

DESIGNING A MULTICHANNEL MAP SERVICE CONCEPT

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Abstract: *This paper introduces a user-centered design process for developing a multichannel map service. The aim of the service is to provide hikers with interactive maps through several channels. In a multichannel map service, the same spatial information is available through various channels, such as printed maps, Web maps, mobile maps, and other interactive media. When properly networked, the channels share a uniform identity so that the user experiences the different channels as a part of a single map service. The traditional methods of user-centered design, such as design probes, personas, and scenarios, proved useful even in the emerging field of developing multichannel map services. The findings emphasize the need to involve users and multidisciplinary teams in the conceptual phases of designing complex services aimed at serving various kinds of users.*

Keywords: *map services, multichannel services, user-centered design, multidisciplinary.*

INTRODUCTION

Interactive map services have been a topic of growing interest for more than a decade (Lehto & T. Sarjakoski, 2005), and new opportunities for such services in different use contexts are at hand. A map service may be used for finding information about interesting places or for planning routes to unfamiliar locations. Along with the development of wireless and mobile technologies, the number of people who use interactive maps in everyday life has grown rapidly worldwide (L.T. Sarjakoski, Sarjakoski, Koskinen, & Ylirisku, 2009). According to Cartwright and Hunter (2001), users are increasingly demanding more from map services. As a

result, the usefulness of a map service can no longer be viewed in a traditional manner only, that is, as a guide in an unfamiliar environment. Instead, the service also must be enjoyable, entertaining, and aesthetically pleasing (L.T. Sarjakoski, Sarjakoski et al., 2009).

A multichannel map service allows the user to access the same spatial information contents through various channels (T. Sarjakoski, Kovanen, Rönneberg, Kähkönen, & Sarjakoski, 2010), and such a service allows the user to acquire information through the most suitable channel for each situation. Recently, there has been a strong growth of services provided through multiple channels (Sousa & Voss, 2006). The multichannel map service in our case study features the following channels: a Web map (see Kettunen, L. T. Sarjakoski, Ylirisku, & Sarjakoski, 2012), a mobile map through iPhone (see Kovanen, L. T. Sarjakoski, & Sarjakoski, 2009), a large multitouch map (see Rönneberg, Halkosaari, T. Sarjakoski, & Sarjakoski, in press), and printed maps (see Oksanen, Schwarzbach, L. T. Sarjakoski, & Sarjakoski, 2011). The digitally interactive channels are shown in Figure 1.

The present study explores opportunities to utilize a multichannel map service within a hiking context. Hiking and spending time in nature is becoming a popular trend (Antikainen et al., 2006; Johansson, 2009; Puhakka, 2007). Hiking involves more than simply navigating through nature: Activities such as planning and reflecting are essential parts of the hiking experience (Nivala, L. T. Sarjakoski, Laakso, Itäranta, & Kettunen, 2009). Existing services to support hikers are mainly printed items or on the Web (Nivala et al., 2009). When planning an excursion, hikers may seek information from several media sources. They may, for example, find details about hiking trails from one Website, the experiences of other hikers from another Website, additional information about the general area from books, and a detailed description of



Figure 1. The three interactive channels (a mobile map, a Web map, and a map on a large multitouch screen) of a multichannel map service.

the terrain from a traditional printed map. In addition to excursion-specific details, hikers may seek a variety of information, such as local weather forecasts, public transportation routes, or locations of parking lots, as well as diverse thematic information for related outdoor activities, such as backpacking, cycling, or skiing.

As a key contribution, we present a design framework (as defined by Cooper, Reimann, & Cronin, 2007) of a multichannel map service, which was created through a user-centered design (UCD) process. We present the design opportunities and design drivers that guided the subsequent process of designing a functional multichannel service for hikers. The presented design opportunities are intended to be useful beyond the immediate case presented here. A functioning prototype of a multichannel map service for hikers is currently being finalized according to the principles, or design drivers, expressed in the design framework. This paper describes the early phases of the development of the multichannel map service concept.

Designing a multichannel map service is a complex task because each channel contributes to the overall experience of the service. One key challenge is the design of a unified identity for the service, so that a user may understand using a single service, rather than multiple services on different channels. Defining potential users and understanding their needs by utilizing qualitative research techniques is essential for a successful design, as stated by Cooper et al. (2007). The UCD methods are useful for studying various potential user groups. The UCD approach promotes a constant focus on users' needs and limitations throughout the process.

We explored opportunities to address hikers' needs facilitated by new technologies and concretized these through UCD methods, such as design probes, personas, and scenarios. In the design process of our multichannel map service, we relied upon fields of expertise such as usability, user research, concept and interaction design, cartography, geographic information science, and computer science.

In this paper, we begin with a review of both map and multichannel services, and continue by presenting our case study. We then conclude by discussing the value of the conducted work with regards to the design of multichannel map services more generally.

BACKGROUND

A multichannel map service consists of different channels that, in their entirety, form an interface for the user to acquire spatial information. The increasing spread of multichannel map services, such as Google Maps including channels such as a Web map and a mobile map, is setting urgent pressure for the study of the design of multichannel map services. However, only a few studies on the process of designing such services are presented in the existing literature.

Interactive Maps and Location-Based Services

Traditionally, maps were static representations and abstractions of the surrounding world. Today, maps increasingly provide interactive interfaces to our environment. The interactive maps, referred to as multimedia cartography by Cartwright and Peterson (2007) or cybercartography in Taylor's formulation (2005), evolved from the need to present geographical information in an intuitive manner. While the visual design of maps still remains a fundamental

issue, the focus in cartography now also extends to usability issues regarding interaction, enabling dynamic maps and map object functionality (MacEachren & Kraak, 2001). Utilizing UCD methods in designing map services is still a new approach (Nivala et al., 2009), although employing UCD methods in the field of geoinformatics is becoming more common, as can be noticed, for instance, in the studies of Flink, Oksanen, Pyysalo, Rönneberg, and L. T. Sarjakoski (2011), L. T. Sarjakoski, Ylirisku, Flink, and Weckman (2009), Schobesberger (2012), and Magnusson, Tollmar, Rassmuss-Gröhn et al. (2009).

Interactive maps in a location-based service (LBS) include an important parameter: the location of the user. An LBS answers such questions as, “Where am I?”, “What is nearby?”, and “How do I get there from here?” (Steiniger, Neun, & Edwardes, 2006). When an LBS also delivers maps to the users’ devices, it can be called a map service (T. Sarjakoski & Sarjakoski, 2007). Several research projects have studied LBSs from the user’s point of view. For example, Van Elzaker and Wealands (2007) presented a case study of a UCD approach for mobile tourism applications; Zipf (2002) studied LBS maps for tourism that were adapted according to a range of variables, such as users’ preferences and interests and the given task or location; and Kramers (2007) presented an example of a UCD process by introducing the development of the online atlas of Canada.

Because of the nature of interactive maps, the map can function as an interface or index to additional information (Kraak, 2001). The user can alter the scale of interactive maps, and the locations and points of interest on the map may include links to text, photographs, videos, animations, and so forth. Existing commercial Web maps include, for instance, Google Maps¹ and Bing Maps,² which offer functionalities such as route planning and map sharing, and OpenStreetMap,³ which offers free user-editable maps. In addition to maps, Via Michelin,⁴ for example, provides additional information on traveling and tourism in its map service.

Existing map services that specialize in supporting hikers in their outdoor activities are mainly print- or Web-based services, although several research projects on mobile maps for hikers have been conducted. Studies on LBS for hikers include the GiMoDig -project (T. Sarjakoski & Sarjakoski, 2007), in which a prototype was developed for delivering real-time adaptive maps to mobile users in a national park context. Also in a national park context, the WebPark project (Krug, Mountain, & Phan, 2003) developed an LBS for recreational use in coastal, rural, and mountainous areas. This service offers adaptive information filtered by relevance to the user’s location, temporal cycles (daily, annually, or other), and user profile settings. The information could be about weather, flora, fauna, routes, trails, restaurants, hotels, one’s current location, unexpected dangers, and so forth. A prototype of mobile maps for hikers in mountainous areas (e.g., the Alps or the Pyrenees) was developed in the PARAMOUNT project (Sayda, Wittmann, Kandawasvika, & Wang, 2005), in which the objective was to provide hikers with navigation and guidance tools that include safety functions, such as sending an emergency call with position reference.

Multichannel Services

A multichannel service involves various channels, which together form an overall interface to access and manipulate the service-related content. It allows for the users to dynamically employ the preferred channel according to a situation. For example, a hiker could plan the hike using a Web map, but refer to a mobile version of the map during the hike. The use of a

multichannel approach is popular, for example, in the newspaper business. Newspapers have multichannel (or cross-media) strategies, in which the news content is supplied not only in print, but also via radio, digital television, the Web, and mobile devices (Quinn, 2003). Banks often offer multiple channels in providing access to their services via the Web, mobile devices, ATMs, in addition to face-to-face interaction in the bank. Also some multichannel map services already exist, for example, Ovi maps⁵ by Nokia and Google Maps.⁶

According to, for example, Pasman (2011), Paternó and Santoro (2012), and Segersthål (2011), people are becoming familiar with different kinds of multichannel services, and this sets increasing pressure on the design of this type of services. Designing a multichannel service is a complex task. Central to this challenge is the establishment of an experience of a unified service, in which the user feels as though he or she is using one multichannel service rather than a number of disparate services. The KANA White Paper (KANA Software, Inc., 2012) describes three key elements in a multichannel service: (a) full integration of channels, which creates a seamless service experience; (b) a consistent user experience across all channels, which requires unified functionalities from every channel; and (c) a reliable user experience that takes place without interruption or slowdown. In a multichannel service, the user's experience of the service builds upon the use of the channels. Therefore, developing a multichannel service requires a broader range of aspects in its design than would be required in a single-channel service. Understanding the integration of the channels is crucial (Parker & Heapy, 2006), as interactions with the service across all the channels must be considered.

CASE STUDY

Our case study explores a UCD effort to develop a multichannel map service for hikers. The study is based on three research projects conducted in the Department of Geoinformatics and Cartography at the Finnish Geodetic Institute (FGI). Two of these projects, MenoMaps (2008–2010) and MenoMaps II (2010–2013) are joint ventures of the FGI's Department of Geoinformatics and Cartography and Aalto University's Department of Design. They involve 13 additional partners, consisting of authorities of various municipalities and public organizations and private companies in Finland. The MenoMaps projects aim at conducting research on and developing a prototype of a multichannel map service for supporting outdoor leisure activities. The third research project, the HaptiMap (2008–2012),⁷ was coordinated by the Department of Design Sciences at Lund University, with a total of 14 partners. The aim of the HaptiMap project is to develop multimodal LBSs that are accessible also by special user groups, such as elderly and visually impaired people and that support their use of spatial information. The FGI's expertise in the projects focused on geoinformatics in geoservices, on map accessibility, and on LBS contents guidelines. The projects shared joint technical development platforms, which provided a synergy for prototype creation and offered a common environment for user studies and usability evaluations.

The focus of the present study is the design of a multichannel map service within these three related projects by applying a combination of UCD methods. In the following sections, we present the methods used and describe how we have applied the methods in our case study.

Design Process

A user-centered approach has been recognized as one of the key factors in the successful design of products and services (e.g., Cagan & Vogel, 2002; Miettinen, 2012). Understanding the user's point of view can be valuable especially in the early phases of the design process, where all design options are still open and changes to the design are easier to make (Koskinen & Battarbee, 2003).

We followed the UCD process as defined by Cooper et al. (2007). The goal-directed design process by Cooper et al. is divided into six phases: research, modeling, requirements definition, framework definition, refinement, and support. Although, as the development of our multichannel map service is still in progress, the last phases of refinement and support have not been yet conducted (see Figure 2). Despite that the phases are usually presented in a sequential manner, in the real process the phases were often overlapping, and thus were informing each other. For example, the modeling of personas was informed by the kinds of activities envisioned to be supported by the service. To reflect that the phases did not happen in a strictly sequential manner, we have named the working units “activities.” The activities that took place in our case study are as follows:

1. The *research activity* involved a background study of technologies and existing services. It also included a user study that employed techniques such as observations, interviews, and design probes.
2. In the *modeling activity*, we utilized the material gathered during research to design the personas, which expressed groups of users through archetypal characters. The chosen personas became the main characters in scenarios that the requirements phase focused on.
3. The *requirements definition activity* created a much-needed link between the users and the design framework. We utilized a scenario-based approach to keep the focus of the scenarios on the goals and needs of the selected personas.
4. During the *framework definition activity* the overall concept was designed. This phase involved defining the basic frameworks for interactivity and visual design.

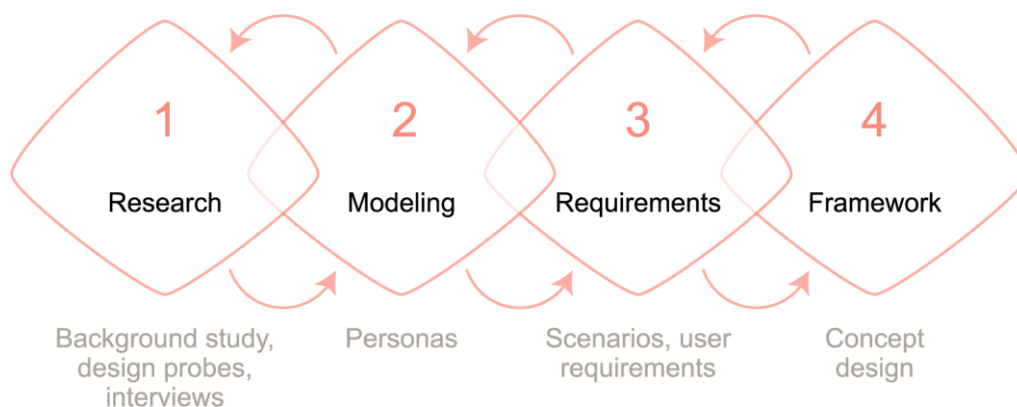


Figure 2. In our design process, we implemented four phases of the goal-directed design process (Cooper et al., 2007). Our interpretation of the phases as “activities” better reflects their true parallel and dynamic character.

The design process did not follow Cooper et al.'s (2007) process phase-by-phase in the order they are present, but rather involved the respective activities (research, modeling, requirements definition, and framework construction) that occurred in parallel and informed each other. The process featured numerous phases, typically in the form of codesign workshops, where multiple activities were advanced in parallel. The original phasing of the activities as a sequence nevertheless resembles in its overall character the progress in our development regardless of it failing to convey the actual dynamics of the real process.

User Groups

We included three user groups in the case study: experienced hikers, boy scouts, and visually impaired persons. Five or more participants represented each group. According to Koskinen (2003), three types of user groups are needed for a successful user study: primary, secondary, and deviant. The experienced hikers formed the primary user group; we expected them to be able to readily describe their specific needs for hiking. The secondary user group consisted of boy scouts, who we expected to complement our understanding of various needs related to outdoor activities of future generations. Finally, we chose to focus on visually impaired people as our deviant user group in order to learn about concrete issues related to accessibility and about particular needs that relate to their outdoors activities. The accessibility view was complemented by also including aging hikers in both our experienced hiker and visually impaired hiker groups.

The experienced hikers group consisted of five participants from 30 to 57 years of age. The three male and two female hikers were members of a Finnish hiking association and were all active hikers and experienced trekking guides. They possessed wide-ranging expertise in organizing different types of hikes for various groups. The boy scouts group consisted of a scout leader and four patrol leaders whose patrols had varying numbers of scouts participating in the studied activities. The four patrol leaders were from 14 to 17 years of age, and the patrol members were from 12 to 15 years of age. The user group of visually impaired people consisted of three male and two female participants from 21 to 78 years of age. Most of the visually impaired participants hiked daily in urban nature; some had participated in long hikes as well. These participants, all having residual sight, used both white canes and guide dogs.

The experienced hikers were contacted through the local hiking association, the scouts were contacted through the participating scout leader, and the visually impaired through an association of visually impaired. The user study was initiated by the introduction of the overall idea of the study: a 10-day design-probes-based documentation activity complemented by interviews. The process began with a meeting in which the design probes approach was explained to the users, and assignments were given. The users were informed that the project was focused on outdoor leisure activities.

Research Activity

Design Probes Study

The design probes study method is based on empowering users to articulate their personal insights, expectations, and goals with self-reflection materials (Mattelmäki, 2006). The

method was originally invented at the Royal College of Art by Gaver, Dunne, and Pacenti (1999) to provoke design teams to think more creatively about their users. The method has since transformed into a less artistic direction and now supports more informative and collaborative purposes (see Mattelmäki, 2006). Typically a user study conducted with the design probes method involves a set of assignments—a probes kit—given to the users. Diary keeping and photographing tasks are among the most common assignments in a probes kit. After users document their practice over an agreed period of time, usually around 1 week, they are interviewed on the basis of what they have documented with the probes kit. The number of participants tends to be limited to fewer than 10 due to the resource-intensiveness of the method. Along with helping researchers to construct a more elaborate empathic understanding of a participant, the stories behind the probes artifacts may also contain readily articulated user requirements.

In our study the probes kits were created based on an initial internal team negotiation of themes related to each user group. We designed distinct probes kits for the experienced hikers, the boy scouts, and the visually impaired persons (L. T. Sarjakoski, Ylirisku et al., 2009). The probes kit for experienced hikers included a diary that they were asked to keep for 10 days. It featured questions related to themes such as hiking habits, hiking gear, and hiking safety. They were also asked to photograph their hiking tools and practices. The kit included a map-drawing task to gain insights on what kind of hikes they plan and what they think when considering a hiking trip as a whole. Within two weeks of finishing the self-documentation two researchers interviewed the hikers individually.

The diary for the boy scouts included questions on topics such as how they plan a hike to a known or unknown place and what was the most memorable trip for them. During the 1-week study they were asked to photograph topics such as scout gear, essential gadgets, nice places, and so forth. The kit also included additional tasks related to the meaning of seasons, people related to the patrol, and the planning of a map-based game. The scouts divided their responsibilities to document their practice with the probes kits so that the scout leader was overseeing the activity, the patrol leaders filled in the diaries, and the other tasks were completed together by the respective patrols. After the self-documentation, which included a weekend hiking trip, one researcher interviewed the scouts in a session where all scouts participated collaboratively.

The probes kit for the visually impaired hikers was adapted to enable documentation even while having severely reduced vision. The questions were handled in digital form, which enabled them to listen to the instructions with a screen reader. The kits included haptic signifiers to allow the participants to feel their way through the materials. We asked the visually impaired participants to keep a diary for 10 days. The kit included tasks on topics such as the use of one's senses on a hike, the use of route maps, and the use of assistive devices and services. Also, they were asked who or what they prefer to have with them on a hike. Two researchers interviewed the participants individually within 2 weeks following the documentation period.

Interpretation of the Design Probes Materials

After the probes study, we gathered as a team to work with the material in order to translate it into a more meaningful and relevant form for further use in the project. This work is often conducted by using an affinity diagramming technique, where individual observations, written on individual slips of paper, are grouped into broad themes in a bottom-up fashion (see, e.g., Beyer &

Holtzblatt, 1998). During the initial phase of the interpretation, we recorded on various-colored sticky notes all observations and impression about the individual participants' experiences of hiking, and placed these notes within bounded columns (see Figure 3). In order to accelerate the process, we chose to categorize initial observations into four broad categories: Characteristics and Thoughts; Events Before, During, and After a Hike; Important Locations and Mobility; and New Ideas for Map Applications. The color-coded sticky notes distinguished observations (yellow) from category headings and places (pink) and new ideas (green). We utilized the same overall strategy and categories for the interpretation of the materials from each participant group.

The initial arrangement of observations according to the broader categories supported our team to work towards a synthesis of the observations because it enabled us to see how the participants were related in their characteristics. The structured organization of observations about participants formed the basis for starting to discuss how the participants were similar to, or different from, each other in regard to their relationship with hiking.

Modeling Activity

Personas are design tools that provide a means to articulate users for design purposes. A persona description typically contains an overview of a particular persona, such as name, age, and profession, in addition to personal goals, fears, and typical activities (Pruitt & Grudin, 2003). Personas are not representations of real people as such, but are based on the real behaviors and motivations of the studied users (Cooper et al., 2007). One of the benefits of using personas is that they communicate information about the users in an engaging and concise manner and allow for designers to address also sensitive issues about users without compromising their identity. Personas are grounded in field study findings and may contain concrete features adopted directly from the participants. The use of visual material is encouraged in order to support effective communication of the descriptions. Careful attention needs to be paid when making the visual parts of the description so that anonymity of the participants will be maintained.

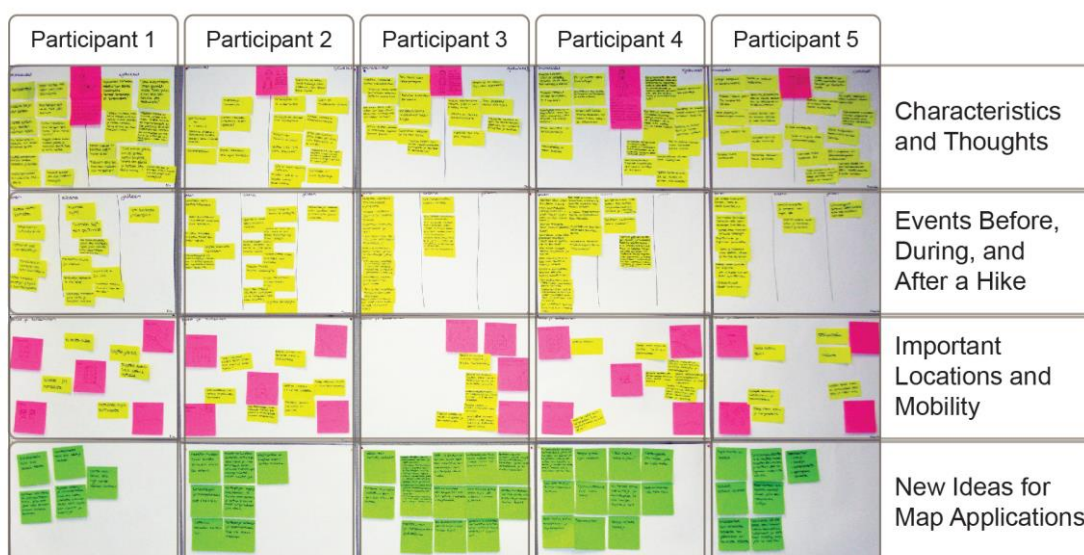


Figure 3. A structured affinity diagram for one participant group.

After we had categorized the observations from the probes study material with the aid of the structured affinity diagram, we began to synthesize the material in order to produce a set of personas fewer than the original number of studied participants. The observations showed that the many participants shared similarities in, for example, their way of hiking and goals related to it, or in their attitude towards technology, while some participants had little in common with the others. The overall intention was to reduce the amount of material while teasing out project-relevant details on a sufficient level of concreteness.

We began the construction of the personas by setting up blank paper backgrounds and discussing how the observations presented differences in, for example, how the participants within that group plan hikes. Then we transferred the notes onto the blank surfaces. Figure 4 presents one example of the new structures that emerged during this negotiation. In order to produce coherent results, we established common themes that were described for all personas: Background, Accessibility Issues, Hiking Style, Hiking related Issues, and Attitude towards Technology. The observations were marked with yellow notes, the themes with orange notes, and the scenarios with pink ones.

The main purpose of the personas in our study was to fuel and inspire designing, rather than to serve as the objective truth derived from field data that could be used to justify all design decisions. This allowed for some freedom in the articulation of the personas. The aim was to attain descriptions with an organic connection to the empirical material, while at the same time achieving a coherent, understandable, and well-rounded presentation. This was challenging because personas amalgamated only a few real people into even fewer descriptions. The process took place as a qualitative negotiation, where designers also utilized their own knowledge and expectations in dialogue with the materials at hand. Each persona became aligned around one

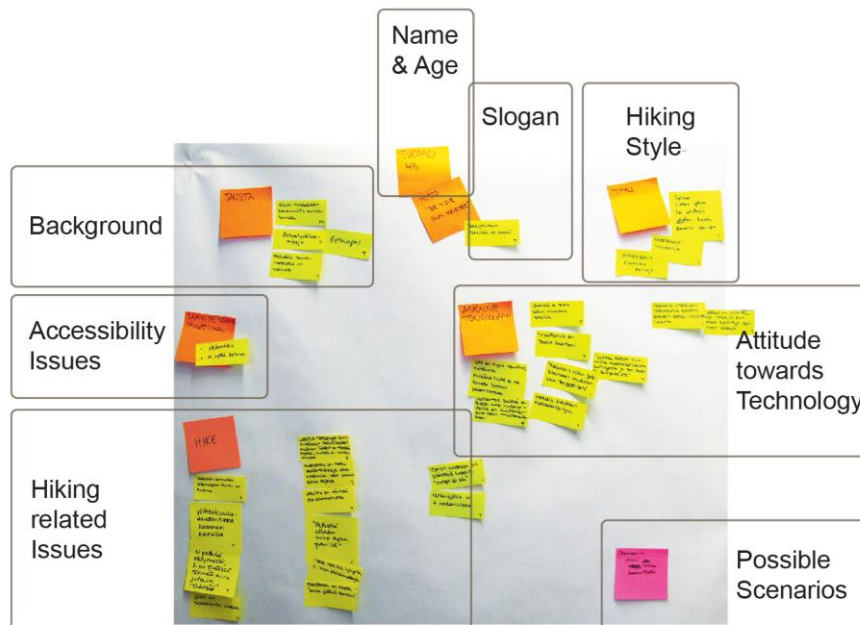


Figure 4. The persona “Tuomo” was first expressed as a collection of sticky notes.

core motivation that related to hiking. This was expressed in a slogan such as “The best hikes are the ones without any plans” (see Figure 5).

The persona construction resulted in three experienced hiker personas (Figure 5), two boy scout personas, and four visually impaired personas. Each persona was assigned a name, for easy reference, and factors such as the role of hiking in the persona’s “life” and its preferred style of hiking. Each persona featured distinct preferences and needs. In a subsequent workshop, the personas were used as the substitute for actual-user participants. Hence, they were talked about as if they were real people. For example, it was convenient to talk about what “Tuomo” wanted, what “Irma” would think about safety or accessibility in a particular situation, or what “Esko” would think of a mobile-only application that would be available only through a small screen. This kind of use of personas encouraged designers to empathize with the potential users.

Requirements Definition Activity

Scenarios

Scenarios are useful for expressing what happens in a particular situation without committing to details of precisely how things happen (Rosson & Carroll, 2002). Scenarios are like stories and tend to be easily understood by the various collaborators in design projects. Scenarios also function as a means for designers to make sense of the potential value of novel technologies for users in concrete situations. Scenarios force designers to think from the point of view of the users when imagining the progress of interaction with the envisioned technologies.

We organized a scenario-building workshop with attendees not involved in the design probes activity from multiple countries (e.g., Spain, Sweden, France, Germany, UK, and Finland) that aimed at identifying generic user requirements for a multichannel map service. Priming, or the sensitization to the theme of a project, is an important aspect to foster the fast-paced development of a shared focus in workshops (Ylirisku, Halttunen, Nuojua, & Juustila, 2009). To



Figure 5. The experienced hiker personas with name, age, profession, and slogan. Their key characteristics were visually expressed to convey their style.

support priming, workshop participants were assigned a particular persona to become familiar with prior to the workshop. In order to ensure the workshop participants would actually invest their time in reading the persona descriptions, we asked them to present their assigned personas to their workshop colleagues at the beginning of the session. The overall intent with priming was to enable the participants to ground their imagination more readily on the empirically founded personas, and thus presumably contribute to the emergence of more realistic scenarios where relevant user needs for a multichannel map service could be discovered.

The scenarios were created by employing the improvised video scenario method (Ylirisku & Buur, 2007). We briefly introduced the participants to the method of improvised video scenarios through an actual example that we had created. The participants first had to decide a rough plot for the scenario: a situation where the main character would encounter problems and novel technology would assist in to solve the issues. We also encouraged the participants to address potential issues, especially social and health related challenges that new technologies could introduce. The participants then planned and acted out short scenes, each embodying the persona that they were assigned (Figure 6).

Requirements for Design

Requirements reveal answers as to what the service should be and what it should do (Cooper et al., 2007). We employed the video scenarios for generating user requirements for the design of the multichannel map service. The video scenarios were collaboratively reviewed by the multinational working group, the same participants who created the video scenarios. After screening all the scenarios, the participants were asked to fine-tune and translate their observations into requirements, if possible. For example, the observation “the appearance of the device causes unwanted attention” was translated into a requirement “the appearance of the device must not attract unwanted attention.”

To serve as canvases for collecting notes into affinity diagrams, four white boards contained one of the following titles: Technical, Social, Adaptation, and Functions. The labels functioned also to foster the articulation of the requirements as well as to enable sorting the requirements under broader topics. When articulating the requirements, the participants were

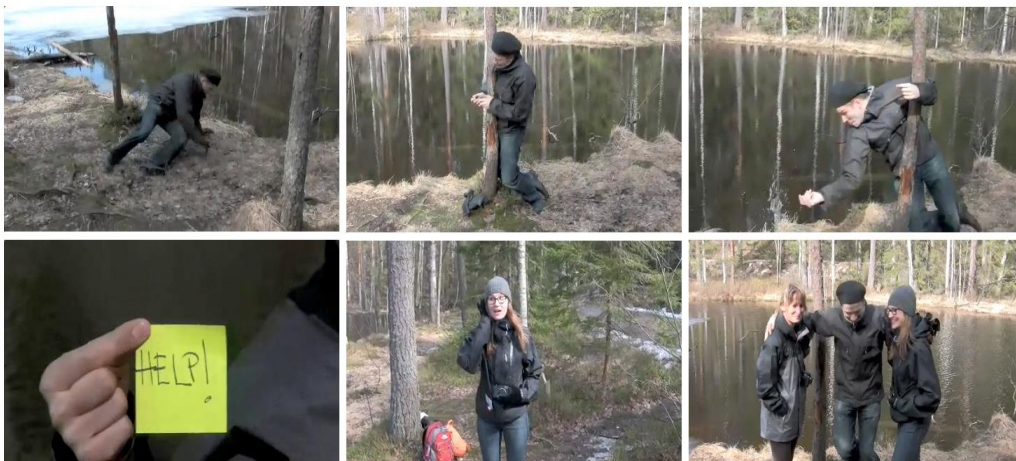


Figure 6. Screenshots from an improvised video scenario (created by the participants of the workshop), where a person falls and drops his assisting device into a lake and gets helped through traditional means.

encouraged to extend and elaborate the requirements according to their knowledge because many of the participants were experts in the field of personal outdoors technology development and have conducted user studies in related contexts.

Once the individual notes about requirements had been placed on the white boards (see Figure 7), the notes were grouped into themes and labeled. Then all requirements labels from the four affinity diagrams were collected on a shared computer screen and grouped to form overall categories of user requirements for design of multichannel map services. The requirements were treated as being prospective, that is, not all the proposed requirements were treated as something that all multichannel map services should implement, but rather as potentially important, depending on which functionalities and characteristics would be selected for implementation later. The overall categories of the user requirements were as follows:

- *Adaptability.* The group addressed requirements such as the possibility to choose what information is shown on the screen. In addition, for the visually impaired, adjustable features are important, such as volume, magnification, type of tactile feedback (e.g., vibration), colors, and level of detail.
- *Usability.* Requirements concerning usability included, for instance, that the application should be designed to fit the intended purpose, hiking.
- *Safety.* The safety issues included requirements such as the mobile application informing the user when he or she is not on the right track and of obstacles (e.g., a fallen tree) on the route.
- *Functionality.* This group included detailed functions, such as the requirement that the mobile application should include a “Where am I?” function with the latest known position or path.



Figure 7. The user requirements were developed collectively in a workshop on the basis of making observations from the video scenarios.

- *Content.* Requirements about the content included the need for additional information concerning points of interest, and important details, such as major roads or rivers, to be emphasized on the map.
- *Technical.* These included requirements such as a water resistant, portable, and durable device; for the visually impaired, the device must be as hands-free as possible.
- *Experience.* The applications should be attractive and include fun elements, such as the possibility for games.
- *Social.* The user requirements concerning social issues included reducing the likelihood to inconvenience bystanders with sounds or other loud noises, and enabling the easy switch to a nonintrusive mode.

Framework Construction Activity

The multichannel map service framework, or design concept, was generated in a session with the core design team responsible for the whole process. The initial development of the channels (the Web map, the mobile map, the large multitouch map, and the printed maps) had started even before the video scenario workshop in order to attain more sophisticated results within the given time constraints for the development. The user requirements were considered in the development of the technical implementation of each of the channels, where appropriate. For example, the tactile feedback was not relevant for a Web map.

The framework construction session was facilitated by a design researcher specializing in concept design. The other members specialized in various aspects of geospatial information systems, such as path optimization algorithms, visualizations, and technical implementation. Similarly as with the video scenario workshop, the session employed priming to foster relevant planning. Each participant was asked to present the state of art in his/her respective area of work on the different channels of the multichannel map service. The aim was to generate a simplified framework of what the multichannel map service and the principles for its implementation were, grounded in the latest technology presented by the workshop participants. One of the presentations recapitulated the identified design opportunities for the multichannel service targeted for hiking.

The Design Opportunities

The design opportunities are expressed in terms of a few key insights:

- Hiking is becoming increasingly popular. Consequently, need is growing for new map services to support it. Tourism has increased everywhere in the world; in Finland, it can be seen especially in terms of an increased interest in spending time outdoors, experiencing nature and hiking (Antikainen et al., 2006; Johansson, 2009; Puhakka, 2007).
- Social media and social sharing have become megatrends. Social aspects could be better exploited in map services because current map services seldom provide ways for social networking or sharing, such as the possibility to create groups and events.
- Making the maps accessible for all could significantly increase their use potential. The design-for-all perspective is not yet well recognized in existing map services (Magnusson, Tollmar, Brewster et al., 2009). The increasingly aging population

potentially could become future frequent users of multichannel map services. The interactivity of maps already allows users to adapt the map presentations to such an extent that the maps remain readable even for those with reduced vision. However, the adaptation of map presentations to suit specific needs has not yet been exploited to its full potential.

The Design Drivers for a Multichannel Map Service

As part of the design framework, we generated principles, or “design drivers,” for the implementation of the multichannel map service. Design drivers are high-level objectives that guide and fuel designing (Keinonen, 2006). Design drivers express briefly the distinguishing characteristics of a particular design, that is, they are the key principles that enable the creation of a coherent and distinct identity for a designed service. Our design drivers were as follows:

- **Maximize the Map Experience.** The map itself is the most important part of a map service, and it should play the central role at all times in all the channels. Designing the map and the overall user experience are very much intertwined: The user interface and the map itself cannot be separated due to the nature of interactive maps (Nivala, 2007).
- **Begin with User’s Situation.** The service should be created with a good understanding of the possible situations the user may get into with the new service. Any feature included in the final service should be justified by referring to a potential situation relevant for the users. The possible situations may be explored, for instance, with the aid of scenarios.
- **Network the Channels.** The channels in a multichannel service should be networked so that plans made on one channel should be available on any other. The channels should also be designed so that they share appearances, functionalities, and resources whenever possible to maintain a common identity and enhance the consistency of the service.

One of the major technical challenges in a multichannel map service is adapting the same geospatial data and similar functions to the different channels. For example, the multichannel map service on a small touchscreen creates different requirements for the user interface than the large multitouch map. The differences influence what can be conveyed to the user and how the interactivity may be facilitated. Therefore, some alterations to content, functioning, and presentation are needed in order to provide smooth and reliable experience across the channels. In addition, the networking of the paper-based maps can be achieved through data matrix technologies, which allows for the opening of associated content through mobile devices.

A truly user-centered process requires recognizing possible future user groups. Designers must gain insights about them and understand their relationships with map services within a hiking context.

CONCLUSIONS

This paper reported on the early phases of a pioneering concept development of a multichannel map service. The study provided a concrete example of the combined use of a wide array of

existing UCD methods in the emerging field of map services. It also illustrated how users' insights could be incorporated into a generative design process where these were not treated as objective facts, but rather as design material establishing relevant conceptual ground for the construction of the multichannel map service framework. The process was informed by the work of Cooper et al. (2007), although, it was shown that the actual UCD process introduced a much less straightforward and more complex and dynamic structuring than the process model suggests.

Our aim was to develop a multichannel map service that is easy to use, effective, and enjoyable. From the design probes study with three different user groups (experienced hikers, boy scouts, and visually impaired people), we learned about the differences between hikers in terms of their needs; for instance, some needed to know precisely their position on the map, while others claim to be happy with a rough overview map. The process of generating personas, that is, archetypal concretizations of the potential users of the service on the basis of the design probes materials, was illustrated. These were employed to ground collaborative authoring of improvised video scenarios, and they served as sources for further extraction of potential user requirements for the multichannel map service. A multichannel map service concept was then designed.

The concluding design concept expresses some characteristics that have been promoted earlier to be valuable for designing multichannel services, for example by Parker and Heapy (2006). They underlined the importance of creating a consistent experience across the channels, and this characteristic of multichannel services is also expressed in the KANA White Paper (KANA Software, Inc., 2012). Our process relied on the close appreciation of the potential users of the multichannel service. The UCD process that was applied produced an understanding of the users' needs beyond the rather superficial treatment in the earlier sources, such as in the KANA White Paper. In further contrast to these earlier works, our concept emphasized the value of the map itself and gave it a pivotal role.

The centrality of the map also created a new challenge. It is not at all a trivial problem to establish a map in multichannel map services. The design of a map becomes intertwined with the design of other aspects of the service, such as user controls and the presentation of additional map-connected data, for example, links to Web sites and photographs. This raises implications for the design of such services and underscores the need for integrative practices that bring together development across the channels. Also designers of multichannel map services need to develop frameworks, such as the presented design concept, that guide design beyond individual maps and comprise also the other aspects of the service. The findings also emphasize the need to involve users and multidisciplinary teams in the conceptual phases of designing complex services aimed at serving various kinds of users.

The presented study is part of an ongoing research project. A prototype of the multichannel map service was exhibited in the Finnish Nature Centre Haltia⁸ in May 2013. The prototype of the multichannel service will be developed further, and usability evaluations will be conducted in an iterative process to ensure the convenience of the service for a large audience.

ENDNOTES

1. Google Maps is reachable at <http://maps.google.com>
2. Bing Maps is reachable at <http://www.bing.com/maps>
3. Open Street Maps is reachable at <http://www.openstreetmap.org/>

4. Via Michelin is reachable at <http://www.viamichelin.com/>
5. Ovi Maps is reachable at <http://maps.ovi.com>
6. The mobile version of Google Maps is reachable at <http://m.google.com/maps>
7. Information on the Haptimap project is available at www.haptimap.org
8. Haltia is an event and exhibition center situated in Southern Finland within the Helsinki Metropolitan area and functions as a “door” to Finnish nature. Its grand opening was in May 2013.

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