
Designing Unobtrusive Display Technology for Cross-Country Skiing

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Abstract

In this paper, we present our on-going research, which aims to design technology to support winter sports in nature, whilst providing an unobtrusive user experience. We focus on cross-country skiing, which is a sport often done in the solitude of a snowy wilderness, and where proximity to nature is an essential part of the experience. We present a concept design for a ski-attached information display, and discuss the design drivers for it.

Author Keywords

Skiing; sports; public displays; nature; design.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

Doing sports in nature, such as hiking and skiing, is, in addition to the physical exercise, often a way to relax mentally. While our urban life is often filled with technology, being in nature provides a counterbalancing context and enables a get-away from technical gadgets. However, technology can enhance outdoor sports activities, e.g. navigation or performance information related to the activity [1]. These two drivers, i.e. an undisturbed sports



Figure 1. Cross-country skiing experience is often closely related to the peace of nature, being undistracted by technology.

experience in nature and the benefits gained from technology use, create a conflict between different requirements. This conflict can (hopefully) be addressed by design.

In this paper, we address the user experience of cross-country skiing, combined with an information display. We present a concept design and discuss the design drivers that aim for an unobtrusive user experience in nature.

Related Work

Seeking solitude and/or escape from technology has already been addressed by some earlier research. Sambasivan et al. [11] report on a user study of everyday practices where people wished to leave technology behind, and the reasons and implications of technology non-use has also been addressed in a larger scope [2]. Directly related to the sports in nature context, Posti et al. present a concept and demo, which enables hikers to avoid meeting other people on hiking tracks [9]. In our research, our aim is to focus on a design that provides valuable information for the user, but at the same time minimizes the distraction caused by the technology.

Whereas HCI research on tracking physical exercise and on different technology concepts related to sports is vast, there are only a few papers that address skiing. Downhill skiing, rather than cross-country, has so far been considered in some studies. Here, Fedosov et al. focus on the social sharing practices [6], Colley et al. present a virtual reality application trialed while down-hill skiing and snowboarding, and in [7], activities in ski lifts are considered. In [13], practices and user experiences with outdoors sports are generally

investigated. The design and usability challenges of different technical gadgets has also been investigated, and whereas the mobile phone has been reported to be a convenient platform, as people carry it around anyway, it has also been criticized for its not-optimal form factor in sports use contexts [1].

As our research focuses on designing an information display for a physical exercise, there is relevant related work in the area of ambient displays in sports. Glasses type form factors have been used for providing information for the user, and examples run from Google Glass to downhill skiing goggles [10], and glasses attachments where information is shown e.g. on different color LEDs in the periphery of the vision [12]. Bicycle displays are commercially available [8] including less intrusive designs [3]. Additionally research has explored also a concept of projected information screen for cyclists, casting a screen on the ground in front of the bike [5].

Cross-country Skiing as a Design Context

Contextual Factors

Cross-country skiing is an endurance sport, where the skier is exercising on nature trails, often over distances of 10+ kilometers in the cold and often dim light conditions of wintery nature (Figure 1). The network of tracks typically expands from tens to even hundreds of kilometers, although junctions are scarce compared to street and road networks. Thus, generally the possibilities to select a route occur infrequently.

The information items that are of interest for the skier are typically the time and distance skied. Other parameters such as heart rate are also of interest for some, requiring the use of a wearable sensor. The



Figure 2. Cross-country skiing equipment includes tight straps for hands and bindings for the boots.

skiing route is typically selected based on its length and difficulty level, and, although a rough plan of the exercise is mentally drafted before starting the exercise, skiers often modify the original plan on the go e.g. due changed weather conditions. For skiers exploring unfamiliar tracks, information about which track to take at junctions would be beneficial.

Cross-country skiing equipment consists of skis and poles, and due the cold temperature, gloves are worn. The poles are strapped to the hand (Figure 2), requiring the cumbersome operation of unstrapping when hands are needed e.g. to remove things from coat pockets. Thus, using a mobile phone app during the exercise is difficult, and touch screen interaction would suffer from serious usability problems. Although audio based interaction is one possibility, this clearly infringes to the silence of the natural environment.

Due the cold temperature, no skin is exposed in the wrist area, which hinders the use of wrist-worn devices. Whereas watch and bracelet type devices such as the Polar Loop are popular among other sports, they are not optimized for skiing task but are rather generic activity tracking devices. Moreover, most of the wrist or arm wearables are primarily targeted for warm conditions. In contrast to these solutions, we seek a dedicated alternative, designed specifically for cross country skiers.

Designing for Unobtrusive UX

Our proposed solution for a cross-country skiing optimized information display is an e-ink type screen attached to a ski, see figure 3 for a concept design. In this location, the display is always in the vicinity of the skier, and the skier does not need to unstrap the hand

or expose the wrist in order to see it. Whereas some snow may get on top of the display, the amount of loose snow on the premade skiing tracks is typically very small. This challenge can be overcome with an UI design emphasizing clarity and visibility.



Figure 3: Concept design for an unobtrusive e-ink display integrated to a cross country ski.

In our current state of research, we hypothesize that the number of information items that are needed are few. For the route information, due the predefined network of tracks, it is enough to show the next crossing. Due the character of the sport and its traditions, we hypothesize that the skier typically requires only occasional information from the system, and the information update rate does not need to be very fast. Moreover, as we seek to keep the mindfulness and meditative nature experience in mind for the design, showing a continuous data stream and lots of detailed information would be obtrusive and even stressful.

For the physical form factor, the display cannot be too heavy in order not to imbalance the sports equipment. We propose that the interaction and GPS tracking is thus operated via a smart phone, which the skier can

carry in a pocket. A e-ink type display is chosen because of its low energy use and its non-luminous characteristics. Glowing lights, e.g. LEDs, would easily disturb both other skiers, and the skier themselves. For dark conditions however, the need for some level of luminance is needed. This could be accomplished in a way that respects the environment, e.g. similarly to night mode in car navigators and dimming instrument clusters.



Figure 4. Concept design for a cross-country skiing mobile app that provides content to the display attached to the ski.

In order not to disturb the balance of the skis, the ski-attached display should be kept as light-weight as possible. Thus, in our concept, the interaction mechanism e.g. to adjust and select the displayed information items would happen over a mobile phone app. A concept design for the mobile app UI is presented in Figure 4. The GPS sensor for tracking the location can also be the one of the phone,

Discussion

In this paper, we have presented our concept design for an information display for cross-country skiers, where providing unobtrusive user experience is a driving design factor. Our concept addresses the design challenge created by the conflict of wanting to track the sports activities to provide information for the training, and on the other hand enjoy the skiing experience without the need of taking one's mobile phone out of the pocket. Especially for the display design, we propose using an e-ink display to avoid the distraction caused by an illuminated screen. As next steps, we aim to evaluate the concept with the target group, e.g. active cross-country skiers, and prototype our solution further.

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