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A Web GIS to Generate Audio-Tactile Maps for Visually Impaired People

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Abstract:

Tactile maps, and even more audio-tactile maps (Brock et al., 2012) are useful tools for visually impaired people to grasp the geographic space that they cannot experience with their sight. Due to low precision of touch compared to sight, these tactile maps have to be very simplified and generalised compared to their counterparts designed for people with regular sight (Touya et al., 2019). This is why it is very complex for orientation and mobility trainers to design and create enough of these maps for their needs. The orientation and mobility trainers we interviewed claim that they need a tool for non-expert GIS users to fasten the time to design and print a new audio-tactile map. Some simple tools exist, such as TouchMapper[1], or Hapticke[2], which allow the generation of a tactile map anywhere on earth from OpenStreetMap data. But these tools fail to generate maps that are generalised enough (Touya et al., 2019). This is why we started the design of the MULTIMAGE platform (MULtimodal Tactile and Interactive Map GEnerator).

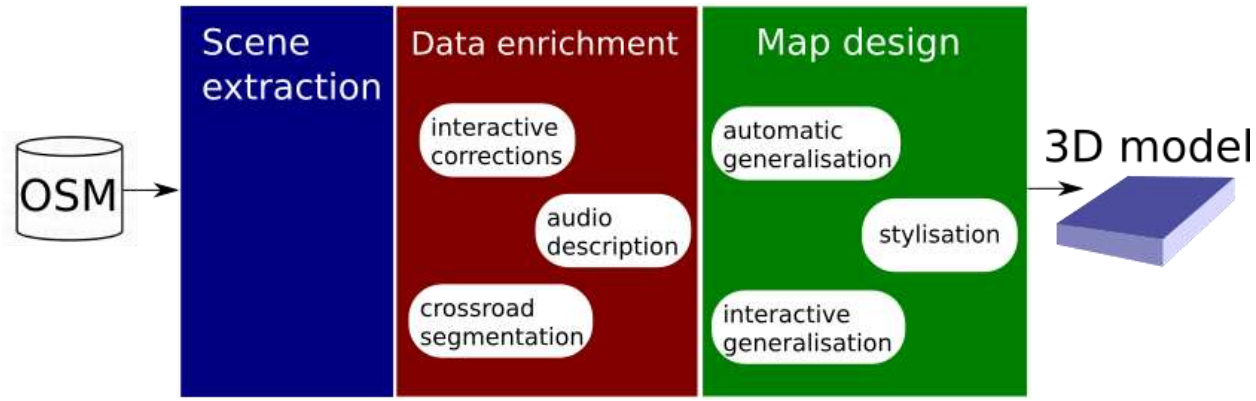

Figure 1. Functionalities of the MULTIMAGE platform to generate a 3D model for a tactile from OpenStreetMap data: (1) a scene (a crossroad for now) is extracted; (2) the OSM data is enriched and corrected with a mix of automated scripts and interactive actions; (3) the map is designed with the enriched data with a mix of automated scripts and interactive actions.

The MULTIMAGE platform proposes a workflow with three steps to generate a 3D model ready to be printed from OpenStreetMap data (Figure 1). The first step is just the selection of the extent, the scale, and the size of the map, and then an automated extraction of the corresponding raw data from OpenStreetMap. For now, our focus is on maps of crossroads at large scales, because crossroads are one of the main issues during the training of autonomous mobility for visually impaired people. The extent of the map is simply selected by drawing a bounding box on a web map. Then, the second step of the workflow is the data enrichment, which enables the use of automated enrichment scripts, as well as interactive actions to correct potentially incomplete or incorrect OpenStreetMap data. The third step is the design of the map where stylisation and map generalisation tasks can be carried out, either automatically or interactively. Then, the map is exported as an extended STL file to be 3D-printed, with information to print buttons of audio description. We also plan the platform to be able to export files adapted to swell paper printers, as swell paper (Figure 2) can be used on top of tablets to make interactive audio-tactile devices (Brok et al., 2012).

[1] https://touch-mapper.org
[2] https://hapticke.mapy.cz/

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Figure 2. The DERi audio-tactile tool (Brocket al., 2012) with swell paper on top of an interactive tablet.

The interactive actions are possible using the map interface presented in Figure 3. As a classical web GIS tool, the edition of the geometry and the semantics of the OSM data will be possible in the second step, and the edition of style as well as manual generalisation operations will be possible in the third step. Regarding the automatic scripts, several are already implemented in the platform. For instance, there is a script to segment and enrich the crossroad with important features such as traffic islands (Favreau & Kalsron, 2022), and a script to generate styles adapted to an audio-tactile map (Jiang et al., 2021). The backend, i.e. the server side of the platform is implemented in Python, using open source libraries such as GeoDjango and Geopandas. The web interface is developed in Javascript, based on the OpenLayers library. Data are stored using PostGIS, and the Web Feature Services displayed in the interface are generated with Geoserver.

Figure 3. Capture of MULTIMAGE, with a map canvas and possible actions to trigger on the right with the list of layers.

The platform is still largely under development, and both the interface for interactive actions, and the automated scripts need to be further developed, and we plan to improve iteratively the platform in the following months. The sources of the platform will also be opened soon. The final task that we plan is the evaluation of the usability of the platform. The orientation and mobility trainers should be able to use the platform, at least in a profile that only uses the automated scripts, because the interactive actions require GIS expertise.

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