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Ubiquitous Connectivity in the Mountains: Enhancing the Ski Experience

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Fifteen years ago, being in the mountains meant being fairly disconnected from the rest of the world. Yet skiing or snow-boarding down the slopes in mountainous terrain, watching the sun shine on picturesque snow-covered peaks, and learning and improving your skills while spending time with friends can be great social experiences. Today, many areas in the Alps, despite the high altitude and distance from urbanized environments, offer ubiquitous mobile phone and data connectivity, with 3G networks widely available. Many ski resorts have recognized their users' desire for connectivity, and some even provide free Wi-Fi hotspots at cable car stations and restaurants. Furthermore, this increased connectivity, along with other advances in pervasive computing, have led to new products and services aimed at enhancing the skier's experience.

EXPLOITING RFID

Providing access control and ensuring that customers pay to use certain facilities is essential for financial success, but the user experience improves when access control is invisible and hands-free. Using RFID technology, ski resorts have been able to seamlessly integrate such access controls. In the late 1980s, automatic access gates to ski escalators were upgraded from electromagnetic stripes and barcodes to RFID, offering seamless billing and connecting different ski regions. Furthermore, users no longer need to search for or insert tickets, because a ski pass can now be read from a distance. Skiing has become more convenient, and ski passes have become more secure against forgery.

Once a user has bought a ski pass and placed it in a trouser or jacket pocket, all gates are accessible. Access gates to cable cars and chairlifts are realized as embedded RFID readers (see Figure 1). When access is granted, the interaction is implicit and the user just walks through. If the reading doesn't work or the user doesn't have permission to use the facility, then the technology moves into the foreground with a red light, making the user aware of the problem.

Today, plastic RFID cards (based on ISO/IEC 14443 or ISO 15693) are used as ski passes, so NFC-enabled phones could easily implement the ski pass functionality and allow over-the-air ski-pass purchases.

ENABLING COMMUNICATION AND COORDINATION

Users have benefited from the ability to communicate and coordinate using mobile networks. Not long ago, it was easy to lose track of other skiers in your group, especially in large resorts or with a group of skiers of varying abilities. Yet much of the fun of skiing is the social aspect, so finding the others is important to the user experience.

SMS and Telephony

Currently, coordination usually occurs through SMS and telephony. Most users carry a phone while skiing, so calling or using SMS seems to be the obvious choice. However, those who have used a smartphone while skiing know that the current user interface design isn't optimal, because removing your gloves is inconvenient and cold. Even when using special gloves that work on capacitive screens (see www.leki.com/850-fuse-s-mf-touch-2.html), the UI elements are hard to hit, because the fingers are bigger.

Fortunately, the research community has presented alternative ideas that could provide some inspiration, such as the Yo-Yo interfaces. These interfaces let a user navigate a one-dimensional menu by pulling a display, which is attached with a retractable string to clothing. Selecting is done by squeezing the display—and the entire interaction can be done with gloves on.[1]

Smartphone Apps

Back in 1999, the Hummingbird research project developed a wearable

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Figure 1. An access gate with an embedded RFID reader. The system is designed to let the user walk through without taking out the RFID-based ski pass (which is shown here for illustration).

Figure 2. The GoPro camera, mounted to the user's helmet, is designed to create digital (action) videos while doing outdoor sports.

computer to support communication in colocated groups of people, giving users continuous awareness of the physical presence (or absence) of others. In a study with six ski instructors, the researchers showed that Hummingbird supported informal social interaction.[2]

Since then, many smartphone applications for group communication and coordination have become available. Such applications range from sending SMS to groups and group chat functions to location sharing. A common approach is to use a map user interface that shows the location of various group members.

Social Networks

In addition to communicating with fellow skiers, interaction with social networks has become increasingly important for many users. Sharing scenic photos with colleagues back at the office or friends at home is a means of self-expression that enhances the user experience. Furthermore, the ski resorts welcome this form of communication, which provides word-of-mouth advertising. A morning Facebook post showing powder snow might motivate friends to take the afternoon off and head to the slopes.

RECORDING AND SHARING EXPERIENCES

Technologies for recording personal skiing experiences have also gradually developed. With digital cameras and wearable sensors, the number of pictures taken and movies made has increased, and we've also seen an increase in fixed installations that enable more professional measurements and recordings.

Wearable Cameras

Digital cameras that can be mounted on the user's helmet, a snowboard, or skis provide new perspectives and let users create exciting action movies. The GoPro Hero 3 (www.gopro.com), for example, is a camera specially designed for outdoor action sports (see Figure 2). It offers waterproof housing, allows high-definition video recording (1,920 × 1,080 at up to 60 frames per second) with simultaneous time-lapse photos, has a mode for high-speed video or 4K movies (3,840 × 2,160 at 15 fps), and includes Wi-Fi connectivity. It's amazing how well these technologies are engineered to deal with difficult light situations (such as looking into the sun) and fast movements.

Running such a camera in a time-lapse mode, where photos are taken every 10 or 30 seconds, lets you create

recordings similar to those of the Microsoft SenseCam (http://research.microsoft.com/sensecam). When reviewing these picture in animated form (for example, in form of a 24 fps movie, which presents an eight-hour day in approximately two minutes), the experience of the day can be relived, enhancing the personal memory.

Keeping Track

Using a GPS tracker or a smartphone app, users can record where they skied, which cable cars they took, where they had breaks, and where they were fastest during their downhill runs.

Endomondo.com, for example, offers a service that provides an overlay on Google Maps with a track and basic statistical information, such as the maximum and minimum altitude, maximum speed, the user's heart rate, and distance of the run. Such information is useful for reviewing and sharing the skiing experience (though it can be used for any sport). Reviewing the information is especially interesting when the skier has gone outside of the marked slopes.

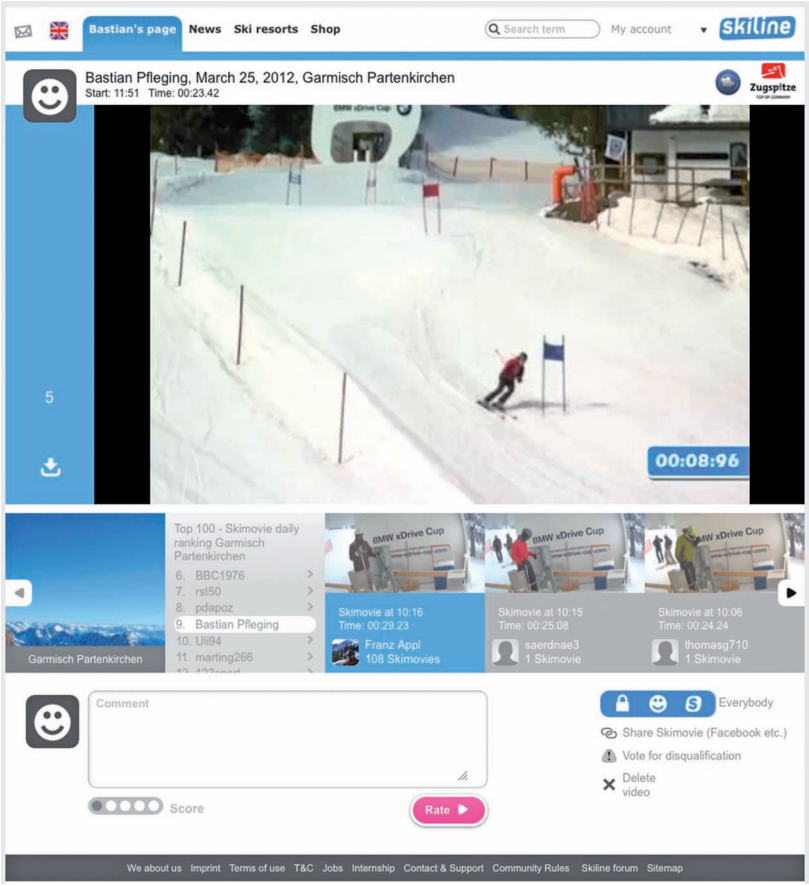
Installations for Timing and Recording

Simple examples of timing and recording technologies are separate race tracks, where skiers can record their times and speeds and compete with friends. The simpler versions of these installations are timekeeping systems without the means for recording or sharing. The measured time is typically shown at the end of the track on an advertising board.

Acquiring movies that look similar to the ski races broadcast on TV requires cameras along the racetrack, but with the ubiquity of RFID in ski passes, more sophisticated recording systems have been installed to do this. The systems store the data on the Internet and use the RFID-enabled ski passes to link it to the user.

One example of such system is the SkiMovie slope (see Figure 3). The basic

(a)



(b)

Figure 3. The Skiline SkiMovie installation provides a fixed installation with (a) an access gate and pan-tilt cameras that track the user while going down a slope. (b) The user can access the video later on the webpage. (Figure courtesy of Skiline; used with permission.)

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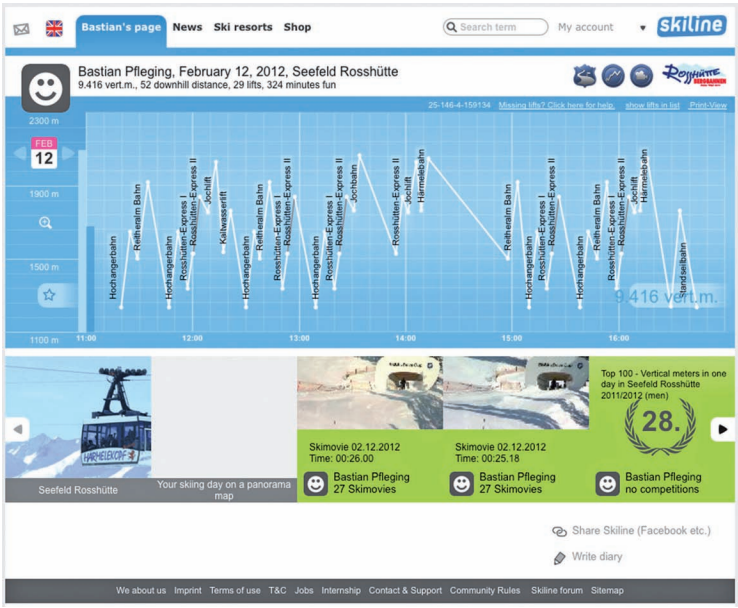

Figure 4. The Skiline online portal provides access to information that is linked to the user's RFID ski pass, which includes cable cars taken and videos recorded. (Figure courtesy of Skiline; used with permission.)

concept is to limit access to the slope to one rider at a time to identify the person via an RFID entry gate and record the run with a permanently installed pan-tilt camera system that can track the skier on the race track. The video can later be accessed online by entering the ID of the RFID ski pass. (Web portals such as skiline.cc or epicmix.com are prominent examples.) This lets the skier not only analyze the general riding performance (altitude diagram, kilometers, or number and locations of lifts ridden) but also view recorded ski movies, rate the riding style, and share them with friends (see Figure 4).

OFFERING NEW OUTPUT DEVICES

Personal devices, such as enhanced sports watches or mobile navigation devices, focus on single users. They allow an in-situ analysis of parameters—such as current speed, heart rate, and vertical meters—or help the user navigate to a certain destination. Interaction with these devices while skiing is difficult, because speeds are high and the devices are hidden under warm garments.

To facilitate access to this information while skiing, Recon Instruments offers a head-worn heads-up display integrated into certain skiing goggles. The system display lets the user see current riding parameters (speed, vertical, and altitude), navigate to points of interest, and control a smartphone and music player (see Figure 5).

(a)

(b)

Figure 5. The Recon Instruments display can be used with (a) certain skiing goggles and shows current speed, altitude, and direction. (b) It can also display other information. (Photos courtesy of Recon Instruments; used with permission.)

These examples are the first commercial steps European ski resorts have taken to change the user experience while skiing. Over the next few years, we expect more technologies to enter this domain and new services and products to emerge.

Looking at research prototypes—in particular, integrating sensors into skis,[3] boards,[4] and clothing—many ideas are being explored. Providing navigational information is another interesting research domain[5,6] with products that don't seem too far out. Needless to say, the products described here are only the beginning.

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