Cognitive model of interaction without vision for tactile exploration of 3D maps

Keywords
Cognition, interaction, evaluation, user-centered design, visual impairments, tactile & haptic devices.

Context

ANR ActivMap (2020-2023) aims to facilitate the task of map producers by reducing the level of technicality and time required for the design process. The project will focus on the issue of orientation and mobility, which has a real impact on independence and quality of life of people with visual impairments (PVIs). The appropriation of urban space is an essential element to improve their autonomy, because outdoor travel is a major issue.
Synthetic and adapted representation with tactile maps and diagrams with adapted interactions is essential for greater autonomy. However, their design based on a traditional approach, craft handed by professionals (mainly Orientation and Mobility Instructors and Tactile Document Makers) in insufficient numbers to cover real needs.

Today, thanks to the availability of open and collaborative data, combined with the diversification of means to produce physical artefacts augmented with adapted interactions (Fig.1), it is possible to consider the development of a set of specialized methods and tools to design multimodal interactive maps in a semi-automatic way. This research project is based on an interdisciplinary approach between Human Computer Interaction, cognitive sciences, geographic information sciences, computer science, and professionals in the field of visual impairments.

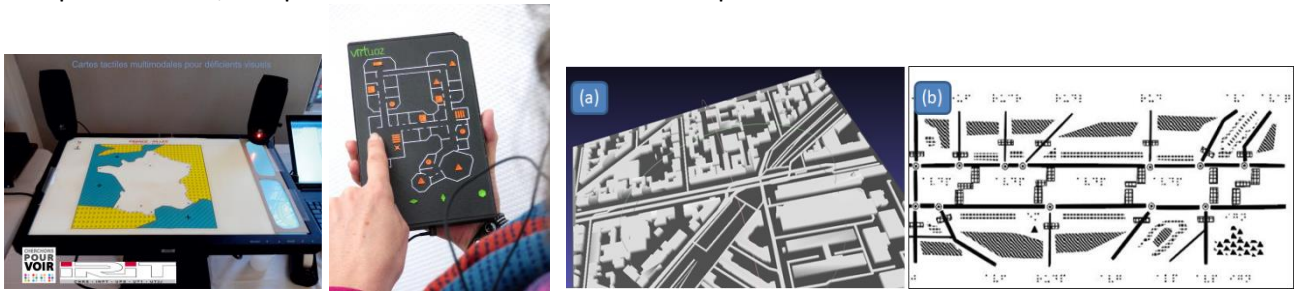

Figure 1. Prototype of interactive tactile map designed by “Cherchons pour Voir”(1); Virtuoz designed for enhancing spatial awareness during indoor mobility (FeelObject) (2);. The surroundings of IGN from touch-mapper.org (3-a) and same area manually generalized, stylized to be better readable for VIPs (Touya et al. 2018)(3-b).

Topic

Several approaches will be explored in ACTIVmap to adapt the map design process to the specific needs of users with various visual impairments and their potential contexts of use by LIMOS and LaSTIG Labs, including different representations of space (raised-lines maps and diagrams, 3d printing, verbal descriptions, etc.). These supports will be augmented with multimodal interactions (haptic or sound) in interactive prototypes by IRIT Lab. and FeelObject, which usability will be evaluated by users such as instructors and PVIs in different use contexts.

The intern will take part to the cognitive evaluation of spatial learning and knowledge transfer (from the map to the real-world and vice-versa), in order to investigate how urban space could be represented to help PVIs with these tools. The prototype will also provide PVIs with the ability to independently select and explore maps adapted to the intended task (general spatial learning or mobility preparation) but also to their own perceptual and cognitive abilities [Gir+17a].

Objectives

Based on the user needs analysis from the project and on previous evaluations of the interactive devices, the intern will focus on the design of a conceptual cognitive model of interaction, describing the mental representation of space, from either the non-visual exploration of tactile and interactive maps, or the non-visual performance of mobility and orientation tasks. The purpose is to characterize the salient spatial arrangements and proxies in the maps, used by various PVI profiles to perform various tasks. This generic model will help to specify better design interaction modalities with the tabletop and mobile devices. This research work will rely on experimental methods issued from cognitive psychology [KJ97, Gir+17a], HCI [Bro+15] and Geographic Information Sciences [Ory+15;18] research fields.

Iterations will be made between the partners of the project to refine knowledge, observations, and the existing models of map design and interaction.

Student profile

M2 Cognitive sciences, psychology studies or Geographic Information Sciences.

This internship is granted by the ANR ActivMap project.

Timing

5-6 months, from March 2020.

Location

The internship will held at the IGN - LaSTIG in the GEOVIS team (73 avenue de Paris 94160 Saint-Mandé, France), with regular interactions with the IRIT Lab.

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