Challenges in Personal Mobile Navigation

Marcio Augusto Reolon Schmidt
Programa de Pós-graduação em Ciências Geodésicas – Universidade Federal do Paraná
Caixa Postal 19001, Avenida Coronel Francisco Heráclito dos Santos, 210, CEP 81.531-990, Curitiba, Paraná, Brasil.
marcio.schmidt@ufu.br

André Luiz Alencar de Mendonça
Universidade Federal do Amazonas
Campus Universitário - Av. Gal. Rodrigo Otávio Jordão Ramos, 3000, Coroado, CEP: 69077-000.
Prédio da FCA2 – Laboratório de Geotecnologias – 2º andar,Setor Sul, Manaus, Amazonas, Brasil
alamendonca@ufam.edu.br

ABSTRACT
Virtual navigation is probably the most complex human activity, because it gathers many aspects as self-orientation, distance estimative, cultural aspects to select and categorize landmarks, different memory schemes, and even mood. Help people navigate in real environment with digital maps and augmented reality in mobile devices presents enormous challenges. This paper presents some of them and focus in as AR can be used as platform to future personal navigation technology.

Author Keywords
Mobile Augmented Reality, Mobile UX, Personal Navigation

INTRODUCTION

Together with ease of navigation and the development of new related tools, smartphones and tablets brought to UX design issues related to maps. The digital era has disrupted all disciplines, with the added dynamism and interactivity opening new possibilities and challenges for cartography [1]. In addition, there is a claim for digital products to be useful and meaningful to people by changing the way we relate to mobile devices - smartphones, tables and wearables.

Seems a bit obvious, but mobile users are mobile [2]. In other words, design should consider that context and needs may change constantly so as interruptions and other issues related to physical environment should occur. Interactive maps and other interfaces have been subject of user and usability studies in cartography, however maps as support for navigation contexts have special characteristics we should address. i. e. should map interfaces also be thought to be dynamic or even if design decisions to ensure performance could affect a user mood and stress load?

The basic concept of Mobile user experience (UX) design refers to the positive experiences the user may have while using these devices. These experiences seem to be important channels to encourage a person to use an app or device. Some of the challenges of Mobile UX [4] in cartography are analogous to those of computer science. In this position paper we present important users aspects to be addressed, under the personal navigation approach.

NAVIGATION MAPS: USER INTERACTION ISSUES

We propose specific definitions adapted to the context of visual navigation with map support, in order to discuss potential points of interest for joint-research of mobile interactions and map use and users cognition and usability.

- Simplified task-oriented interactions: Generally, users look for the simplest way to get information in the shortest time period [3]. Every time someone seeks a spatial information such as a feature or a route, there is a particular goal/task. This map-user interaction should be efficient and least time consuming as a crucial way to gain a better experience. Anticipating possible workflows and make them more efficient would provide better usability and satisfaction.
- Progressive Disclosure: Progressive disclosure should be provided in order to make information visible on digital map as needed. So the map should change itself presenting more or less data or more or less additional information or more or less complex mapping techniques, as needed by user and its context. Progressive disclosure would reduce cognitive load and improve comprehension of the interface on initial steps of navigation and, on the other hand, could enhance spatial learning and improve explorative processes;
- Visual Hierarchy: This UX classical rule is related to the UI elements being shown in a clear and logical sequence, accordingly to the user context, in order to make content comprehension easier. While exploring visual variables and Gestalt aspects map-makers could improve map-like representations in static or digital maps. In the case of navigation process, it is expected that data will be different as the user goes in the environment. So the challenge here is to maintain navigation consistency. At the moment, the visual solution is focused on visual signifiers (such as contrasting colors for call-to-action buttons) to drive user interaction [3];
- Color Design: Color can draw attention, form visual groups, categorize information and influence users' actions on touchscreen interfaces [4,5]. In mobile devices, color design for maps and related interfaces has to consider luminosity and weather conditions for indoor and outdoor environments. Studies are being carried out in Brazil by the authors suggesting severe sun light conditions changes dramatically color perception for maps in mobile devices, used in open spaces and in close rooms.

- Location and context based-content: mobile devices should be able to update and present the relevant information to the user in a specific context of use. For example, when the context is related to the use of tourist maps, relevant information is about places for visitation with respective schedules and prices, pharmacies and restaurants, or other facilities location, adapted to the user needs. On the other hand, if a city worker needs to repair a water supply network the goal would be to make maps responsive to the context, including data and tools available to that specific user and use;
- Culture: Although hard to measure, there are studies who attest culture - defined by social and educational aspects of a certain group of people - as an important factor to comprehend interaction and visualization,. How people see the world influences direct their choices on spatial references [5], and this view changes over time. This factor is constantly forgotten in usability evaluations. We believe the success of user experience could be, in certain way, influenced by the recognition of how he/she sees the map and information in real word and the representation.

Ergonomics and spatial representation: Navigation with mobile devices implies on holding devices with human hands or vehicle/body mounts, dealing with movement, vibration and environmental conditions (i.e. wind, sunlight), variable orientation and distance from user, and some interaction, either by voice, simple/complex gesture or direct interaction with touch devices, fingers or joysticks. All of the possibilities should be discussed as part of UX design and so as map design. A simple example would be locking orientation accordingly to the best-fit format of the area of interest, display size and distance from the user, in order to maximize the usable display area.

Augmented Reality (AR) and Navigation

Presented issues are a set of aspects to be addressed in cartography research, being a joint research problem for mobile mapping, cognitive and UX studies in cartographic science. One more aspect on navigational interfaces is the increase of virtual reality techniques, in special AR.

Compared to other forms of virtual reality, AR offers the advantage of true mobility and location awareness. From a practical point of view, it makes possible to create only those objects necessary for the supplementation of what is perceived by a camera (reality) together with possible elements pre-defined in the map. In other forms of virtual reality often the whole environment needs to be represented. As result of introducing virtual objects into real-world visualization, models in AR are used to reduce the effort required to create, process, manipulate, manage, and update virtual 3D content in the animated scene. In addition, this technology seems to provide satisfactory solutions to some of the challenging points presented above.

Navigation and AR however, present some issues still to be addressed, as accurate positioning, symbol orientations consistency, and possible excessive cognitive load. For example, interface should guarantee symbols would match the camera captured image since the overlap of these elements will ensure that real world and map symbols will be perceived as the same thing by the user's mind. This becomes a particular challenge when it comes to moving from indoor to outdoor environments and vice versa. This requires, among other things, maintaining the relative perceived distance of each virtual object in the field of view and its correspondents in the real world, whereas symbology changes accordingly to movement, updating the relative position and orientation of the user.

Lastly, the reference system and reference identification varies greatly in different environments and light conditions. This essentially means an issue since most positioning techniques in controlled environments are performed on a physical structure of reference points, such as markers painted on the floor and walls. Interfaces in AR have the need to adapt to accommodate all possible user's contexts. The platform designed for use in real environments must be composed of computing devices capable of processing the position and update of the symbology quickly enough for the user not to lose the feeling of immersion.

CONCLUSION

With this paper, we introduce some important challenges to mobile maps and interaction with users on navigation interfaces. Some of those need to be addressed by scientific agenda, others by developing specific technology solutions. However, some of the challenges, such as cognitive and cultural aspects, are deeper and require extensive research to lay the groundwork for possible solutions.

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