Relief map design tool for visually impaired people

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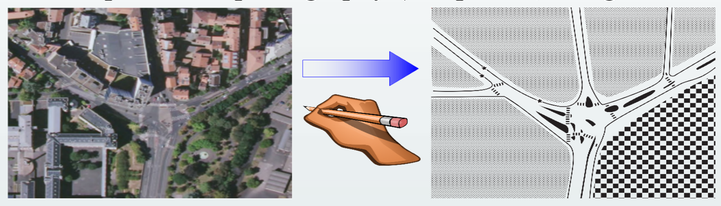
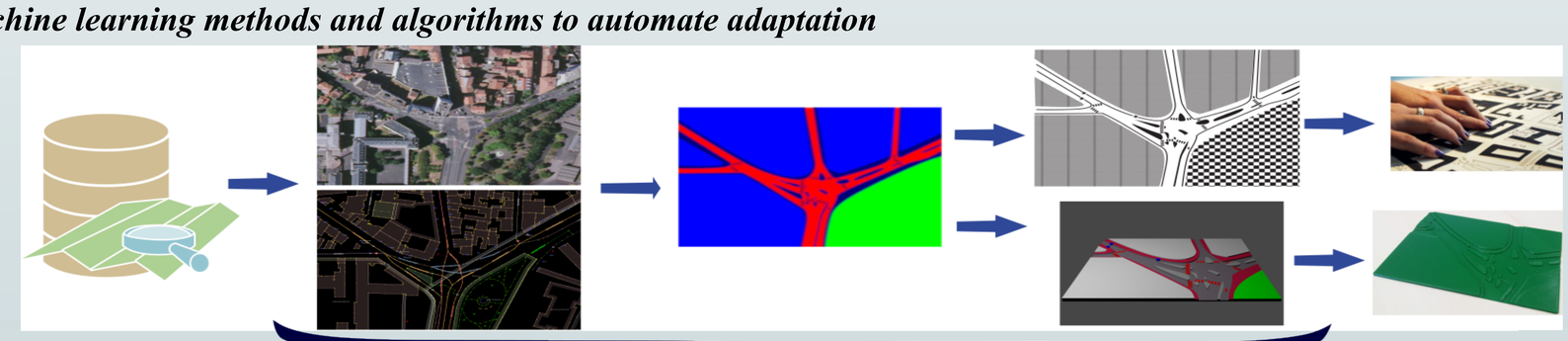
Introduction

This research project, called ACTIVmap, is aimed at developing a tactile maps design tool for visually impaired people. Nowadays, the adapted map are made by redrawing manually the roads, buildings and everything that needs to be represented using a traditional map or aerial photography (Géoportial, Google Earth...) as support. This is a time consuming process and does not permit a real adaptation to the handicap.



The goal of the project is therefore to automate the adaptation and the 3D formatting of maps. To do this, we have sequenced the work in different steps:To do this, we have sequenced the work in different steps:

- ***exchange with professionals to collect their know-how***
- ***Collection of adapted maps***
- ***focus of our work on the maps used by locomotive instructors***
- ***testing 3D printed cards***
- ***implementation of machine learning methods and algorithms to automate adaptation***



Works

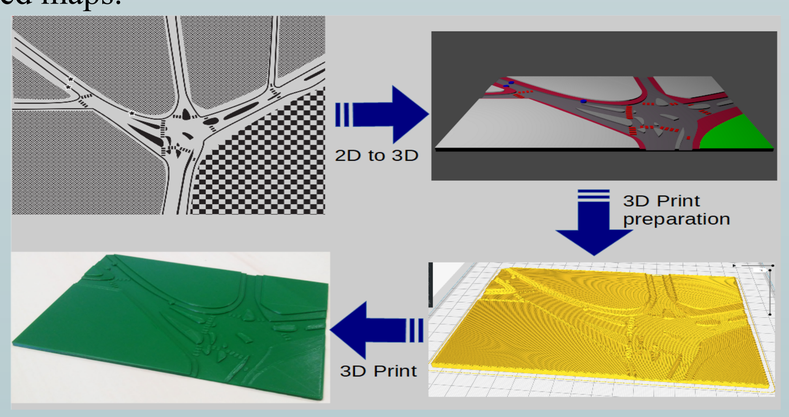
We organized a map collection campaign to made a set of samples that :

- ***describe and illustrate the experts practices***
- ***offer a possible input dataset for the machine learning methods***

The participation campaign for the acquisition of adapted maps allow us to collect a little over a hundred maps.

We worked on a proof of concept relief map done by 3D printing to explore a other way to fabric and a new representation mode of the map elements (roads, building…).
With multiple elevation, 3D print offer the possibility to present more informations, classic methods use textures variation and blind people can only differentiate 3 to 5 of these textures template.

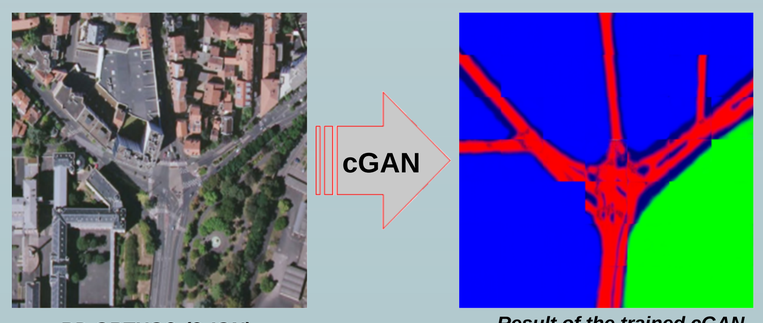
The first reactions to 3D-printed maps look promising, even if improvements are to be made, the first feedback on the field tests carried out by instructors in locomotion at the "Centre de Rééducation pour Déficient Visuel" (CRDV), in Clermont-Ferrand, returns a fairly good understanding of the urban space.



Top left adapted image by MARTIN Durga (© CRDV), top right 3D model, bottom left 3D model prepared for printing and bottom right the printed model that made ourselves

After an initial approach using style transfer methods by segmentation and extraction of regions, which was not conclusive, we turned to Conditional Generative Adversarial Networks methods (cGAN) [3].

From an input aerial image (BD Ortho®, top left) the learned cGAN generate a color image incomplete (top right, the visible tiles are due to the subdivision used by the method implemented) but near of our ground truth (see in the process diagram).
Next step use this resulting image and the filtered OpenStreetMap (OSM) informations (roads, buildings…) to refine our Output and prepare a vector representation.

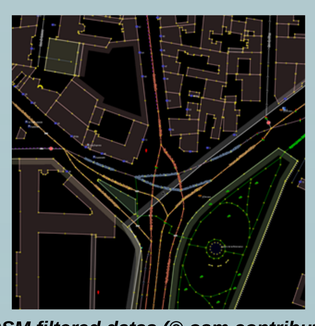


BD ORTHO® (© IGN)

Result of the trained cGAN

The automation of the map adaptation process using machine learning and algorithms is perfectible but shows promising results for the future under development. Work is underway to strengthen learning and post-processing algorithms to improve the robustness and reliability of the results.
For the future, further research is needed and the following options are being considered:

- ***Generation of a 3D mesh from the generated data***
- ***Automation and improvement of 3D printing***
- ***Improvement of the processes for a public release***



OSM filtered datas (© osm contributors)

WORK IN PROGRESS

Bibliography

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2. Hennig S., Zobl F., Wasserburger W., 2017 - *Accessible Web Maps for Visually Impaired Users: Recommendations and Example Solutions*, Cartographic Perspectives volume 0 number 88,
3. Isola P., Zhu J.Y., Zhou T., Efros A.A., 2017 - *Image-To-Image Translation With Conditional Adversarial Networks,* Conference on Computer Vision and Pattern Recognition (CVPR), PP. 1125-1134

For more informations see the related publication :

Fillières-Riveau G., Favreau J.M., Barra V., Touya G, forthcoming publication – *Conception de carte en relief pour les personnes déficientes visuelles*, Cartographie des récits, Presses universitaire Blaise Pascal (PUBP), France, 12p.