion and distinction between OSM Indoor and OSM support for 3D BIM is very important to guarantee that we focus on OSM indoor without the temptation to include BIM features. In this paper we discussed the difference between both approaches and we argue that both models can co-exist in OSM.

Having stated that, the OSM indoor is a wise compromise, to enhance the OSM, without moving right now to fully support 3D BIM. That will take time, and OSM indoor will be around for a while, since users are more familiar with this kind of space representation.

For OSM indoor, we need to create some broad consensus about the tags, but it would be easier if we provide tools to support and explore that additional information. Together is this proposal, we started an open source implementation of all necessary tools to fully explore the indoor data, as described.

[1] UDEN, M., & ZIPF, A. (2012). OpenBuildingModels - Towards a Platform for Crowdsourcing Virtual 3D Cities, 1-17.

[2] NAVIGATION, I., & SCANNER, T. L. (2008). 3D Indoor Navigation : a Framework of Combining BIM with 3D GIS. Building, 1-10.

[3] GOODCHILD, M. F. (2007). Citizens as sensors: the world of volunteered geography. GeoJournal, 69(4), 211-221. doi:10.1007/s10708-007-9111-y

[4] HAKAN KOYUNCU AND SHUANG HUA YANG. A Survey of Indoor Positioning and Object Locating Systems. Journal of Computer Science, 10(5):121{128, 2010.

[5] GOETZ, M., & ZIPF, A. (2010). Extending OpenStreetMap to Indoor Environments : Bringing Volunteered Geographic Information to the Next Level, (Hansen 2004).

[6] HALVORSEN, C. (2011). Campusguiden - En navigasjonstjeneste for innendørs bruk. Master’s Thesis,Norwegian University.

[7] ZIPF, A. (2010). University of Heidelberg OGC Services Emergency Routing with OpenLS RouteService 3D Visualisation with W3D in the GEOSS Architecture Implementation Pilot – Phase 3. Response, 49(March).

[8] GISCIENCE GROUP. 2011. IndoorOSM - Mapping the Indoor World (2D). *Institute of Geography, University of Heidelberg*. Retrieved July 25, 2012 from: http://indoorosm.uni-hd.de/

[9] GISCIENCE GROUP. 2011. IndoorOSM - Mapping the Indoor World (3D). *Institute of Geography, University of Heidelberg*. Retrieved July 25, 2012 from: http://indoorosm.uni-hd.de/3d/

[10] HALVORSEN, C. 2011. Campus Guiden. *Gløshaugen campus of NTNU, Norwegian*. Retrieved July 30, 2012 from: http://www.campusguiden.no/?lang=english.

[11] GOMOGI. 2012. Campus-GIS. *Alpen Adria Universität Klagenfurt*. Retrieved July 27, 2012 from: http://opengeo.org/gallery/klagenfurt/

[12] OSM WIKI. 2012. Indoor Mapping. *OpenStreetMap Wiki*. Retrieved August 6, 2012 from: http://wiki.openstreetmap.org/wiki/Indoor_Mapping

[13] OSM WIKI. 2012. OSM-3D. *OpenStreetMap Wiki*. Retrieved July 26, 2012 from: http://wiki.openstreetmap.org/wiki/OSM-3D