EXPLORATIVE USER STUDY APPROACH FOR LBS INNOVATION FOR HIKERS

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Abstract

In this survey, user requirements for location based services (LBSs) for hiking purposes were studied using an empirical user study approach of 'design probing'. Potential future LBS users were recruited from the following user groups: experienced hikers, teenagers (scouts) and visually impaired having residual sight. The results from the probe study were further used for the creation of so called 'Personas' describing the characteristic users of the LBS for hiking. Based on these results the identified main user requirements were about: new technical properties, adaptability, graphics, sound and vibration, physical properties, data content and interaction. The paper also gives recommendations of the utilization probing approach for developing user requirements for LBSs.

1   Introduction

The development of location based services (LBSs) is currently facing an increasing number of novel challenges in serving users' needs. The expanding use of LBSs, ageing of population and technical advances are trends that dramatically change the ways in which the needs of LBS users may be addressed. The increased diversity in the field also sets challenges for serving user groups, such as the visually impaired, with special needs. Technical advances, such as personalized map adaptation and navigational context sensitivity, however, do not merely pose problems, but also expose novel opportunities for innovating new kinds of spatial applications. More research is needed on the requirements of the mobile users with respect to technical advances.

The use context of the current LBSs is mostly car navigation and city tourism. This leaves a great variety of potential use practices, such as hiking in a forest, largely unaddressed. While in many other countries moving in the nature is not a self-evident

possibility, in Finland such user groups as elderly and handicapped people may take benefit of accessible and easy-to-use systems for personal navigation in the nature. On the other hand, what was previously considered as a satisfactory solution may no longer be appropriate. For example, teenagers have grown under a strong influence from media, such as video games, and would often need an 'extra' experience in order to be drawn to the nature.

The user study presented in the paper is a part of two on-going research projects carried out at the Finnish Geodetic Institute (FGI). The project, 'Multi-publishing in supporting leisure outdoor activities' (MenoMaps), started in the spring of 2008. The aim is to provide the users with an interface to LBSs that is easy-to-use, useful, challenging, and that provides a pleasurable use experience (Sarjakoski et al., 2009). The main outcome of the project will be an LBS prototype for mobile and web users for outdoor activities.

In the autumn of 2008 another project funded by the EU, 'Haptic, Audio and Visual Interfaces for Maps and Location Based Services' (HaptiMap), with a similar focus was launched. The project is co-ordinated by the Lund University, and the FGI is one of the 13 partners. The aim of this project is to develop multimodal LBSs that are accessible also by user groups with special needs (Magnusson et al., 2009). The project's assumption is that with better perceptualizations ('visualization' for other senses than the visual as well) and interface designs one could greatly increase both usability and accessibility of navigational systems, especially for special user groups such as elderly and visually impaired people. One of the use cases to be implemented in this project is hiking in a national park. The test environment for both of the projects is the Nuuksio National Park near the city of Helsinki and in its surroundings.

At the FGI, the user requirements for these projects were studied by using an empirical user study approach of 'design probing'. As identifying relevant user requirements for LBSs is a challenging task (Elzakker et al., 2008), the presented study aimed to seek for novel explorative methods in gathering user requirements, focused on hikers' needs, for LBSs. After a detailed presentation of the probes-based study, the findings are further used in the creation of 'Personas' that characterize the main users. The paper discusses the main user requirements that resulted from the probing phase. The requirements are addressed from the viewpoint of hiking users. Finally, some recommendations of using the design probing approach in developing user requirements for spatial applications such as LBSs are exposed.

2 Background

2. 1 The method

The method called 'Cultural Probe' was originally invented at the Royal College of Art in the UK by Gaver et al. (1999). The word 'probe' refers to an automated recording

instrument sent out to space that people cannot directly reach from the Earth in order to capture signals. A Cultural Probe is a package sent to the users' reality. The original use of the probes was artistically inspired, but during the last decade the method has grown into a widely utilized asset for practical design purposes as well. The form of a Cultural Probe is open. A probe may include a diary, a voice recorder, or a disposable camera, and usually it contains tasks and questions related to the study theme. It may contain some design material as well, such as clay, or some provocative material. Also digital and interactive probes are an option to consider.

2.2 Previous studies

Gaver et al. (1999) introduced cultural probes in an experimental, design-oriented project called Presence. The theme of the project was to develop interaction techniques to increase the presence of the elderly in their local communities in three different countries. The main reason for using probes packages was expressed as "understanding the local cultures was necessary so that our designs would not seem irrelevant or arrogant, but we did not want the groups to constrain our designs unduly by focusing on needs or desires they already understood".

Since then, the method is widely used in projects with different themes such as gathering waking-up experiences for designing emotionally sensitive alarm clocks (Wensveen, 1999), exploring emotional issues, cultural attitudes, practical needs and opportunities in home environment among senior citizens (Mattelmäki, 2003), and gathering material to understand how intimate relationships between close family members might be supported by interactive technologies (Kjeldskov et al., 2004). In the context of spatial information, Nivala et al. (2009) applied probing for collecting information on user requirements regarding LBSs in support of hiking activities.

Earlier studies show that a probe kit works best when it employs different means of expression (e.g. writing, drawing, photographing etc.) and when it is accompanied with other methods such as interviews or observations. Using this method results in understanding and visioning rather than in concrete concept ideas, and for this reason the method has been criticized by product and service developers (Gaver, 1999; Mattelmäki, 2003).

The user study approach conducted with probes goes in some extent beyond what could be traditionally considered as exploration. Boehner et al. (2007) stated that probes "frame an alternative account of knowledge production in HCI design." There are different ways to gain insights about the users' reality. Sanders (2001) outlined three paths to approach it, namely through what people say, what people do, and what people make. The user study approach, which is reported in this paper, illustrates the different aspects.

3   The set-up for probing

In the first part of this research, the user requirements for the projects described above were studied using the design probing. In order to develop an understanding of the users' thoughts, feelings, dreams, experiences, lives, and relation to hiking and using maps, the users studied were asked to interact with a probes kit during a ten-day period. Potential future LBS users were recruited from the following user groups: experienced hikers, teenagers (scouts) and visually impaired having residual sight (Braille reading was not supported in our study). There were 5 persons in each of the user groups, which completed the tasks given in the probe.

3.1 Probe study for experienced hikers

Five hikers, aged between 30-57 years, were recruited for the user study in the Helsinki metropolitan area. The 3 male and the 2 female hikers were all active members of a Finnish hiking association, Tunturilatu. All were experienced hikers who had worked as trekking guides, and represented a group with a long experience in planning and leading various kinds of hikes. Two of them suffered from presbyopia. One had osteoarthritis.

The users were contacted by email and the process began with a meeting organized at the FGI at the end of February, 2009. In the meeting, the Design Probes approach was explained to the users and the assignments were distributed among them. The users were informed about the project's interest, particularly on outdoor activities. The probe kit (Figure 1) given to the participants included several tasks; a diary with theme questions for ten days, picture tasks and a map-drawing task. A brief introduction to both the Design Probes and to the project was included in the package.

Figure 1. The Design Probe kit for the experienced hikers.

3.2 Probe study for scouts/ teenagers

The second user group in the study consisted of teenaged boy scouts. One scout leader and four patrol leaders with their patrols were participating. Besides a group meeting for

the scouts, the scout leader was interviewed alone. Topics discussed were, e.g., scouting in general, activities at different levels, paper and mobile maps and logistics on camps.

The four patrol leaders chosen were aged 14 to 17 and the patrol members were aged 12 to 15. The probe kits for the patrols were delivered in a group meeting at the local group's meeting place in March 2009**.** The patrols worked with the probes for a week. They had one or two meetings during the period, but no excursions took place. The probe-working period was followed by an interview.

3.3 Probe study for visually impaired

A user study was also conducted among visually impaired people for the HaptiMap project. The study started at the end of February 2009 and took a couple of weeks. Two of the users were female and three were male aged 21 to 78 years. Most of the users used to hike daily in urban nature and some of the users had participated in long hikes. The users wore both white canes and guide dogs, as shown in Table 1.

Table 1. Summary of the visually impaired participants.

| Age, gender	Visual impairment	Aid	Hiking style
21 years, female	Tunnel vision, one eye blind	White cane	Urban walks
51 years, female	Tunnel vision	White cane, guide dog	Long trips even abroad, urban nature
37 years, male	Nearly blind	Guide dog	Urban nature, hiking organizer
45 years, male	Macular degeneration	White cane, mobile phone navigator	Urban
78 years, male	Macular degeneration	Magnifier, wife, Nordic walking poles	Urban nature

4 Tasks in the probes

The user study was conducted in three parts. The first part was the Design Probes phase, during which the users spent a period of approximately 10 days with their design probe kit. Different kits were designed for the experienced hikers, visually impaired persons and scouts. The second part was an interview conducted soon after working with the probes kit. The third part consisted of constructive interpretation of the materials. During the interpretation, individual observations were made, together with the researchers, of the material of each of the users. These observations were clustered in order to develop Persona descriptions (Cooper, 1999) of the potential users and to

identify the main user requirements of mobile navigational applications for hiking purposes. These phases are illustrated in detail in Paragraphs 4.1-5.3.

4.1 Tasks in the probe kit for the experienced hikers

The *diary* covered 2 pages per day, over a period of 10 days. The first page was for personal notes about what happened during the day and for the thoughts that the participant had had during the day. The question "What would you have liked to do today?" at the bottom of the page was aimed to illustrate conflicts with the person's daily life. Each day's second page asked a question related to outdoor activities and hiking. In addition to the daily questions, the diary also contained two tasks: one about the meaning of the seasons and one about an ideal map application. The *picture tasks* included ten parts. The method for creating the pictures was left to the users to decide. They could, for example, take photographs, create collages, or make drawings. An explanation was required for each of these pictures. The pictures were asked to be returned either with the package or by email if they were in a digital format. The *map-drawing task* was intended to address the most memorable hikes that the users could recall, Figure 2. Important points on the route were asked to be marked in color.

The Design Probes study ended with an individual interview with each of the users within two weeks of the return of the probes. Two members of the FGI's research team participated in each interview and all the theme interviews were videotaped (Ylirisku and Buur, 2007).
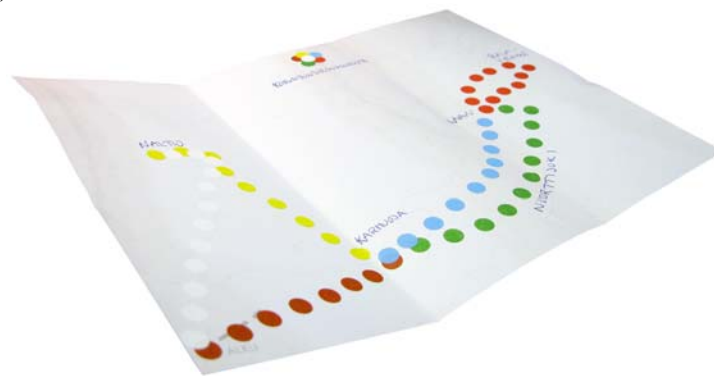
Figure 2. An example of a map drawing task of experienced hikers.

4.2 Tasks in the probe kit for the scouts

The probe kit for scouts included a diary, a photographing task and three additional tasks (Figure 3). The diary was filled by the patrol leader, and other tasks were done together by the whole patrol. The diary had two pages for each day: the first page had a question "What happened today and what kinds of thoughts did you have?" and the second page included a theme question with different topics such as known/unknown place and unforgettable trip. For the photographing task the patrols were asked to take 8

photos, one for each of the following topics: scout gear, nice place, nice atmosphere, excitement, disgust, an important gadget, the favorite piece of gear and something crazy. The four patrols were supplied with 2 disposable cameras. The three additional tasks employed drawing and writing. The first one was about activities related to different seasons, the second task was about people related to the patrol (our patrol, scouts, friends, other people), and the third task was to plan a map game.


Figure 3. The probe kit for the teenagers/scouts.

The patrol leaders were interviewed in a group interview after the probes working period of one week. One member of the research team met the patrols' leaders in the local group's meeting place**.** In the interview, cameras were returned and diaries and tasks were discussed.

4.3 Tasks in the probe kit for the visually impaired

It was necessary to adapt the probe kit to the characteristics of this user group to allow it to be handled by those with severely reduced vision. All the tasks were designed in a way that the materials were aurally (i.e. with a screen reader), visually and haptically easy to recognize for the participants. For those with a computer and a screen reader, the instructions were delivered in a digital format (in a file format that the participant preferred) in addition to the paper version with a distinguishable font. For those, who did not have a computer and a screen reader, the instructions were explained in advance, and it was ensured that they were able to call the researchers or utilize someone else in repeating the task briefs. Each kit consisted of a box that included instructions and materials for the tasks, a diary and information about the project and the method (Figure 4).
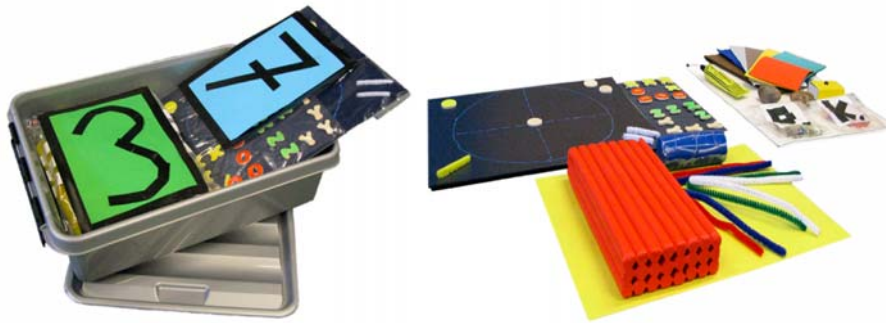
Figure 4. The probe kit for the visually impaired people. The materials were marked with tactile hints that were described in the task instructions.

The kit contained eight tasks that covered topics such as route maps, appliance prototyping, use of senses on a hike, preferred hiking company, and the use of assistive devices and services in everyday life. In addition to performing tasks, users were asked to keep a diary during ten days. In addition, a couple of questions about the vision of the participants and their hiking method were asked. After the kits were returned, the participants were interviewed. Two members of the research team participated in each of the interviews that were all videotaped.

5   Results

5.1 Interpreting user material

The third part of the study consisted of constructive interpretation of the materials that were obtained during the Design Probes study. During interpretation, individual observations were made of the material of each of the participants, and these observations were clustered in order to develop so called Persona descriptions (Cooper, 1999) of the potential users.

In order to help the interpretation of the interview and probes, the material from each of the probes kits was placed into structured affinity diagrams (Beyer and Holtzblatt, 1998). The researchers made observations of the material and wrote these on sticker-notes. Each participant was represented as one vertical column in the overall diagram. The stickers were stamped under broad theme headings, which were namely 'characteristics and thoughts', 'events before', 'during and after a hike', 'important locations and moving around', and 'new ideas for map applications', as shown in Figure 5. Within these themes the notes were grouped to form more fine-grained themes.
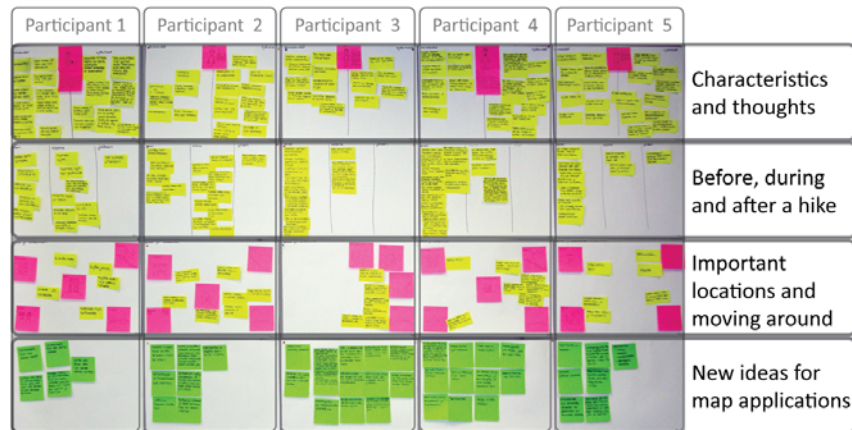
Figure 5. Working with affinity diagrams.

5.2 Characteristic user personas of LBSs for hiking

Based on the probe study material, a total of 9 'Personas' for typical users of LBS for hiking were created. One example of them was 52-year-old Esko. For Esko, nature and hiking has always had a great part in his life and he wants to pass this on to his children. When he uses a map it is important for him to see the whole route at once. That is why he is not fond of car navigators. One of the two personas from among the boy scouts was Ville, a 15-year-old who likes the action in boy scouts and is always eager to take part in the activities. He thinks a map application could be very useful when hiking, it could, e.g., give clues about the locations of interesting places. Four of the personas were visually impaired: e.g. 38-year-old Antti who is almost totally blind and tries to ease his everyday life with technology. He likes to move around in the city and make detailed plans of his daily routes.

5.3 Main user requirements

The study resulted in identifying the user requirements for LBS in the hiking context for the following domains: 1) New technical properties. The group of experienced hikers told, for example, that three-dimensionality would add a lot to a map. The scouts would have liked to be able to book cottages with text messages. And the visually impaired thought that one necessary feature might be an infrared or laser radar warning against obstacles in front. Another necessary feature given by the visually impaired was that the map objects would rise on the screen of the device, just like on a tactile map, (Weckman, 2008). 2) Adaptability. The experienced hikers mentioned that the database should be easy to keep up-to-date. For visually impaired, adjusting the features is important and at least the following should be made adjustable: volume, magnitude and type of vibration, colors and level of detail. 3) Graphics. The experienced hikers hoped the map would look the same on the device and on the printed graphic maps. The scouts would have liked to see, for instance, the fireplaces marked on the map. 4) Sound and

vibration. The group of visually impaired participants listed the following desired properties for this domain: clear sound, a possibility to mute the sound quickly, volume adjustment and a possibility for a replay. 5) Physical properties. The experienced hikers pointed out that the device should be water resistant, light and durable. The scouts hoped to be able to utilize their mobile phones for several tasks. The visually impaired hoped that the device could be used with one hand, preferably hands-free. 6) Data content. The experienced hikers talked about thematic maps and hoped there could be different maps with themes such as birds, geology, ice age, mushrooms and berry picking. The scouts suggested an idea of an application that is able to give clues about points of interest during a hike. From the visually impaired group came an idea of a device that would, instead of route instructions, describe the surroundings (what is ahead, what is on the right / left) allowing them, on the basis of this knowledge, to decide themselves where to go. 7) Interaction. An example of a desirable interactive feature was given by the experienced hikers: for them it would be great if the user could say, for example, "I want to see an owl" and the map would present the areas where seeing an owl is most likely. The visually impaired proposed a "Where am I" button on the device, which would help them to discover their location.

5.2 Recommendations for the procedure

The procedure, which was employed in this user study, contained 7 main phases: 1) focusing, 2) creating the probe kits, 3) handing out the probes, 4) interacting with the probe, 5) interview, 6) interpretation of the material, and 7) making it into workable design material. During the focusing phase the relevant themes of the project are identified and articulated. The focusing can benefit of the use of a multidisciplinary team. In the creation of the probe kits the project team should focus on making the kits concise and engaging to use. It is also important to pay attention to the tasks, so that they fit to the skills of the participants. The study with the young scout boys revealed that they had difficulties in keeping their attention on the diary task over a period of one week. The interview with the boy scouts and their leader, as well as the observation of how the group spends time together gave more insights and ideas of potential applications that could serve the scouts.

After the participants are finished with their kits, an interview session is necessary in order to gain a detailed understanding of the contents of the kits. For example, there is usually a story behind each of the pictures taken by a participant, and this is what makes a picture valuable for a design project. The stories may contain ready-made user requirements, or merely help to establish a better understanding of the user. During the interpretation session the materials should be discussed in order to form a holistic picture of the user practice.

6   Conclusions

This paper studied the user requirements for LBSs by using the empirical user study approach of design probing. In the empathic design approach adopted for the study, the resulting output from the user studies is usually understood as design material rather than scientific data. It was not objective truths that the researchers were after, but useful content that would have the potential to foster the discovery and development of user requirements for navigational applications for hiking purposes. The material in this case was formed by the stories in the diaries, the photographs, the drawings, the hand-made appliance mock-ups, and the explanations by the participants.

User requirements are complex issues related 1) to the kind of the LBSs (e.g. a mobile display-based tool for car navigation has quite different requirements from those of an aural device for the blind people), 2) to the users' characteristics (both the apparent demographic and physical as well as the more subjective and experiential ones), and 3) to the practice (for example shopping, sailing, etc.) where the LBS will be placed. The explorative user study approach addresses the latter two of these aspects. Probes and persona creation are useful methods for gaining insights about the user characteristics and especially about the subjective aspects of their relationship with LBSs. By using probes it is possible to get information about things that otherwise might have been disregarded. Probes raises up not only information, but also feelings, thoughts and wishes. The main user requirements identified in the presented user study consisting of probing and persona creation were about: 1) new technical properties 2) adaptability 3) graphics 4) sound and vibration 5) physical properties 6) data content and 7) interaction.

The explorative approach is radically different from questionnaires, which provide with quantitative data about the users. Unlike questionnaires, the exploratory approach focuses on details and attempts to construct a picture of the context where the planned LBS will be placed. The importance of understanding the context is becoming increasingly important for LBS designers as customers have an increasing amount of options available, and these are currently competing with qualities that are related to how the users experience the use of an LBS.

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