PEER-REVIEWED PAPER

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SnowSense

A Case Study of User-centered Location-based Services

Abstract

SnowSense is one of the projects at the core of the research in Information Design at the IUAV University of Venice, especially dealing with the development of Location Based Services (LBS). This article reports on a case study conducted in cooperation with the WSL Institute for Snow and Avalanche Research SLF[1] in Davos, Switzerland. The project sets out to open up new ways for preventing avalanche-related accidents by applying a user-centered design approach and new technologies. The embracing research framework addresses the evolution of LBS and how their adoption changes the way people interact with the places they live, work or act in.

Introduction

The fact that today most information about a specific location is almost immediately available changes the way people approach certain locations or plan relocation, such as when traveling to a foreign country. On the one hand, this may decrease the quantity of information we think we have to seek out before moving to that new place; on the other hand it opens up vast opportunities to access information at the right time or even generate new information that can be shared with others. To information designers, the scenario is an invitation to investigate how this information should be structured first and distributed successfully second, to the end-users.

Since many of the issues related to the subject rise from social behavior, a decision was taken early in the project to look for applications that impacted socially relevant areas. The objective was to study the different dynamics between information, people, their activities, and their location. The purpose was not to create just another location-based service (LBS), but to demonstrate that design applied to relevant activities may become more relevant to other people as well.

Following up on Jorge Frascara's call to become “problem identifiers instead of problem solvers” (Frascara 2006), a specific area and problem was identified that could be addressed through a design process even if at a first glance it did not seem to present such a relevant design issue. It happened nonetheless to be very close to personal interests, and socially relevant in the local context of the Alps mountain region. Every year a high number of

[1] The WSL Institute for Snow and Avalanche Research SLF is part of the Swiss Federal Institute for Forest, Snow and Landscape Research WSL and is based in Davos, Switzerland.

incidents happen in the Swiss Alps because of avalanches triggered by skitourers, snowshoers, or other people working or moving around the slopes and crests. This personally affected me as a back-country skier as well, and prompted the question if the use of mobile technology, LBS and information design could help raise the level of awareness of the problem and eventually decrease the number of incidents.

While obviously LBS are not limited to be used in outdoor activities, users such as skiers are familiar with the use of these networks and services, and choosing the area as a field for investigation provided, besides all considerations of its social relevance in a country like Switzerland, a challenging topic addressing an audience willing to listen.

How LBS are Becoming More and More Location-based Social Networks

Thanks to the widespread availability of portable computing devices connected to the Internet and of GPS technology, we find ourselves increasingly confronted with services that access, use, or broadcast our personal location. In exchange for our disclosure, these location-based services promise to provide us with the location of objects or entities which might be of interest (Poolsappasit & Ray 2009) or with information related to our current point in space.

Most of the LBS which first came up were mainly static data and a geographic location combined into what is called “geolocation data”.

These datasets get coordinated with the current position of the user who could search for nearby emergences, such as various “points of interest” (POI) (e.g. gas stations, restaurants or historical sites), and be under the impression that these pieces of information are actually “attached” to the location (Espinoza et al 2001). At the same time, many present-day LBS also integrate in-progress and dynamic content, such as traffic information, temporary POI for events or happenings, or even the position of other users and content they generated.

This is an important step that mimics the move from a static and hierarchical Web to a dynamic and modular Web 2.0, fueled by the increasing willingness of users to share personal information and reveal their current location (Mason & Eckert 2010). These systems make social information visible (Erickson & Kellogg 2000) and are constantly evolving and turning former static LBS more and more into Location-based social networks (LBSN) (Schapsis 2010).

Within this evolution, the interplay between the data, the service provider, and the location provider on one side, and the user with her requests (Poolsappasit & Ray 2009) or self-generated content on the other side, configures a highly complex structure. Mostly information-based, this structure offers quite a wide field to investigate these dynamics from the point of view of information architecture and information design.

The Issue with Avalanche Victims

It is largely agreed that avalanche accidents are the results of many different concurring conditions. For example, there is a whole range of human-related factors which avalanche research and prevention have considered to be subjective hazards on avalanche terrains for more than a century now (McCammon 2009). On the other hand, the terrains themselves with their objective hazards are intensely investigated by research in snow science by analyzing the snowpack, weak snow layers, fractures and flow dynamics, the correlation between avalanches and weather conditions (e.g. temperature, precipitations, sun impact). The moment in which a skier actually triggers an avalanche is still considered to require full scientific description (Heierli et al 2010).

From an information design point of view the lack of information on current in situ risks is also an important issue, and the rescue of people lost in an avalanche remains a great organizational challenge. In order to find the weak point in the interplay between skiers, terrain, snowpack, useful information, prevention and rescue, I conducted a series of interviews with mountain guides, mountaineers, rescuers, insurance companies and snow- and avalanche-experts to obtain a ‘thick description’ of the context (Sandino 2007), as most of the knowledge about avalanche accidents is generated by the experts' experience and practice.

Furthermore, in qualitative research, stakeholder interviews are an appropriate discovery method especially when designing user-centered services (Goodwin 2009). The outcome was ambivalent: interviews showed that, on the one hand, the rescue team seems to be perfectly organized and most professionals working in the field have access to all the important and up-to-date information they need; on the other hand, those who go skiing could use more and better advance information about the location they ski in, in order to be able to make the right decisions.

Surprisingly, the interviews showed how knowledge of the terrain is underestimated by a number of people. Rescuers underlined how “mobile phones have changed a lot of things”[2]: offering people the opportunity to call for rescue[3] from the field, phones might actually encourage some to assume unwarranted risks or downplay informed decision-making because help is always within reach.

During the interview sessions I found out that many skiers, apart from ordinary mobile phones, carry with them smartphones and use the Internet and GPS-driven mapping applications as an additional source of information. How to exploit this behavior to give them new opportunities to improve their knowledge of the terrain without fully delegating part of their responsibilities to a device? A location-based social network aimed at the preparation and execution of a backcountry ski trip seemed an interesting design answer.

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[2] Interview with R. Frey and P. Keller from the REGA Swiss Air Rescue, conducted by Jan Eckert on January 1st 2009

[3] In some cases a cell phone might even be located by the rescue team themselves in order to arrive precisely at the place where the accident happened.

In the past few years, the WSL Institute for Snow and Avalanche Research SLF developed two mobile applications: “mAvalanche”, for mountain guides and avalanche forecasters, and a didactical application for skiers called “White Risk Mobile” (Suter & Harvey 2009). As this latter application does not consider the skiers' current location, it was decided that SnowSense should focus on the preparation of a ski trip at home as well as on its execution in the field.

Getting to Know the People you Design For

“Feedom lovers” might be an appropriate description to characterize people who head out into the backcountry far from resorts and other skiers in order to walk or ski on untouched terrains. In fact, this quest to get “off the beaten track” (Buzard 1993) makes it hard to communicate with and give advice to these people, especially when it comes to the “right” planning or decision-making process.

Many in this group are excellent skiers, they are in good physical shape, and their capacities sometimes make them skip over proper trip planning. Under certain circumstances, the desire to ride untouched terrain or “powder fever” as some call it (McCammon 2002), might prevail while conscious evaluation of the current risks and caution are put aside and the readiness to assume risks increases. Improving this conscious decision-making process is key to safer backcountry skiing.

Out in the field many factors, including snow or weather conditions as well as human factors such as personal strength or group dynamics, are constantly changing and influencing decisions taken during the trip. Psychologist Jan Mersch and the ski instructor Wolfgang Behr describe the skiers’ decision making process as an interplay between rules, intuition, knowledge and the capacity to take some mental distance from a given action or situation (Mersch & Behr 2009).

While experienced mountain guides might be able to rely on their experience, knowledge and mature intuition, intermediate or beginner guides bases his decisions much more on rules (Mersch & Behr 2009).

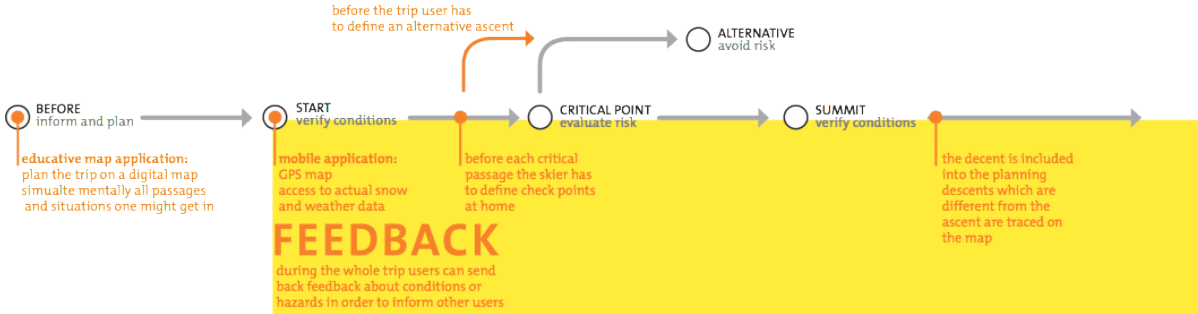

Figure 1: Action chain diagram and service design touchpoints

In order to further understand the users we were designing for, the skiers process itself has been analyzed and drafted in an action chain diagram

(Figure 1). Aim of this analysis is to detect possible gaps or critical points which might influence the decision-making process. A parallel survey of the literature on decision-making was conducted.

Gary Klein writes about “expert’s experiences which grow out of the ability to run mental simulations”, and maintains that constructing a mental simulation involves forming an action sequence in which one state transforms into another (Klein 1998).

Is there any way to improve a skiers experience by mentally simulating a ski trip? Although planning a trip on a map gives people already most of the information they need, they will need to make decisions in the field. Consequently, the decision was taken to focus on a map-driven application helping people to simulate their ski trips before heading out into the backcountry.

Since our application and service is user-centered and user-driven, the touch points have been identified among the items in the skiers process (Figure 1): the idea was to avoid SnowSense becoming “something more” users had to learn, use, and do, but rather making it match and integrate what they are already doing.

Different Users And Different Depths of Information

The people we were designing for had very different backgrounds and skills, from very experienced mountain guides to people having their first trip off piste. This was also true in respect to technology: their skills in interacting with information delivered on a screen-based device varied wildly.

To meet these different levels of knowledge and ability we invested part of our research time into understanding how the data and information we worked with is gathered, processed or interpreted, and also which are the single steps and filters it passes through before getting delivered to the users (Figure 2).

The resulting information flow diagram gave us insight about how a situation is captured by the weather measurement stations in the field or by the local observers in the various resorts, how this data gets distributed and computed by weather and snow models, evaluated by avalanche experts before a specific event is actually predicted, and released as a forecast to our end users.

Here another opportunity opened up; why not give the different users different way to access the single datasets they might be interested in. For example: an experienced mountain guide might be interested in the raw data measured by the weather stations, whereas a skier might need an interpreted version of this data, in the form of a forecast or warning, since she might not be able to interpret the measurements by herself.

This resulted in three user roles or profiles being created: beginners, intermediates, and experts (Cooper et al 2007).

Each of these profiles receives different quantities of information and has different ways to access it. The snow and avalanche forecast released by the SLF twice a day in the Winter already sports both a visual and a text versions which give people the possibility to get to different depths inside the information pool they are interested in.

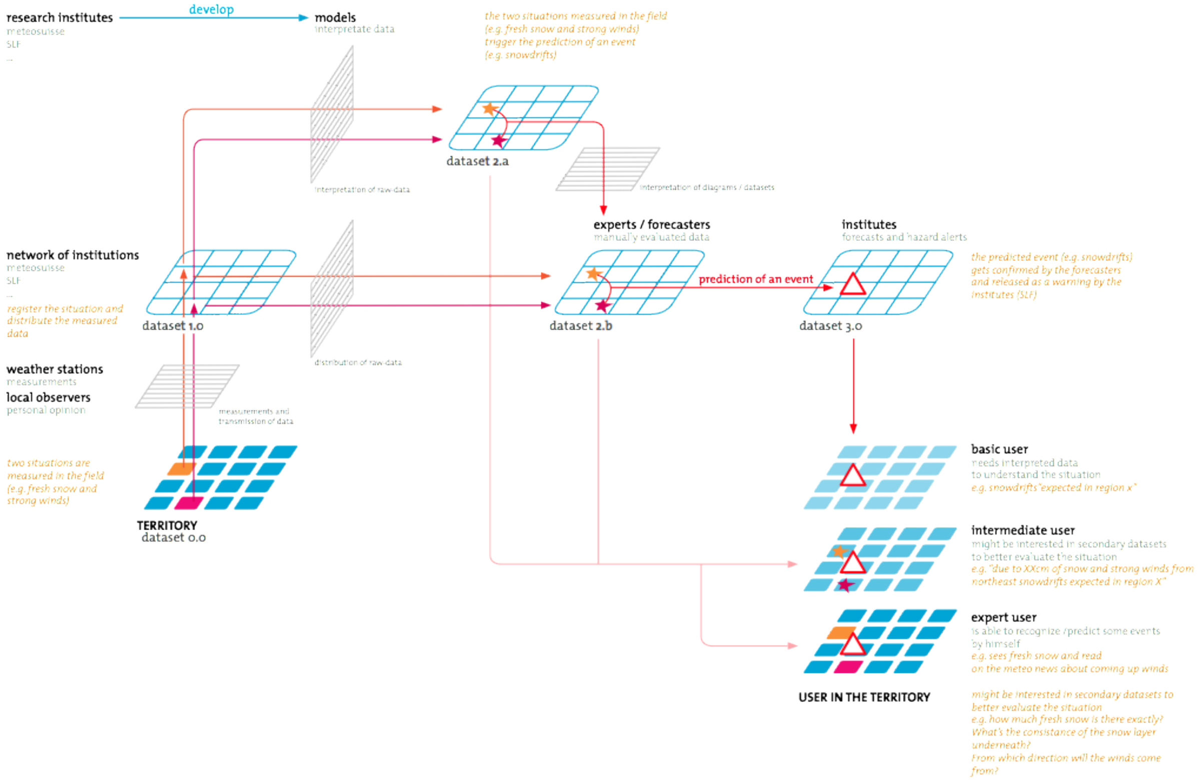

Figure 2: Information flow

Consequently, SnowSense incorporates this visual and text-based language using the same diagrams, keywords or information patterns (such as snow patterns) already used there.

This way beginners and intermediates can concentrate on the visual part of icons and symbols, but still can dig deeper into the dataset if they want by reading through a description of the expected avalanche forecast. Expert users can access all data from the weather measurement stations in real time via a digital map that allows to download all necessary diagrams (Figure 3).

Figure 3: From left to right: snow patterns, weather measurement stations, icons from the avalanche bulletin

Working in a Co-creative Context

Since we were designing in a field which heavily relies on personal experiences and our service was meant to interlace with these, a strongly co-productive context based on generative methods (Sanders 2002) has been maintained from the beginning.

The reason for this co-creative approach was the fact that these individuals are the ones who know in detail the process we were trying to improve. Well-known and familiar methods such as brainstorming, mapping or paper prototyping were used to create the foundations from which two programmers and a designer created the final application.

All of the people contributing to the final prototype were backcountry skiers themselves, and mountain guides, avalanche forecasters and specialists involved in education and prevention worked support during focus groups or workshops in the field.

For the map application we decided to create a dialogue that accompanies the user while planning his trip on the digital map. A widget takes users through 7 consecutive steps (Figure 4). While doing so, users continuously interacts with the map. They have to draw their trip, spot difficult passages, check the hill slope, exposition and altitude. They also have to look up snow and weather forecasts as well as define a timetable, decision points and alternative routes for the trip. This way they factually simulates the entire trip on the digital map and gather important information they would otherwise miss.

The project group decided not to fill in automatically data, such as snow and weather information, that is technically available when other parameters are in. The reason for this is that the group agreed that gathering this information should always be part of the preparation, even when not using SnowSense, which was always meant as an additional tool to be coupled with other existing methods such as paper maps, or avalanche courses. By looking up the single strategic information pieces users learn how to manage the process and they develop a habit of doing so without depending on the application.

Figure 4: SnowSense Web GIS, all windows popped up

For the actual ski trip, a mobile client was prototyped. This client allows skiers to save their trips, visualize them on a map, and get tracked via their smartphone's GPS. Reminders of all the steps defined before are available, as well as the possibility to look up the weather forecast and compare them with the real conditions on the field. A series of feedback functions are also available: while on the trip, skiers can select add “observations” that are represented by small icons on the “Unterwegs-screen” (Figure 5).

Clicking any of these icons positions the related observation on the map, and makes it visible to all other users. Photos and text can be uploaded and posted as a message, and information about the weather, slope conditions, difficulties or hazards may be shared within the community. As service providers can include this user-generated content into the forecast itself, this feedback enriches not only their ability to check how accurate the forecast was but to document events in the field.

In terms of interaction and interface design, we had to tackle the fact that even though the whole service addressed a rather serious subject, our freedom-loving users are out there to have fun: it had to capture the user and ‘persuade’ her with its technology and design (Fogg 1999), its general look and feel had to invite people to use and interact with it.

The fact that users included people having a good time (the skiers) and people on their work duties (mountain guides) set some boundaries which had to be acknowledged. A fully innovative, “never seen” interface was ruled out as some users might not take it seriously, or would have problems getting used to it.

Figure 5: Selection of icons on the unterwegs screen

The icons on the Unterwegs screen, for example, have been taken from educational books edited by the Swiss Alpine Club for their avalanche courses because of their familiarity, even if they did not completely suit the original visual concept.

Furthermore, we were developing on touch-devices, so we had to take into account how people navigate applications in this environment. We paid particular attention to the usability of SnowSense, since it was meant to be used under quite extreme environmental conditions: in cold weather, blinding light, or poor visibility[4].

The Good Thing About Projects are Surprises

After our SnowSense prototype had been successfully tested with a group of skiers during Winter 2010-11, we had the opportunity to present the project during a live event celebrating the anniversaries of the Institute for Snow and Avalanche Research and the local Alpine Club in Davos. During one day in March 2011, we sent out twelve groups of skiers, equipped with smartphones and our SnowSense application, after having them planning their trips. The skiers were asked to send us feedback from the field on both expected conditions and actual conditions.

Those carrying a smartphone were GPS-tracked, so we had the current position of each group and we visualized this data was on a screen down at basecamp (Figure 6). Visitors had the chance to see how each group

[4] For example, we set a maximum menu-depth of 3 clicks, as well as an enlarged grid for all of the buttons, and all important functions had to be always reachable directly through an action bar in order to actually spend as less time as possible moving through the interface.

Figure 6:

proceeded and how the trip had been planned, step by step: they could look up the difficult passages, hill slopes, altitudes, visibility, temperatures, and so on.

Figure 7: Main screen at the SnowSense live event

An added benefit was the fact that this way we managed to communicate to visitors from the area that backcountry skiers are not just people who go for unplanned adrenaline, risking their lives and precious resources, but that there is a whole process of preparation and evaluation in the field behind every trip.

We received a surprising amount of feedback from our skiers: uploading photographs for example was much more successful an option than expected. We long discussed the possibility that users would minimize interactions with SnowSense simply because taking the smartphone out of their pockets could mean getting cold hands, but we were proved wrong. We got pictures documenting everything: their preparatives, skinning up, summiting and skiing down, and the cold beers they drank to celebrate after the trip.

Also, the necessary 'seriousness' did not prevent SnowSense to be perceived as a 'fun tool' as well. Freedom lovers enlarged the scope of possibilities by transferring behavior from other applications they might use, such as social networks, and introducing that into the application process. Being informed did not prevent enjoying themselves and what they were doing together with other people, effectively kick-starting the transformation of the tool from LBS to LBSN. The awareness of what other participants were doing and the vital tension between privacy and visibility (Erickson & Kellogg 2000) drove our users to widen the range of action of SnowSense.

Handlungsspielraum – Range of Action

The results of the live event in Davos led to the conclusion that we need to further investigate the phenomenon of how users go beyond the possibilities we first gave them.

Initially, the SnowSense WebGis and mobile application were designed for the planning and execution of a backcountry ski trip, dealing with rather serious information and issues: the rich feedback of photographs and messages which users sent back during the test event has shown that they have effectively broken those boundaries and added new layers for connecting the application to the physical and social context they found themselves in. This turn-around on a function which was considered to be rather marginal by the project group has led to the conclusion that the range of action play a crucial role while designing LBS and LBSN.

Common user-centered approaches mainly focus on affordance[5], the “invitation of an object or artifact to take use of it”, or “the appearance and configuration of an object or artifact which indicates how to use or interact with it” (Saffer 2009). The concept of the “range of action” focuses instead more the user-side of what is happening, what the user makes out of the artifact. This is best described by the German word “handlungsspielraum”, where between the two words “handlung” (action) and “raum” (space or range) stands the word “spiel”, play.

This could be both read as a “hidden invitation” to access new interactions in a playful way, and to always allow some “play”, some “tolerance”, in respect to the way users will use an artifact. We could say that affordances may be the way to access a range of actions (Bonsiepe 2009), and that the “handlungsspielraum” itself is the space where the users' actions unfold.

The concept of “handlungsspielraum” will be further investigated: the aim is to generate a small number of exercises or methods around it and make it a part of a user-centered design process.

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[5] Gibson first mentions the term affordances in 1966 and 1979 further develops the concept of affordances in his The Ecological Approach to Visual Perception. Boston: Houghton Mifflin. in 1988 it gets taken up by Norman who extends the concept in The Psychology of Everyday Thing, New York: Basic Books.

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