Exploring Future Challenges for Haptic, Audio and Visual Interfaces for Mobile Maps and Location Based Service

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Abstract
In this article we give an overview of some challenges in how to make geospatial information more useable and accessible. We also suggest a roadmap for dealing with these challenges – and introduce a new EU project HaptiMap.

Keywords
Haptic, Audio, Visual, Mobile, Geospatial, Location Based Services, Maps

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Accessible and useable geospatial information – some future challenges
The need to improve the general usability of interactive (mobile) maps is widely recognised [1][2][3]. On the other hand, map users desire increasingly intelligent systems that are aware of the context, adaptive and flexible for different types of users, and adaptive to the usage situation and the devices on which maps are presented [4][5]. The growing numbers of mobile applications, to a large degree map-based navigation system, are directed towards users who do not using and interpreting maps on a daily basis. The map

information hence need to be simplified and personalized to the specific usage situation [6][7][29] - as is the case for visually impaired users. It is also important that data for LBS-services (e.g. icons and text labels) can be presented clearly to the user [30]. The development of interfaces for emerging mobile map applications has, however, to a remarkable extent leaned on the traditional map metaphor in which space is regarded as flat and static [8], and the opportunities for more flexible and usable interfaces for geospatial interaction have not been properly explored.

Getting access to 2D graphics such as maps is still a large problem for users that are visually impaired. It is also a problem for sighted users using small-screen devices on the move. Using a haptic display in combination with audio feedback is one way to make applications more accessible. General guidelines to create and develop haptic applications and models are collected in [9]. Applications making practical use of non-speech audio and force-feedback haptics for map type applications for visually impaired people are e.g. [10][11]. In [12], a study on a haptic drawing and painting program is presented which also involves map type usage. Another study which investigates tactile and audio feedback is the one presented in [13] which indicates the design dependency of the effects of different feedback channels. In the study [14] it was studied how image processing can be used to extract information from bitmapped maps and represent it using haptics and audio. Taken together these studies show that the design of cross-modal perceptualizations of map type data is still an open field where much needs to be done. A particular area where little is known is mobile force-feedback interaction. The use of the sense of touch in mobile applications has been explored through vibrotactile icons (Tactons), skin stretch display platforms, wearable displays and haptic pens [15][16][17][18][19]. One-dimensional systems such as [20][21][22] have also been suggested. The ViFlex 2D haptic device [23] from CEA provides a more flexible haptic feedback which is potentially well suited to wayfinding applications.

For desktop interactions, the use of a visual display to present the focus and 3D audio to present context for a map based display on a mobile device has been studies [24]. One has also investigated other forms of audio and tactile feedback to display information non-visually whilst mobile [15][16][25][26]. As well as output, it is important to consider input when on the move. Small keyboards can be difficult to use when mobile for sighted people but almost impossible for those with sight-impairments. There has been some investigation of gestural interaction as an alternative to keys. This could be gestures on the screen of a device [27] which is now becoming popular with the release of Apple's iPhone. They can also be done with the device itself, moving it around to make gestures, or using other parts of the body (for example the head) which is not much used when mobile [28]. Taken together these studies have shown that the use of other modalities (also when combined with visual displays) can have a significant impact on usability for mobile interaction.

A roadmap for the future

We have identified three particular challenges for more accessible and useable geospatial applications:

- Maximize the haptic and auditory channel themselves. Design the non-visual channels as an enhancement of the visual will reduce the

application areas – while non-visual feedback that can stand on its own will widen the range of possible usages.

- Find out what the users want and when they want it. The amount of information potentially available is huge, and systems need to be good at giving users relevant information at the right point in time.

- Understand that accessibility is for “us” not for “them”. Depending on the situation everyone may experience problems associated with e.g. not being able to see things on the screen, or not being able to cognitively attend to complex information.

These topics are of general importance, but they are also the focus of a newly started European project, HaptiMap which is aimed at making maps and location based services easier to use and also more accessible by using several senses such as touch, hearing and vision.

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