NatureCHI - Unobtrusive User Experiences with Technology in Nature

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NatureCHI - Unobtrusive User Experiences with Technology in Nature

Abstract
Being in nature is typically regarded to be calming, relaxing and purifying. When in nature, people often seek physical activity like hiking, or meditative, mindful or inspiring experiences remote from the urban everyday life. However, the modern lifestyle easily extends technology use to all sectors of our everyday life, and e.g. the rise of sports tracking technologies, mobile phone integrated cameras and omnipresent social media access have contributed to technologies also arriving into the use context of nature. Also maps and tourist guides are increasingly smart phone or tablet based services. This workshop addresses the challenges that are related to interacting with technology in nature. The viewpoints cover, but are not limited to interaction design and prototyping, social and cultural issues, user experiences that aim for unobtrusive interactions with the technology with nature as the use context.

Author Keywords
Nature; unobtrusive interaction design; value based design; mindfulness.

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

Technology Meeting Nature

What we call “nature” is inherently and integrally an important aspect of life. It can be referred to as the home and origin of humankind, a refreshing place to seek experiences and adventures, and to perform physical exercise. In the hectic pace of urban lifestyle, people often seek serendipity and calmness, and pure and refreshing experiences from nature. Furthermore, as presented in [3] “Real and virtual engagement with nature elicits positive and restricts negative affects (e.g. anger, aggression); re-balances physiological arousal and renews attentional resources...”. We seek engagement and connection with nature through various activities – e.g. hiking, gardening, or visiting places as a tourist. Values linked to themes such as sustainability, recycling and ecologic lifestyle are based on a respect for nature.

On the other hand, technology has become an integral part of our everyday life in the so-called ‘developed world’. Certainly, a significant ‘first world problem’ is the fact that we can be connected to our social networks 24/7 through smartphones and tablets, even up to the point of problematic and addictive behavior [11], and document and blog daily events. Technology use has also arisen when we are in nature – using navigation apps and digital maps, or taking selfies with smart phones at beautiful nature views, for example. Technological aids are also used e.g. when hunting with dogs [10] or tracking sports [1], and more concepts have been suggested e.g. for mountaineering [8] and backcountry skiing [7]. Technology can be used to bring people to defined places to enjoy the same experiences [6] or to facilitate solitude by providing guidance on how to avoid other people [9]. It can offer a way to bridge different ways of knowing, such as those of indigenous or rural inhabitants in e.g. [4, 5]. In addition, the way we design things or utilize the possibilities of interactive installations can raise our awareness of the fragility of nature as well as something “red in tooth and claw” - highlighting the vulnerability of human kind if an ecological catastrophe takes place, as pointed out in [5]. Elements of nature can also intensify the emotional aspects of interaction, as explored with plants in [12].

Bringing technology into nature may potentially distract the nature experience, but can also provide possibilities to share the moment, store mementos, and access services “in-the-wild”. This workshop addresses the overlapping area of technology usage and experiences with nature, looking at the challenges, potential conflicts, and novel possibilities between these. Examples of research areas interesting to the workshop are illustrated in Figure 1.

Workshop Topics of Interests

The topics of interest for the workshop include, but are not limited to the following:

• Design and use of unobtrusive technologies and services for interacting in nature
• Novel UI mechanisms and metaphors for interacting with nature
• Nature integrated UIs and technologies
• Cultural aspects of interactions in nature
• Social acceptance of technology use in nature
• Non-use of technology vs. the use of enabling technologies in nature
• Technologies that enable going into nature but do not interrupt the user’s experience of nature
• Reliance on technology in nature, and its potential consequences
• Value based design and respect of nature
• Temporal design aspects and ephemeral user interfaces with nature as the use context
• Designing for individual users vs. travelling together, and converging and diverging user group behavior in nature
• Recommendations for being in nature in the relevant context, e.g. weather, floods, ground saturation

This workshop will bring together researchers and practitioners from academia, industry (e.g. experience industry, tourism, natural resources) and art-based design to discuss and share their research and insight. We welcome participants working with user research, ethnography, design, prototyping, evaluation, natural materials, and want to facilitate a multidisciplinary approach through the workshop.

Goals of the Workshop
The most important goal of the workshop is: 1) to gather together the researchers who are conducting research in the cross section of technology and nature, and build the network among these people. The other goals of the workshop are: 2) to identify the key trends of current research and future research guidelines in the area, and, 3) promote the research of technology usage in nature and make larger audiences aware of current research as well as the promise and risks related to the topic. Yet another goal is: 4) to foster the research community and create a plan for sequential workshops or other events.

Organizers
Jonna Häkkilä is a professor at Faculty of Art and Design, University of Lapland. She has led User Experience (UX) and concepting teams in Nokia Research Center (2007-2011) and Center for Internet Excellence, University of Oulu, Finland (2011-2014). Her research interests include mobile and ubiquitous interaction and user experience design. Currently she is working e.g. on using natural materials for tangible interactions.

Nicola J. Bidwell is Prof. and Prof. Extraordinaire at the Universities of Namibia and Pretoria in southern Africa and affiliated researcher at Royal Melbourne Institute of Technology, Australia. Since 2003 Nicola has focused on designing interactions with ICTs for rural settings and Indigenous and African cultures. Nicola takes a critical design perspective and applies situated, ethnographic and participatory methods. She has 100 publications including a book: At the Intersection of Traditional & Indigenous Knowledges and Technology Design

Keith Cheverst is a Reader with the School of Computing and Communications, Lancaster University. A significant focus of his research over the last 20 years has centered on the design and deployment of mobile systems that provide support for locative media experiences and wayfinding in both rural and urban settings.

Johannes Schöning is Professor of computer science at Hasselt University working at the Expertise centre for Digital Media (EDM). His main research interests lie at the intersection between human-computer interaction
(HCI), geographic information science and ubiquitous interface technologies.

**Simon Robinson** is a Research Officer at Swansea University. His work focuses on the human side of mobile interaction, arguing for heads-up and real world-based approaches.

**Ashley Colley** is User Experience researcher and PhD student in the UX team at the University of Oulu, Center for Internet Excellence. He has more than 25 years industry experience, mostly in creative technologist roles, and is the inventor of more than 25 patents

**Website**
The workshop web pages can be found at [www.naturechi.net](http://www.naturechi.net). The web pages contain the details of the workshop call, link to the submission system, and upon acceptance, workshop papers.

**Pre-Workshop Plan**

**Key dates**
The important dates associated with the workshop’s organization are as follows:

- Call out: 15 November
- First submission deadline: 16 December 2015
- Notification of acceptance: 21 December 2015
- Second submission deadline: 13 January 2016
- Second notification of acceptance: 12 February 2016
- Workshop day: Saturday 7 May or Sunday 8 May 2016

**Before the Workshop**
The call for the workshop will be distributed in HCI related emailing lists. A flyer will be designed and distributed at HCI venues, and we will advertise the workshop at upcoming HCI conferences and among key research groups. The distribution of the call also happens through the members of Program Committee. We will also recruit people through social media and our personal networks. Web pages for the workshop have been set up by the organizers.

**Workshop Structure**

**Workshop Format**
The workshop is organized as a one full day workshop. It will consist of workshop paper presentations, demos, out of the classroom group exercise and discussions, and will be held in a lecture room for ca. 25 people. The estimated number of workshop participants is 15-20. Each participant will contribute to the workshop with a position or research paper (4 pages in CHI EA format), which introduces aspects of the participant’s prior research, future plans, insights or interests in the area. The submissions will be reviewed by the workshop program committee and organizers. The selection of participants is based on the EA reviews for the quality, novelty and inspirational aspects, aiming for a good balance of different perspectives on the workshop topic.

**Activities and Timing**
The preliminary workshop schedule is as follows:

- Opening of the workshop
- Morning session(s): paper presentations (ca. 5 minutes per paper), followed with a discussion
- Start of hands-on group work outside the classroom
- Lunch
• Presenting the group work
• Exercise with design probes
• Coffee
• Demo session
• Results of the design probes session
• General discussion of future directions
• Closing of the workshop
• Evening: workshop dinner

Group work will consist of an interactive exercise done in groups of 4-5 people. In this out-of-the-classroom exercise, the groups have 45 minutes to explore the environment (preferably outdoors) and find a place where they design a concept around a nature experience. The place is documented with photos and/or videos, and where appropriate found artefacts, the concept should integrate a non-disruptive technology element to the experience with a nature. A presentation about the concept is created as a ppt presentation or video (preparation time appr. 30 minutes). After lunch, the concepts are presented and discussed. The organizers will provide physical low-fi prototyping equipment, such as frames, transparencies, post-it notes and creative stimuli that can be utilized in the concept creation.

The material probes exercise will consist of design probes: large posters of natural views, and natural materials. Participants go through these probes in groups, and create a map of key elements in the experience, and how the context or material presented by the probe could be integrated with the technology to create an unobtrusive, enhanced experience.

Post-Workshop Plan
After the CHI workshop, we will conduct a hands-on design workshop on Nature and HCI at Arctic Design Week in February 2017, hosted by University of Lapland, Finland. We will apply to have a summary article for Interactions Magazine. We also plan to organize a journal special issue where the participants will be encouraged to publish their work. The workshop papers will be available via the workshop webpage prior and after the workshop, providing opportunity for participants to familiarize themselves with all papers prior to their presentation.
Call for Participation
The ‘NatureCHI - Unobtrusive User Experiences with Technology in Nature’ workshop addresses the overlap of technology usage and experiences with the nature. The ever-growing omnipresence of technology in our everyday life and the idea of nature with pure, meditative or adventurous experiences may create conflicts in values, cultures and user behaviour. On the other hand, technology may be used to share or intensify experiences, or for bringing a piece of nature closer (as well as more accessible).

This workshop focuses on the challenge of designing unobtrusive technology usage and user experiences in nature. We welcome researchers and practitioners working on ethnographic studies, user research, design cases, prototype development and artistic installations related to technology and nature. The one day workshop will include short presentations, exercises outside of the classroom and with design probes, and a demo session.

To apply to the workshop, submit a max. 4 page position or research paper in CHI EA format (references will not count towards page limit), through the Easy Chair submission system (see workshop webpage). The submission deadlines are December 16th 2015 and January 13th 2016. The papers will be reviewed by the workshop organizers and program committee. Accepted papers will be made available at the workshop webpage. Upon acceptance, at least one author of each accepted paper must attend the workshop. All participants must register for both the workshop and for at least one day of the conference.

More details can be found from the workshop webpage: http://www.naturechi.net

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Ephemerality as a Design Driver: Evanescent Screen Enabled by the Arctic Weather Conditions

Abstract
This paper contributes to the discussion on weather-based phenomena as an affordance for creating user interface elements. The transient characteristics of nature concretely represent ephemerality and provide novel metaphors for interaction design. We have studied arctic weather conditions as a new possibility in the context of ephemeral user interfaces and evanescent information presentation. In this article we present our work in progress dealing with an evanescent screen concept referred to as BreathScreen. BreathScreen is an ephemeral surface for projections enabled by breath clouds produced by human beings in arctic weather conditions. Our work entails preliminary observations from experiments with BreathScreen and introduces possibilities for the presentation of personal information. It also and brings out pragmatic challenges encountered in the implementation of BreathScreen.

Author Keywords
Evanescent screen; ephemeral user interface; arctic; weather; vapor; fog; cold; winter.

ACM Classification Keywords
H.5 Information interfaces and presentation (e.g., HCI)
Introduction
Nowadays people are balancing between social visibility and privacy. Those are the drivers of an increasing interest in apps and other solutions that make data and information ephemeral and self-destructing. Ephemerality and evanescence have recently gained a growing amount of attention in the human-computer interaction (HCI) field of research (Dun et al. 2012; Seah et al. 2014, Shein 2013; Döring, Sylvester and Schmidt 2013; Kwon et al. 2015). According to Döring et al. (2013), an ephemeral UI includes elements that are intentionally created to last for a limited time and typically utilize materials such as water, fire, soap bubbles, and plants.

Accordingly, after Snapchat became popular, several large companies, including Facebook and Apple, have launched ephemeral features such as disappearing and self-destructive messages (wired.co.uk 2015; en.softonic.com 2015). However, owing to the absence of materiality, these solutions do not fully meet the definition of an ephemeral UI (Döring et al. 2013). Most of the existing implementations utilizing ephemeral materials are designed to be used indoors or they require stationary infrastructures (i.e. Barnum, Narasimhan and Kanade 2010; Imura et al. 2011; Rakkolainen and Lugmayr. 2007; Plasencia, Joyce and Subramanian 2014; Kwon et al. 2015; Sun 2015). We argue that evanescent screens constitute an important ephemeral UI element in the context of information presentation. The term evanescent means quickly fading or disappearing (Oxford dictionary 2015). We define an evanescent screen as a user interface that presents perceivable information for a few seconds.

In our view, the existing UI implementations have not fully utilized actual weather conditions. We therefore focus on weather and a mobile evanescent screen concept referred to as BreathScreen to address the possibilities of evanescent information presentation enabled by exhaling in Arctic weather conditions.

Artic weather conditions as an affordance for creating evanescent screens
With arctic weather conditions we refer to the typical winter season in northern Finland when the mean temperature remains below 0°C/32°F (Finnish Meteorological Institute 2015). Weather is an essential part of our everyday life. However, research on weather-based phenomena as an affordance in UI elements is lacking. According to Gibson’s (1977) theory of affordances, we not only perceive objects as forms and spatial entities, but also as possibilities for action in the environment. In this light, natural phenomena such as weather can be considered to be mostly unused potential for interaction and information presentation.

To stimulate this discussion, we propose the novel notion of a weather-based user interface (WUI). A weather-based user interface is defined here as a UI building on weather phenomena that are used as an essential part of interaction or information presentation. For example, when we exhale in cold weather, our breath mixes with cold air and condenses into visible vapor. Hence, we can momentarily see a fog cloud. We call this phenomenon a cold breath and consider it as a mobile evanescent screen that affords the presentation of personal information.
Our objective regarding the BreathScreen concept was to create a human-driven, mobile, and evanescent screen that affords personal information presentation. The concept was formed using the combination of arctic weather conditions, cold breaths, and a mobile projector. We projected images in mid-air on cold breaths, making several experiments outdoors in the dark with varying wind speeds and in temperatures ranging from -4 to -12 degrees Celsius. We also made experiments indoors in a dark laboratory environment, where an arctic climate could be created artificially. The temperature in the lab varied between -8 and -20 degrees Celsius and the wind speed between extremely strong and no wind at all. We experimented on various images ranging from simple, single-coloured symbols such as arrows to more detailed pictures such as butterflies.

The first experiment (Figure 1) revealed that BreathScreen requires dark surroundings to generate a visible image. The projection has to be made approximately at the height of the user’s eyes to achieve a clear and understandable image. We also observed that a projection on a cold breath near the user’s face results in a splinterly image. If a projection was made with a one-second delay, the cold breath had moved further away allowing the formation of a more coherent image. Although it was possible to create a perceivable image, the experiment revealed that the receding cloud was extremely vulnerable to wind. This made image formation difficult and unstable. Whenever an image formed, it was also visible to other viewers nearby, reducing the level of privacy.

Based on the first experiment we decided to work on the vulnerability of the image formation and bring the content near the user’s face. In the second experiment setting, the exhalation flow was directed to the palm with uplifted fingers at an angle of 90 degrees (fig. 2). The resulting fog screen produced a perceivable image, but it was challenging to find the right blowing angle to generate a steady screen. When the image was formed near user’s face, the bystanders only saw a fragmented, unrecognizable image.

In the third experiment we created a flat and wider screen that is easier to form. We made a wide blowing array comprising eight straws side by side with the end part pointing up at an angle of 90 degrees (fig. 3). The array produced a vertical fog screen 20 centimetres away from the viewer’s face. The projected image was clear, and the screen was also wider and easier to form than one made with the palm. Also, in this experiment setting the content could not be viewed by the bystanders.
In the last two experiments we managed to generate a clearly perceivable image that stayed in the air for less than five seconds. It produced an illusion of the image hovering above the palm or in mid-air near the face (fig. 4). The experiments show that the distance as well as the projection angle with respect to the user and the cold breath are critical. The projection has to be made from the user’s viewing angle, and the ideal BreathScreen angle is 90 degrees with respect to the user. The screen should be formed near user’s face in order to maximize the privacy of the projected content. However, the greatest challenge to privacy is that the projected image may remain visible if there are surfaces beyond the fog screen.

The screen in the third experiment was more stable and easier to produce than a fog screen made with the palm. The optimal environmental conditions consist of a dark space, low wind, and a temperature of minus degrees Celsius. The experiments showed that simple, high contrast, and especially yellow or white pictures projected against a completely dark background are easiest to perceive.

**Conclusion**

This paper contributes to the emerging discussion on ephemeral user interfaces by introducing two supplementary concepts – the evanescent screen and weather-based user interfaces (WUIs). In addition, we have demonstrated the potential of WUIs by presenting the evanescent BreathScreen, involving the momentary cloud of a cold breath produced in arctic weather conditions.

The main idea of BreathScreen is that a cloud of fog is created in front of the viewer’s face by exhaling in cold weather. The fog is then directed to flow vertically as an evanescent screen for projections. Our screen solution is easy to implement because the vertical air flow can be created with the palm or with some other simple and inexpensive construct. Evanescent screens enabled by cold breath present a new opportunity to implement human-driven solutions for presenting ephemeral information. The transient characteristics of a cold breath concretely manifest evanescent information and provide a novel metaphor for interaction design. This analogue can be seen as an advantage in the context of ephemeral UIs and nature – potentially in other contexts as well.

However, there are some pragmatic challenges to the wider utilization of BreathScreen, for example limiting the projection on the fog, the complexity of weather phenomena, and the requirement of arctic weather conditions. Hence, in the future we aim to systematically explore the physics of the weather conditions enabling BreathScreen. Also, we will examine the solutions to limit a projection on the fog and the possibilities to create an artificial cold breath.

**References**


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 experience...
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 than 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 downhill 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 on 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 wintry 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 1. Cross-country skiing experience is often closely related to the peace of nature, being undistracted by technology.](image-url)
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](image-url): 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](image.png)

**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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Encouraging Visitor Engagement and Reflection with the Landscape of the English Lake District: Exploring the potential of Locative Media

Abstract
The Lake poets were a sub-set of the 18th to 19th century Romantic poets that lived in, and were inspired by, the English Lake District. For example, William Wordsworth’s poem ‘Yew trees’ makes reference to four Yew trees located in the Lake District’s Borrowdale valley. In this paper, we present our research into the design (and formative evaluation) of Locative Media Experiences (LMEs) that may facilitate visitors to the Lake District in engaging both with the landscape and with the poetry itself.

Author Keywords
Locative Media; Nature; Lake District; Lake Poets.

ACM Classification Keywords
H.5.m. Information interfaces and presentation.

Introduction
The rugged and mountainous landscape of the English Lake District was a significant inspiration to many English poets and artists during the so-called Romantic period of the 18th to 19th century [5]. Notable English artists include Joseph Mallard William Turner while poets include William Wordsworth and Samuel Taylor Coleridge; both of whom were amongst a small
group of poets (known as the Lake Poets) that lived in, and produced works inspired by, what they felt to be the sublime qualities of Lake District [13]. Furthermore, many of the works themselves relate directly to the landscape of the Lake District and its Borrowdale valley\(^1\) in particular (see figures 1 and 2). For example, Turner’s painting looking south into Borrowdale\(^2\) and Wordsworth’s ‘Yew trees’ poem [12] that makes reference to four Yew trees located at the head of the Borrowdale valley\(^3\).

*Those fraternal Four of Borrowdale,*  
*Joined in one solemn and capacious grove;*  
*Huge trunks! and each particular trunk a growth*  
*Of intertwined fibres serpentine*

The Lake District National Park is located in Cumbria in the North of England and a significant portion of the land and more of the public bridleways are managed by the National Trust (NT) conservation charity. In addition to conservation activities, the NT also provides and maintains signage, e.g. signs to support wayfinding on public footpaths and bridleways or information signage such as that shown in Figure 3 which provides visitors with information relating to Wordsworth’s poem at the site of Yew Trees.

In this paper, we discuss our formative research on enhancing the visitor experience to the Borrowdale valley through Locative Media Experiences (LMEs) that feature the poems and paintings inspired by the landscape. In particular, we wish to support visitors’ engagement with both the landscape and the painting or poem that relates to it. However, one of our major concerns is that the locative media experience (and the GPS-equipped mobile device delivering it) does not distract the visitor from this engagement. The remainder of the paper is structured as follows. In the next section we present background and related work. This is followed by a section describing our current research including meetings with the Lake District NT and the brief reporting of a formative expert field trial of a LME. A discussion section follows this and, finally, we present future work and concluding remarks.

**Background and Related Work**

In this section we start by briefly introducing the role of non-digital technology in nature and the Lake District in particular. This leads onto a description of so-called ‘viewing stations’. Following this we survey the related HCI literature involving studies of digital technology in nature. Next we introduce Locative Media.

*Guidebooks: a Non-Digital Mobile Technology in Nature*  
To start to unpack ‘unobtrusive user experiences with technology in nature’ we should first consider what we mean and include by way of the term ‘technology’ or indeed ‘mobile technology’. A popular resource used by ramblers walking in the Lakes is Alfred Wainright’s series of Pictorial Guide to the Lakeland Fells\(^4\). These books are available in A5 size and so can fit in the pocket of a rambler’s waterproof jacket and can be considered as an example of mobile technology (albeit non-digital). The books contain sketches of landscapes which many would consider as works of art in themselves [2]. A rambler can use the sketches to support her wayfinding by comparing the landscape in front of them with the perspective of landscape

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\(^1\) [www.nationaltrust.org.uk/borrowdale-and-derwent-water](http://www.nationaltrust.org.uk/borrowdale-and-derwent-water)  
\(^2\) [www.william-turner.org/Looking-south-into-Borrowdale,-Lake-District.html](http://www.william-turner.org/Looking-south-into-Borrowdale,-Lake-District.html)  
\(^3\) [www.theborrowdalestory.co.uk/literature-and-art/](http://www.theborrowdalestory.co.uk/literature-and-art/)  
\(^4\) [en.wikipedia.org/wiki/Pictorial_Guide_to_the_Lakeland_Fells](http://en.wikipedia.org/wiki/Pictorial_Guide_to_the_Lakeland_Fells)
presented in the sketch; hence the sketches encourage engagement with both the landscape and the sketch.

Lake District Viewing Stations
The first guidebook to the Lake District was published by Thomas West [11] in which he described the picturesque scenery from locations referred to as ‘Viewing Stations’. The Lake District NT is currently re-establishing four of the Viewing Stations highlighted in West’s guidebook. One of the Viewing Stations is the Bowderstone (figure 5). Another is Ashness Bridge, which affords a stunning view facing West (Figure 2).

Technology in Nature within HCI/Design Literature
A review of the HCI/Design literature reveals surprisingly few examples of research that has studied the role of technology in nature. The relatively few systems that do report on technology interaction ‘outdoors’ typically focus on the learning domain, e.g. the Ambient wood project [10], the GreenHat Mobile Augmented Reality System (supporting students in learning about biodiversity [8] and the MobileGIS system which forms one of the case studies described in [1]. Examples of systems where learning is not the goal typically focus on wayfinding, e.g. the Hobbit ‘asocial hiking app’ [9]. Recent research that adopts a research through design approach [7] includes [4] and its use of so-called Nature-technology hybrids.

Locative Media
One of the earliest examples of a locative media project (dating from 2002 and actually pre-dating the locative media term) was the ‘34 North 118 West’ project (http://34n118w.net/). The project coupled location sensing (GPS in this case) with mobile computing devices in order to support a ‘locative narrative’ in which users would be pushed audio narratives relating to the history of places they passed by in Los Angeles. A thorough coverage of Locative Media systems, including the contemporary issues associated with smartphone apps is presented in [6]

3. Timeline of Current Research
In this section we briefly describe our stakeholder meetings involving the NT Office in Borrowdale, and the design and outcomes of a formative expert field trial.

Initial Meeting with NT
An initial hour-long meeting with the Lake District NT took place in June 2015 and was attended by a researcher (one of the authors) and a NT Forest Ranger who had been active in the Borrowdale valley for 15 years. The scope of the meeting was to discuss potential research collaboration and, in particular, whether the concept of providing LMEs based around the works of the Lake poets and artists such as Turner would be something that fitted within the NTs values.

During the meeting the Ranger discussed the NT plans to re-establish four of the Viewing Stations including Ashness Bridge and the Bowderstone. We also discussed Wordsworth ‘Yew Trees’ poem for which the Ranger had a personal interest (having written a dissertation on the subject). The meeting provided an opportunity to discuss the tensions raised by utilizing smartphones and tablets to support interaction with Nature. This led onto a discussion regarding the lack of connectivity within the valley and the researcher was able to clarify that content could be stored locally on a tablet device and use GPS to trigger location-based events without requiring connectivity to mobile data.
Formative expert field trial of LME in Borrowdale

In July 2015 we carried out a formative trial of a LME which included content such as an excerpt from the Yew Trees poem. The trial participants (one male, one female) were two experts in Mobile UX and neither had visited the Borrowdale valley previously. The LME was created by one of the authors using the locative media authoring tool that forms part of the SHARC framework [3] (see figure 7). The framework also includes a mobile Android app for playing LMEs. In brief, the authoring tool enables the author to define POIs and to associate media items with these Points of Interest (POIs). Furthermore, the author can define geographic ‘trigger zones’ around these POIs such that when a user enters a given trigger zone the associated media items are pushed to the device (see figures 6 and 8).

The LME contained POIs representing two viewing stations, namely: Ashness Bridge and the Bowderstone. Content included an excerpt from Wordsworth’s Yew Trees. Images associated with the two POIs included images and paintings (see sidebar). The expert field trial lasted two hours. Each expert was given a nexus 7 tablet with the LME downloaded and were both asked to ‘think aloud’. While space precludes detailed discussion of the findings we note here that the experts appeared engaged in the content and the landscape it related to. Furthermore, the visualization of ‘trigger zones’ around POIs [3] meant they were not constantly looking at the display. At Ashness Bridge, the experts were observed matching the perspective and content of the paintings with their view, noting the strong similarity. Conversely, at the Bowderstone, both noted the difference in forestation between Ogle’s 1864 print and the current state (see figures 4 and 5). One expert also suggested that the ‘Yew trees’ poem should have an audio playback option in addition to the text.

Second Meeting with the Lake District NT

A second two-hour meeting with the Forest Ranger took place in the Borrowdale NT office in November 2015 and was attended by both authors. The LME used in the field trial was presented to the Ranger. His reaction was enthusiastic and he particularly appreciated the content related to the viewing stations. The LME also acted as a useful frame of reference for discussing a range of themes. One notable theme was the potential to ‘dispel myths’ with the Ranger pointing out Wordsworth’s reference to male Yew trees where studies indicate a mixture of male and female. A further meeting is scheduled for January 2016 involving the NT’s Visitor Engagement manager, General Manager and Curator.

4. Discussion

Visitors to Borrowdale may be motivated by a desire for its nature to provide them with: peace, nourishment, inspiration, perspective, solitude, adventure, to list just a selection of possibilities. As noted by the NT Ranger, the intention is not to tell visitors “this is a great view” but rather to provide LMEs that encourage visitors to linger a little longer at a given place in the valley (such as a viewing point) and reflect on that which inspired the Lake poet or artist to create their work. In addition, the visitor may reflect on the visual change (or lack thereof) that is apparent at that place and be curious as to what may have caused the change.

5. Future Work and Concluding Remarks

Our work on locative media is currently at a formative stage but is showing promise given the positive feedback from the expert field trial and encouragement from the NT who have generously agreed to support future end-user field trials and to provide access to their extensive photo and written archives.
References


Abstract

The unique affordances and properties of plant life hold many possibilities for augmentation with digital interaction without detracting from their natural presence. These possibilities have the potential to create more organic interactions with nature. This paper draws on previous work we have conducted relating to interactions with plants, alongside an account of a Social Media and Interaction themed Hackathon\(^1\) that used plant life as a key material to prototyping interactive media to promote sustainability. From this, we propose early questions, abstract ideas and the possible challenges researchers and designers will encounter working with human-plant interaction.

Author Keywords

Plants; organic; emotion; interface; interaction;

ACM Classification Keywords

H.5.2 [User Interfaces]: Haptic I/O; Input devices and strategies

Introduction

Modern technology can often intrude on our experiences with nature and the world around us. A simple glance away from the beautiful horizon to look down upon our smartphones can completely remove us from the moment. In

\(^1\)http://www.planthack.org
some cases, it can be argued that the information being delivered and engaged with is not the issue, rather more the technology that delivers it. Technology can function to enhance engagement with nature (e.g. [3], [6], [7]). It can be the tool to find nature trails, information about wildlife or the camera that captures those important memories. It can even act to bring creativity and self-expression people often seek from nature. With this, we believe the tools which we use to interact with information in our natural environments need to be natural too, so as not to remove us from the moment. Nature is a diverse tapestry for interaction opportunities and we believe that using plant life can offer unique and fun experiences for creating more natural engagement with digital systems when in an area surrounded by nature. Our current work has sought to understand user experience when using plants and explore their different properties and affordances that might function to create such unique experiences. In this workshop paper, we discuss our works implications for designing “Unobtrusive User Experiences with Technology in Nature”.

Related Work
Previous work has explored the use of living interfaces for tangible interaction (e.g. [3], [6], [7]). Botanicus Interactus [6], gave both visual and audio responses to capacitive touch sensing of an array of gestures on a variety of plants. They demonstrated how certain gestures are more natural on particular types of plants. Another study named My Green Pet, addressed the difficulty that children have in perceiving plants as living [3]. The system recognised touch gestures with which the plant would respond with humanoid reactions. Our resent work attempted to build upon this research by deeper understanding how users interact with plants for digital tasks [7]. This work is discussed throughout this paper. Other work explores using plants to communicate information to users (e.g. [5], [4] [2] [1]). This is done by manipulating plants in a variety of ways from light tropism [2], controlling photosynthesis [4, 5] and changing the colour of cabbage by adjusting it pH level [1]. These plant-based prototypes were appealing to people, describing the sense of emotion via organic change.

This prior work shows the beginning of what is possible when creating interactive plants and the experience it provides to users. In this paper we use this previous work, research we conducted and an account of ideas from Hackathon in Social Media and Interaction that used plants as a key component of the ideas developed. To propose early questions, abstract ideas and the possible challenges around the use of plant interaction for designing “Unobtrusive User Experiences with Technology in Nature”.

Unique Challenges and Opportunities

Tangible User interaction
Tangible interactions with plants offer diverse textures and gestures. Our interviews with participants showed that this exploration and the idea of the interface living enhanced experiences [7]. We also observed how common elements of plants such as leaves, stems, vines and branches afforded diverse sets of gestures. Plants with thick rubbery stems can be plucked, causing the stems to wobble due to their elasticity. Plants with hanging vines and leaves afford the gesture of users brushing their hands through the hanging leaves or tilting certain branches. In our past study, this was described as relaxing and therapeutic. Leaves of plants can be rubbed, touch and even removed. Other gestures like tilting the stems, mimicking a joystick. These gestures were seen in a small subset of plants. Exploration of the many different spices opens a broad opportunity for tangible interactions. The next challenge is how we would provide a natural means of feedback to the user.
**Organic Output Methods**

In our previous study [7] we used screen output in the form of mini-games and interactive graphics. During ideation, this was never seen as a concern as we were interested in how people would use them for computer input. An interesting question would be how removed are users when switching to look at the screen compared to keeping the system as both plants based input and output. Which could serve to minimising obtrusion on users experience when interacting with nature. This is a significant challenge due the lack of control we have over living interfaces to provide alternative feedback methods. One approach would be the use of audio feedback, this way feedback would be received but not distract from the plant. Another method would be physically actuating the plant, similar to how you would certain puppets. This would require an understanding of natural movement as unnatural moment could take the user out of the experience, like poor special effects in a movie. The final method we identify is the manipulation of tropisms. Tropisms is a plant’s response to external stimuli such as light, water, gravity, touch etc. Designers using these methods of manipulating the plant life will need to be mindful of the speed of output. The majority of tropisms that effect the plant’s to growth, change and decay happen over days, months and years. This long period of output provides its own set of unique design opportunities and challenges.

**Growth, Change and Decay**

Plants are highly ephemeral over the course of growth, change and decay interaction can be different. This can be due to the passage of time and the environmental factors at work. This opens opportunities and challenges surrounding how interactions are affected by such changes and what influence this has on the user. As the naturally changing properties of plants will change the gestures, textures and user perceptions. Our past study highlighted how participants interacted differently with a more withered plant. This could offer slower digestion of information and organic control over content, with each new leaf grown new media can be accessed. Taming their ephemeral properties proposes a challenge to designers, the natural interaction it affords could offer users a more natural engagement with nature.

**Emotional Connections and Context**

Another key aspect to interaction with plant based interfaces in the emotional connection it brings. Plant are almost like pets in the sense that understand they are living and with their own set of need's that we care for. These factors bring a deeper emotional connection to the interface. A key voice that emerged from our interviews was the concern for the plant’s wellbeing [7]. They reflected on using the interfaces as a collaboration, they felt as if they were working with the plant rather than using it. This theme is very interesting as it begin to show how interfaces made from plant material remove some feelings of using a computer.

**Physical Digital Prototyping**

The many prototyping kits and technologies provide the opportunity to connect plants to digital interactions. MaKey MaKeys and Arduinos allow us to rapid prototype with sensors to quickly form basic interactions. These forms of kits are affordable and require little engineering knowledge to start making interactive prototypes. This low barrier to entry opens opportunities for members of schools, communities and families to begin prototyping new engaging ways to interact with nature. Looking to the future, researchers and engineers have the challenge of advancing the diversity and level of fidelity for natural and unobtrusive interactions.

**Ideas and Use Cases**

We held a social media and interaction Hackathon with the key challenge of using plants as interactive material to pro-
mote the concept of sustainability in the field of HCI. During this event, we gave HCI researchers and designers prototyping kits and a variety of different plants. The ideas developed there hold potential points of interest for designing “Unobtrusive User Experiences with Technology in Nature”.

One team’s prototype was “Planticipation”, this is a networked communal watering system and with sound art installation designed to be situated throughout a residential tower block. The foyer area acts as a communal indoor garden. Each plant within the garden is paired with one in the residents homes. The watering of a plant in one area triggers watering of the plants partner. “Planticipation’s” output from cooperative watering was a beautiful soundscape alongside tweets of stories and information, to draw in and support the gardeners. The system promotes social connections via plant life, as well as to create a space for shared responsibility, action and improving the built living environment. This integration of plants and technology engages people with nature in the city where nature can often be difficult to find and connect with, this integration of technology is a great example of the possibles the technology has to attract people to experience with nature.

Another teams prototype was “Family Tree” this aimed to aid the sustentation of life-long relationships through shared passions. The teams scenario envisioned grandparents and their grandchildren sharing knowledge about gardening. Each family member is given a plant, then interactions such as touching and talking about the plant will be recognised and shared with the grandparents. This feedback is then output on the grandparent’s plant via movement and the grandchildren can see that the interactions are being shared via LED indicators. Hoping the next time they meet these interactions probe conversations with the family members about their knowledge their shared passion. Both of these prototypes present the idea of connecting nature across distances. The addition of technology enables plant interaction to encompass engagement beyond their roots. Another interesting factor in the shared experience with others via nature both prototypes.

**Future Work**

This paper has identified many of the opportunities and challenges that occur when using plant material for HCI. To better understand its application for the future we identify some future work and research questions. Beginning with research of plant interfaces in nature-rich environments. This opens possibilities to understand how these forms of interfaces can offer interaction away from individual experiences, and instead with our environments. Within this context, we believe applications such as games and interactive art installations would be beneficial use cases for promoting education about wildlife and sustainability. We also identify exportation of using plants to enhance user creativity, for work such as graphic design or music creation. With the different textures and new gesture, sets of plants could afford new creativity possibilities and more natural mediums for people to express themselves. Nature is already a source for creative and technology its a great tool for creative. The seamless connection of these two should aid to free people’s self-expression.

**Acknowledgements**

We thank the people who participated in the Symposium and Hackathon in Social Media and Interaction, that kindly allowed us to discuss their ideas. Dmitrijs Milajevs, Shauna Concannon, Pollie Barden, Sophie McDonald and Katja Knecht, Timothy Neate, Tom Owen, Emma James, Jon Herlock and Matt Roach.
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Outdoor Nature Lovers vs. Indoor Training Enthusiasts: A Survey of Technology Acceptance of Climbers

Abstract
Especially runners and cyclists have a variety of possibilities to record and analyze their workouts. In contrast, climbing did not find much attention in consumer electronics and human-computer interaction. If quantified data similar to cycling or running data were available for climbing, several applications would be possible, ranging from simple training diaries to virtual coaches, or usage analytics for gym operators. In this position paper we report our experiences from a survey on climbing technology that enables similar features as running and cycling technologies. The goal of the survey is to gain insight in the acceptance of technology in climbing. The main finding of the survey is that the sample can be divided into leisure-oriented outdoor climbers and sports-oriented indoor training enthusiasts.

Author Keywords
Climbing; technology acceptance; activity tracking; survey.

ACM Classification Keywords
H.1.2 [User/Machine Systems]: Human factors; H.5.2 [User Interfaces]: Evaluation/methodology, user-centered design.

Motivation
Rock climbing in its original form was only practiced by smaller, more adventurous groups of people who have gained expertise in handling the necessary protection equip-
ment such as ropes and bolts whilst climbing outdoors. Rock climbing in mountainous areas depends on various factors (e.g. route difficulty, access, remoteness, and weather conditions) that require fitness, experience, and planning.

In the last several years, a new style of climbing emerged which generally focuses on the athletic aspect and the physical exercise of the climbing activity. The latter is today known as **sport climbing**, differentiating itself from **traditional climbing**. Sport climbing can be performed both indoors and outdoors. Climbing outdoors usually requires more experienced climbers while indoor climbing is much more accessible. While indoor climbing on artificial walls and plastic was initially thought as a form of training for climbing outdoors, many people only engage in this form of climbing.

In wearable computing and HCI, climbing received little attention so far. Some related work exists regarding instrumented climbing walls [1, 3, 7, 8], automated skill assessment and route recognition using a wearable device [6, 5], and augmented reality [2, 4]. The relation of performance and experience of sports watch usage has been studied in runners [9] indicating that wearable technology can both improve performance and the experience. In this position paper we report and discuss the results of a survey on the acceptance of climbing technology that enables similar features as running and cycling technologies.

**Climbing Technology Survey**

An online survey has been conducted to get initial insights in the acceptance of climbing technologies and whether or not climbers are tracking their sportive activities. The study consists of an online questionnaire with 17 questions from five categories: (1) demographics, (2) climbing and bouldering, (3) general sports tracking, and (4) climb tracking. Altogether, 92 climbers participated (34 female, 58 male), with an average age of 29.8 (SD = 8.5). The average climbing experience was 5.6 years (SD = 7.57) while the average bouldering experience was 3.1 years (SD = 4.76). As a usual climbing and boulder location they mostly prefer outdoor rock for climbing (53 outdoors vs. 39 indoors), but indoor plastic for bouldering (63 indoors vs. 29 outdoors). In the following the main findings of the survey are briefly introduced.

**Sports Tracking**

Half of the participants did not use any sports tracking at all (52%), while the other half used either a special tracker (14%), a smartphone app (17%), or both tracker and app (17%). Tracked activities range from running and cycling to more unusual sports like kayaking or hang gliding (see Figure 1). A variety of tracking devices (see Figure 2) and smartphone apps (see Figure 3) were used. Participants who do not track their workout mostly stated that they are not interested in the data. Another main reason for not using tracking technology was the focus on fun and recreation rather than training (“I simply enjoy training and I listen to my body rather than statistics.”). Online portals were used by 22 participants used to manage their activities. They were either related to a smartphone app (e.g. Runtastic, Strava) or synced with a tracking device (e.g. Garmin Connect, Suunto Movescount). Again the main reason for not using such a portal was the missing interest in the accumulated data. One participant had privacy concerns and stated that she does not trust the provider.

**Climb Tracking**

Regarding climb tracking two distinct groups can be identified: People who track their climbing progress and people who do not track at all. When asked how they keep track of the climbed routes, the following methods were proposed: Marking climbed routes in guidebooks (45%); Spreadsheets
or structured sports diaries (23%). Unstructured diaries or lists collected on paper or in books (19%); Smartphone apps or online portals like 8a.nu (16%). When asked why they did not keep track of their climbed routes, most of the participants stated that they do not see a benefit in it (“I could remember the routes they have climbed including routes that I have not send so far”, “I can remember all routes I climbed outdoors or will at least recognize them when standing in front of them”, “I can usually remember the routes I climbed”). Another reason that was stated multiple times was that it would be too cumbersome and time consuming. As in the question concerning general tracking, some participants stated that they are climbing for fun (“Climbing means fun and freedom to me not training an performance”, “I am climbing for fun not performance”, “I prefer to spend my time climbing and not documenting”).

The 54% which would not use a tracking system stated that they are not interested in the data. One climber stated that such a system would only be useful if used during every climbing session. Some participants stated that it would be not worth the effort since they are beginners or are not climbing enough. They supposed that such a system would be more useful for competitive climbers. The participants who where not reluctant against tracking were asked whether routes or climbing style should be tracked (1=routes and 10=style). Most participants ($M = 7.05$, $SD = 2.32$) preferred tracking style, e.g. static, dynamic, or fast rather than climbed routes. 46% of all the participants (also including participants who do not track at all) would use an automatic tracking system. As possible manual interactions the participants would accept the press of a button on a wristband, scanning of a QR code with the smartphone, selection of a route in a smartphone application, or even a manual entry of an ascent.

**General Feedback**

The feedback on how technology could enhance climbing was quite varied. Some climbers suggested using a smartwatch that could guide the climber, e.g. by pointing them to the next hold. Sensors could be attached to the climber’s arms and legs to sense how efficient they perform. Another idea was that these sensors could also determine which part of the route leads to an unstable position. An application could propose a motion sequence which would solve this problem. Heartrate sensors can determine the level of effort during an ascent. Several participants addressed statistics and virtual trainers. One participant described a system that would suggest routes that he did not yet climb, but would be able to, based on his climbing history. Many climbers requested a functionality which would be able to record the length of a route, time spend in the route and general statistics to climbing sessions and progress over time. One user stressed that it would be possible to create an objective difficulty measure instead of the currently used more or less subjective ones, based on the success or failure of cumulated ascents.

**Discussion and Conclusion**

The main finding of the survey is that the sample can be divided into two distinct groups of climbers. The first group is represented by climbers who perform climbing predominantly for leisure and relaxation purposes. They do not have any interest in quantifying their sport or even in the usage of technology. In contrast to that, the climbers of the second group represent sports-oriented indoor climbers. They track different sports and are also interested in tracking their climbing progress. The second group of participants are the ones who do not track at all. Most of them do not track out of persuasion, since for them, climbing is a sport which should be performed without consumer electronics (“The beauty of the climb and remarkable single moves can
only be experienced but not tracked by a computer”). One should consider if changing the attitude of those climbers is a goal which should be pursued. Nevertheless, there might be applications other than the envisioned tracking technologies that might attract this target group. Future work should study this target group more in detail, e.g. in open-ended questionaires or (semi-structured) interviews.

The findings of the survey may inform the design of climbing technologies, for example a climb tracking system. The results show that some of the climbers are willing and/or are currently recording the routes they already climbed. Many of the climbers stated that they would track other sport activities, but that it would be too cumbersome to track all the routes they are climbing. This could be, for example, a smartphone application which provides, besides the tracking functionality, an additional value such as more detailed information of a route or exhaustive statistics. Future work needs to further explore technical aspects as well as human factors of wearable climbing technology (e.g. the proven concept of a combination of wearable device and smartphone application for activity tracking).

In future work we plan a survey that will focus on climbing technologies for outdoors climbing. We will further study tracking technologies enables similar features as running and cycling technologies were diverse.

References


Service Design for a Wilderness Experience Restaurant

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Abstract  
Experience design is one of the rising trends. In this paper, we describe a service design case, where experience design was applied to a wilderness restaurant in the arctic nature. In the design case, the perception of simplicity and technology-free environment is essential, and technical solutions need to fit to the holistic concept design. We present the design process and a concept design where the solution seeks to enhance the experience of the wilderness.

Author Keywords  
Arctic design; experience design; nature; service design.

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

Introduction  
Today, so called experience industry has grown into a large business done. Especially this is true in the areas where tourism forms a significant part of the service base, and where tourism services are actively developed. One of these type of areas is Lapland, which extends roughly from Arctic Circle towards north in Finland (as well as Sweden and Norway). Sparsely populated Lapland is known for its wildernesses,
remoteness, cold and snowy winters, and outdoor lifestyle. These are also the key points for the local tourism business to attract visitors around the world.

In this paper, we present a service design case, where an experience driven design process was conducted to enhance the visit to a wilderness restaurant. The central idea behind the concept design was to maintain the remote and somewhat mythic experience of the place, while intensifying the atmosphere and providing visitor a high quality service experience. The context for the design case is a remote wilderness location, away from the urban everyday life, people and technology.

In prior art, enhancing the experiences in the nature has been addressed in Ambient Woods project, which added contextual multimedia elements in the woods for educational purposes [5]. Earlier works include examples, which combines QR codes and mobile device in order to achieve located presentations in a cultural heritage setting [7]. Posti et al. [4] have presented a demo and user study on a hiking application, which warns the user of approaching people in order to guide them towards more quiet tracks. However, contrary to the earlier examples, in our design case, we wanted to get away from the visible or obviously technical solutions. This approach has been promoted also in [1], where technology is faded to the background but simultaneously used to help people to experience the natural places differently. Designing for solitude and emphasizing the magical feeling of the wintery nature were the keys.

**Design Case Wilderness Restaurant**

**Context and Background**

Our design case addresses an exclusive high quality restaurant located in the forestry wilderness of Finnish Lapland, figure 1. It has an impressive history of being the hide away place of a former Finnish president Kekkonen, who used it to dining and have sauna with the heads of other countries, running important negotiations during the cold war times. Now the place belongs to an experience safaris company, and it still obtains the amazing atmosphere that made it so favorite for the president.

![Figure 1: The wilderness restaurant.](image-url)
**Design Process**
The design process included the following steps:
- mystery shopping, where the place is visited and observed as a customer
- co-creation workshops
- interviews with employers and management
- co-creation workshops with the service provider

In the co-creation workshops the story and style of the place was outlined, and the story behind the place was compared to customers' experience the place. As the outcome, the story was written and enhanced in the servicepath presentation with interior design, decoration, graphics, working clothes and actions of employees in a way that the all parts enhanced the story and the atmosphere. Story should be sensed multimodally. [1]

**Restaurant Concept and the Role of Technology**
In a hideaway place in a wilderness, the nature has to be relevantly close to the user. In an exclusive place like this everything has to function well and smoothly, which means that also technological solutions are needed. Hiding the technology is essential to create right kind of atmosphere. [3]

Speakers have been hidden in wooden elements that disappear to the wooden roof and walls. In the dining room there is fire place with an open fire and candles, but the rest of the place is illuminated with artificial lights that emphasize the coziness of interior design. Lighting has to support the scene and give enough space for natural light.

Bear's lodge is used for exclusive dinners and sauna evenings. As in Finnish sauna tradition there is a hole in the ice for swimming. The hole is kept open by flowing water. At Finnish winter time it starts to get dark after 2 pm, so it can be already dark when the customers arrive. At the dark the nature can’t be seen more than 20 meters from the windows. In the wilderness restaurant area, the nature has to be illuminated with technology. There are bright lights and real fire used to get mystical lighting as well as the nature visible for the customers.

The view from the Bear’s lodge comes to a natural pond. The trees before and after the pond is illuminated so the customers get the feeling of nature, see figure 2. Beyond the lights everything else is pure in darkness. In this nature the coziness and exclusiveness of the place becomes stronger.

![Figure 2: Illumination concept for the place.](image)

**Arctic Design Approach**
This work is an example of Arctic Design design approach. The arctic environment and conditions force specific challenges and needs for services and products. Arctic design approach is looking for answers to the extreme conditions that living in the arctic enforces to us. Distances between towns are long, land area is sparsely populated, natural living conditions are harsh and, in some places, population is rapidly ageing.

Design methods and approaches can help overcoming these geographical and environmental challenges.
Arctic design helps us to integrate and understand local communities with their histories and cultural context and develop new service solutions that utilize storytelling, as demonstrated in this case.

Arctic Design is about producing extreme wellbeing and competitive edge for circumpolar areas considering both natural environment and technological solutions that help in enduring and solving challenges as well as coping in the extreme conditions. Further, Arctic Design is a multi-disciplinary approach that connects areas of interaction design, industrial design, service design and social design to increase wellbeing of the periphery and the marginal. Many new solutions include the use and interaction with new technologies. Arctic design is about design for extreme affordability, which focuses on need finding of the users, user empathy, user centered design, rapid prototyping, and collaborative dynamics as well as issues of social design [3].

Arctic design approach works as a living lab where we are able to design new technological solutions in collaboration with communities and companies located in the north that live with the extreme natural conditions. Companies can benefit from the use of arctic design approach when developing technological solutions in collaboration with various stakeholders. For example local tourism business can develop new solutions that both benefit from the local natural phenomena and maintain sustainability.

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References
Presence and Use: Sensors In Community Gardening

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Abstract
Sensor technology offers the opportunity to augment our experience and understanding of ‘natural’ environments, however introducing technology into shared natural spaces can also disrupt the experience of these environments.

Our research with forest gardeners and other community food growing groups suggests that presence in the shared space is vital. We argue that successful nature technologies must minimise disruption to presence to be accepted. Situating data into the environment can support community practices in shared spaces, without disrupting core aspects of the experience.

Author Keywords
community gardening; community data analysis; situated interfaces;

ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous

Introduction
Sensor technologies can help us to augment our experience and understanding of natural spaces, by
revealing information we wouldn’t otherwise be able to sense (such as the rate of photosynthesis occurring in a leaf), and by helping us to integrate information in new ways, such as understanding aspects of the environment (like light levels) which change over time. However, embedding technology in natural spaces also has the potential to disrupt the experience of the space.

Community food growing represents an interesting case for exploring this tension, as it is an area where sensor technology could be beneficial [3], but where existing technologies have been rejected [7].

Why would we want sensors in the forest garden anyway?
Establishing and maintaining ecosystems with the intent of producing food is a complex task requiring domain knowledge and understanding of local environmental conditions [6]. There are webs of interdependencies between species and a multitude of environmental variables which change over time on multiple nested cycles (seasonal, diurnal, lifecycle), chaotically (weather) and with long term trends (climate). Decisions such as what to plant and where to plant it have to be taken for the garden as a whole [6], and these interdependencies can be especially difficult to grasp due to the extended timescale of action and reaction.

Sensor technology can support community groups in making these planting decisions [3, 6]. A number of technologies have been developed to help farmers and gardeners make planting decisions and assist with maintenance, such as ‘Precision agriculture’ sensing and analysis techniques used in agriculture [8]. However, despite demonstrated benefits in commercial settings ranging from large agricultural concerns [8] to smaller horticultural businesses (such as vineyards, [2]), this kind of technology does not transfer well to a community context [3].

Non-use and rejection
Both Odom [7] and Goodman & Rosner [4] observed resistance to technological augmentation of practice in community growing groups. Odom argues that this is due to community members feeling that introducing technology to the growing space will make things ‘too easy’, prevent the development of holistic understanding of the environment and interfere with community building and learning interactions that occur between people in the growing space [7]. People worry that ‘Technology’ will take away from the essence of the activity; it will prevent ‘getting hands in soil’ [4].

Hirsch [5] and Odom [7] conclude that garden level sensing technology is not appropriate for urban agriculture groups. However, others have argued that it is the specific design of many technologies that is inappropriate to a ‘natural world’ context, rather than technology itself [1], and [4] point out that although participants expressed concerns about technology, they were actually observed interleaving technology with their practice.

Rejection seems to focus around automation, the removal of agency and the adding of intermediation between the person and their chosen task - for instance, Goodman & Rosner [4] describe one gardener’s rejection of automatic watering / weeding systems: “I don’t want to be cut free. I might want...
to be informed, but I want to have an engaged relationship”. Hirsch [5] posits that the resistance is due to the ‘hobbyist’ nature of the groups, and that more commercial entities may not be as resistant, and indeed research on sensor networks in vineyards has shown that optimisation and automation were desired in this more commercial context [2]. However, there were still some aspects that participants felt should never be automated - for instance, when to harvest is always a ‘judgement call’ that growers wanted to make themselves. Additionally, even here participants felt you ‘can’t farm remotely’ as there is a need to visit, see and touch the crop [2].

The importance of presence
The rejection of ‘technological augmentation of practice’ [7] in the previous section appears to be driven by fears that the technology will interfere with the relationship with the growing space through automation and the reduction of agency [4], and thus be detrimental to learning, community building and the experience of ‘getting close to the soil’. Ultimately, these fears are around the disruption of presence in the natural space; the establishment of distance between people, the space and the others that inhabit it.

The importance of presence has been a core thread throughout our ongoing contextual research on community food growing groups, (comprising of contextual interviews in community food growing groups, design workshop and long term study with a forest gardening group), underlying decision making and knowledge formation and dissemination processes. We have observed a number of key themes across our studies, but the most salient for decision making is that for community food growing groups, decisions are ‘ad hoc’ and in the garden. Most of the groups perceived their decisions as ad hoc and off the cuff - community members explained their process as “...just wing[ing] it”, however observing decisions being taken it is clear that although such decisions are highly ‘in the moment’, they are informed by knowledge about the space and the domain. Systems that support this kind of decision making must also be present in the space in order to be accepted and used.

Additionally, learning and education is important, and rooted in the physical space. Learning about the environment and about growing in general was vitally important to community members. Both their own learning, and the teaching of others was considered important. The former was strongly tied into ‘learning by doing’, and the latter to peripheral participation, both anchored in the physical space of the garden. Skills are learned and shared through action and knowledge is gained by participating in discussions and ad hoc decision making and experimentation. Situating information in the environment can support this learning focus; not only can the data help people to acquire knowledge about the environment, but additionally shared artefacts support learning via peripheral participation, e.g. when experts are discussing a course of action and novices are peripherally involved. Automating or centralised approaches that reduce presence interfere with this knowledge building practice.
Designing for presence?

Designing to enhance presence may provide a route to supporting the co-located, collaborative decision making and learning processes observed in these communities. We are working with a forest gardening community to investigate whether closely mapping data onto the physical space of the garden can enhance presence and support planting decisions, and to explore what form that mapping should take. We have deployed environmental sensors into the garden and will introduce a series of prototypes for community members to use to reveal and interrogate the data within the garden. We intend to iterate on the mappings based on the usage and reactions to the prototypes, resulting in a final design that will be valuable to the specific community we are working with, as well as helping us to understand how we can design to support presence in this context.

References


Kids Need to Run Wild: Using Technology at the Zoo

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Abstract
The zoo is an environment which aims to evoke the natural world and encourage connections with wildlife. This gives rise to a number of barriers to incorporating technology (as a non-naturalistic feature) into the zoo experience. In this paper, we draw on our case study investigation into technology at Melbourne Zoo to explore the nature of the tensions around technology use at the zoo, and some of the challenges involved in designing and deploying technology in this space. From this, we identify three considerations relevant to the design of technology for the zoo setting, relating to the importance of play and free movement, and the primacy of the animal viewing experience.

Author Keywords
Naturalism; zoos; visitors.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous; See http://acm.org/about/class/1998 for the full list of ACM classifiers. This section is required.

Introduction
Zoos occupy a hybrid status as built environments which aim to create the impression that the visitor is entering a natural space [3]. The overarching goals of
modern zoos are centered on educating visitors and the community, motivating positive attitudes towards wildlife and conservation, and engendering relevant behaviors. [11]

In support of these goals, zoos aim to help visitors feel close to nature [2]. Central to this goal, and the zoo experience as a whole, is the opportunity to get close to animals, ideally in an environment which mimics their wild habitat [5]. It has been shown that seeing animals close up in naturalistic exhibits can positively influence visitor attitudes towards wildlife. [1,4].

A number of researchers have investigated how mobile technology can improve on existing static signage to support collaborative learning in a free choice environment [8–10]. O’Hara and colleagues [8] relate how a QR-code system for accessing content using mobile phones at the animal exhibits was used to share by visitor groups. They contend that delivery using QR-code signage supported visibility and coordinative work better than location based triggers, despite the fact bottlenecks occurred around single point access information points.

When accessing information about animals on a mobile phone, users move to a position where they can see both the animal and the information on their screen, looking back and forth between the two [8]. In response to the risk of technological displays distracting visitors from viewing animals, it has been proposed that augmented-reality systems might allow visitors to see information about an animal while viewing it [6,7].

In this paper we investigate further the challenges of deploying interactive information systems for use in this naturalistic context which aims to foster both recreation and education.

Methodology
As part of a case study investigation into the deployment and use of digital technology at Melbourne Zoo, we conducted interviews with six members of zoo personnel. We observed five digital systems in use and interaction of zoo visitors in the vicinity, and inspected these selected systems and their content.

This paper draws on researcher observations and interviews with interpretations staff (two) and an educator (one) that reflect on how technology can be deployed for the zoo’s education and conservation goals. These interviews shed light on the objectives and constraints for design and deployment of technology in this naturalistic space. In this work we focus on a highly successful installation (the Zoopermarket) and the envisaged future use of technology as part of the zoo’s education programs.

Findings
Creating Engaging Visitor Experiences
For interpretations staff, innovative use of technology is seen as a way to capture the attention of visitors and engaging them with conservation and education messages. Digital signage provided using iPads (Figure 1) is seen as a mechanism to offer people access to a range of content, allowing them to select the materials that respond to their own interests. Technology is also a potential tool to enable people to more readily take steps towards conservation actions: for example, the highly successful Zoopermarket (Figure 2) makes it easy for visitors to send an email to manufacturers in support of sustainable palm oil use. It is important that...
such interventions be sufficiently quick and simple to use that a parent can complete the envisaged task while looking after a number of children at peak times.

A key challenge in the design of such installations is to avoid distracting the visitor from the experience of viewing the animal: “you don’t want to take their attention away” [Interpretations Staff]. Researchers observed that parents were reluctant for children use digital signage, instead encouraging them to look at the animal on exhibit.

In addressing this challenge, the location of the installation is critical. For example, the Zoopermarket is housed where visitors have had a chance to view the animals. Observations of visitors at the exhibit indicate that visitors are attracted to investigate the Zoopermarket display only after they have seen enough of the orang-utans or when there is no opportunity for a good view of the animals.

The Zoopermarket incorporates hardware that allows users to perform the physical act of taking a handheld barcode scanner, holding it to a selected product and squeezing the trigger to scan the item – resulting in a familiar feedback tone, and the display of relevant information on the screen. Interviews and observations indicated that this offers a form of physical play which is greatly enjoyed by children. It is often children who instigate use of the system, though children were generally unlikely to use the system alone for long. Visitors seen at the Zoopermarket installation were most commonly adult-child dyads or groups, interacting around the system or using it concurrently.

**Education In Situ**

Melbourne Zoo educators aim to frame the visit of school groups, encouraging them to experience the animals and exhibits through the lens of a conservation message or scientific question. This is accomplished through presentations at the beginning and end of their visit. Accordingly, a concern for educators is that students are likely to forget the messages and questions presented to them as they roam the zoo and encounter the animals. “The kids can sometimes walk in to the orang-utan exhibit, walk out, and not have considered our questions because they didn’t remember that the orang-utan was one of the ten” [Educator].

Educators are keen to provide context-relevant reminders and guidance to students as they pass through the zoo, both to encourage them to visit areas most relevant to their educational goals, and to remind them of the message or perspective introduced during their introductory presentation. This would allow educators to extend the interactive and challenge-based learning experience throughout the zoo. Delivering location-specific content to students’ own mobile phones is seen as a prime opportunity for achieving this vision. However, it is important for educators that students should not spend extended periods looking at their phone. Rather, location-based alerts are seen as a way to encourage students to engage with nearby learning opportunities, and make conceptual connections between their experiences at different exhibits.

In contrast, educators were resistant to technology which proposed to intervene in the act of viewing the animal. For example, an iPad app which could be used...
to view an animal as though through binoculars was not well received: “all it was really doing was making a kid look at an iPad and not the real deal” [Educator].

An important concern for educators is that interactive experiences should be able to cater to the interest of dozens of students entering a significant exhibit at the same time. “We don’t want to send every kid that we have here on site in a day to an experience that’s a one person at a time type thing” [Educator]; this is particularly relevant to the more prominent animal exhibits, which may be visited by hundreds of students in an hour.

Discussion
From the observations and interviews described above, the following considerations emerge.

Support free movement
It is important that interventions at the zoo should support the free movement of groups and individuals between and around exhibits. Visitors need be able to roam as they choose through the zoo, rather than following a pre-determined path. It is evident moreover that systems which require queuing and turn-taking are unlikely to be sustainable during peak hours. This suggests that techniques are needed which will allow good visibility of the experiences on offer, as well as enabling multiple users to pass through at once.

Encourage physical play and interaction
Children and parents alike value the zoo as a place for physical play: technology interventions need to allow children to run ahead of the group and keep their hands free for climbing and clambering. Similarly, when moving around the zoo parents need to keep their hands – and attention - free for pushchairs or bags, and for interacting with children.

Ideally, interventions should encourage physical interaction or movement, rather than screen-based interactions. It is therefore uncertain whether use of mobile phones when moving between exhibits will be attractive to family groups.

Avoid distracting from the animals
It is important that technology should enhance the time that visitors spend viewing the animal, rather than attempting to intervene in this experience. Our early research suggests that augmented-reality based information overlay systems might be problematic. It seems that there might be stronger potential in systems for use before or after seeing the animal. These might include interventions to direct or frame engagement with the animal; informational and experiential systems to supplement the viewing experience; contextual materials aiming to create connections between different exhibits.

Conclusion
As a naturalistic space, the zoo is an environment that encourages families and young people to observe animals in (a recreation of) their natural habitat, as well as engaging in unstructured exploration and physical play. It is important that technology interventions for this context should avoid negatively impacting on these activities. Accordingly, we propose three high-level considerations for designing technology for zoo visitors.
References


A Concept Design for Capturing Letters from the Sky

Abstract

In this paper, we present a design concept that aims to combine a purely natural phenomena of falling snowflakes and new communication technologies. We propose a new application that helps the user to connect with nature in a way that is at the same time educational, playful and aesthetic. We utilize a mobile platform to analyze and process the information received by the camera equipped with a specially designed gadget. We also present the background information for our concept and offer applications where the concept can be adapted.

Author Keywords

Snowflake; nature; photography; UI/UX design.

ACM Classification Keywords

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

Introduction

Yoshinori Furukawa from the Institute of Low Temperature Science of the Hokkaido University explains in his article "Ice Crystals in Space - Understanding the Formation of Ice Crystals" that "There are many crystals around us. Crystals are used in electronic devices such as cellular phones and computers, as well as daily accessories. They are a very useful type of matter, and play a key role in
industry.” [1] More than any material known to man, ice can assume many different crystalline structures. Snow is an accumulation of packed snow crystals that are made of a number of tiny ice crystals stuck together.

Vast regions of our planet are seasonally or perennially covered with snow and ice; the ground becomes rock hard, lakes and oceans freeze, and snow falls from the sky. For nearly everyone, snow crystals induce a visceral response, be it an annoyance during one’s commute or the enthusiasm of an impending ski trip [2]. Snowflakes fall with a fascinating variety of shapes and patterns -- including stellar dendrites, hollow columns, triangular crystals, and many more. (Figure 1) The shape of snow crystals depends on the temperature and humidity of the atmosphere in which they have grown (Figure 2) [3].

However fascinating, people rarely get to experience their beauty given the fact that they’re small to the naked eye. And, the DIY camera/lens configurations available on the web are mostly quite complicated to construct.

In this paper we present a concept for a gadget accompanied with a mobile platform/app that would make it possible to capture, edit, share and explore pictures and short videos of snowflakes/crystals in addition to creating games and interactive applications.

We believe that our concept will democratize snowflakes/crystals photography and, we envision it to be an easy to use tool for educators and hobbyists.

Figure 1. The chart on the right lists 35 snowflake types, which covers most of what you will find under your magnifier. Photo by http://www.snowcrystals.com/guide/guide.html

Figure 2. In this Nakaya diagram, the vertical axis shows the density of water vapor in excess of saturation with respect to ice.

Figure 3. Two dendritic snow crystals, each about 1 cm in diameter, on the monofilament line in the chamber.

Related Work
Education
There has been attempts to produce artificial snow crystals in controlled environments for educational purposes. One noteworthy research describes a Snow crystal Growth Chamber used both in Japan and the United States. The apparatus, was developed in Japan.
in 1996 and has been in use in schools there for several years. It allows students and teachers to actually watch snow crystals grow [4]. (Figure 3)

**Hobby**

There are a number of gadgets that make use of the smart phone camera to enhance its potential for photography hobbyists as well as for medical professionals in 3rd world countries for quick and effective diagnostics. Examples are micro/macro/360 degrees photography lens attachments, microscopes for scanning the pupils etc.

There are several DIY snowflakes/crystals photography rig instructions on the web ranging from fairly easy to very complicated setups. (Figure 4) However we failed to identify a unified solution that targets snowflakes/crystals photography.

![Figure 4. Different DIY camera setups. Google images.](image)

**Our Concept**

We offer a mobile application that can process information through a camera, record and store the data and use it to create interactive games, individualized snowflake galleries, screensavers, animated videos, messages etc. By capturing these messages and utilizing the information on different levels – informative, aesthetic, poetic, emotional etc. – one can create a totally unique means of communication that is made possible by combining natural phenomena with new technologies.

![Figure 5. Snowflake photography. Taken from http://chaoticmind75.blogspot.fi/2013/08/my-technique-for-snowflakes-shooting.html.](image)

A 3-D printed device, designed in the Open Design format, comprised of a macro lens and a transparent surface, attaches to user’s mobile device to act as a platform for snowflake photography. The software scans the image and draws the shape of the snowflake then stores the data and the edited image for further analysis and processing.
Figure 6. Concept design for the application. After collecting the snowflakes on the camera lens, and taking the picture, the user (here) is presented with different editing features to choose from.

Applications

Learning environments

Observing and collecting snowflakes outdoors can be a great learning opportunity. Our solution encourages users to go outside for a snowflake hunt. This could even be turned into a learning game for children. By
gathering snowflakes art and science are combined – who will be the first one to find all the classified snowflake types? Whose snowflake is the most intricate?

Tourism sector
Johan Edelheim argues that snow is an almost magic element not only as a purely physical phenomena but also as is the actual experience of snow for people who come in touch with it. In some places, for example, the Finnish Lapland, snow experiences are promoted as a main feature of the destination’s offerings for tourists. However, in addition to active sports events and other winter activities other more passive ways of experiencing snow are also needed [5].

By combining a natural phenomenon, playfulness and interaction possibilities through new technologies we can offer the tourism industry and related industries opportunities to give their customers highly memorable experiences of the Arctic Winter.

Travelers can record their experiences of interacting with snow (perhaps this being their first encounter) by capturing snowflakes as they fall from the sky. They can use these recordings to preserve the experience, to send as messages to others or use as decoration on digital devices.

Discussion
In this paper, we have provided a concept for an educational, fun, and social platform to interact with nature. The shape of the snowflake (one of the 35 basic classified types that the software recognizes) from simple “columns” to intricate “dendrites” can be used for communication, interactive games and media installations – whether it is to record information of the climate at that moment as snowflake form is related to the conditions of the atmosphere (temperature, humidity) or transmit more poetic messages from nature, the applications are only limited to one’s imagination.

References
Graveyards as a Design Context for Unobtrusive Interaction

Abstract
In this paper, we consider graveyards as a design context for unobtrusive interaction. Graveyards are places of mourning, remembrance and peace, and they are typically places of natural beauty. On the other hand, graveyards can be places of cross-generation interaction, and contain historical information about families and location, which can be interesting to visitors.

Author Keywords
Unobtrusive interaction; death; cemetery; graveyard; deathscapes.

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

Introduction
This paper focuses on design for a specific context of use – graveyards. Graveyards are special places both from people’s personal viewpoint, as well as from the cultural point of view. From the personal point of view, graveyards are places of mourning, remembrance, hope and peace, and they carry strong emotional meanings. From the cultural point of view graveyards have both religious and social meaning, and incite behavior norms, which inherently define their
atmosphere and the visitors' code of conduct [17]. Whilst there has been much work on graveyards from historical, architectural and ethnographic viewpoints (e.g. [4, 5, 11, 12]), they have been largely unexplored context for HCI research.

Death as a HCI research topic itself has been only little studied, although recently it has gained more attention due to the practices of everyday life in the digital age, e.g. the digital footprint people leave behind after their death [13]. Research has explored the actions of mourning and rituals followed with materials left behind after the death of a loved one, such as mobile phone text messages and photos [14], and how life carries on post-mortem on personal social media sites [2]. Here, technology use has typically been investigated from the viewpoint of the ‘digital remains’ of the deceased person.

In contrast, in our paper we consider the resting place of the physical remains, i.e. the graveyard, as a context. Thus our work is linked to the physical environment and the requirement for any technology to be introduced in a considerate and unobtrusive way. In this, our preliminary work on the topic, we draw together different aspects that are relevant when considering graveyards as a context for technology design.

**Related Work**
A wide variety of fully online memorials to the dead, ranging from dedicated websites for deceased pets, to those injured in particular conflicts to social media pages for an individual exist [19]. Whilst a body of work on design for this digital memorial area exists, e.g. [2, 13], work on design for the physical graveyard environment is limited.

**Graveyards as a Place of Peace and Natural Beauty**
Graveyards are places of natural beauty and peace, which are often described as having a special atmosphere and tranquility. The connection with death as an eternal rest and hope for the afterlife call for an environment that reflects these thoughts, and isolates the place from the rush of everyday life. Loud noises and hurry are not expected, and people may choose to leave their information technology devices behind, as a way to respect and focus on the peacefulness of the place [18]. Old trees, grass, and sheltered walkways are typical environmental settings for graveyards. They also host traditions that are aesthetic in a quiet and harmonious way, such as candles burning in the dark Christmas nights, see figure 1.

**Figure 1**: Visiting a graveyard with children for lighting living candles at Christmas time.
Graveyards as Public Spaces
One role of the graveyard is as a historical site, which may be visited, for example, by those researching local history, genealogy, or in the case of the graves of famous people, as a graveyard tourist [9]. Graveyards employ maps for supporting the navigation, and often stories behind people or historical events are illustrated with short texts, see figure 2. Guided tours of graveyards are also available, see figure 3 [10]. A smart phone based digital guide to a graveyard has been created as part of the Future Cemeteries project in Bath, UK [6]. Here, NTC tags are used to provide details on individual graves when they are touched with the smart phone. The project has also examined the use of mobile projection to augment the graveyard visitor experience. Collaborating with Sheffield General Cemetery in UK, the meSch project, working on tangible interactions with cultural heritage, has designed concepts that would make visitors experience in a historical cemetery more attractive, such as a tangible UI with a located audio guide [14].

Graveyards as for Individual Mourning
Whereas anthropological and historical research has documented the cultures of individual mourning at graveyards, we have been unable to find it addressed in HCI research - perhaps understandably so, as this is an intensely personal activity. The act of regularly visiting the grave of a passed away loved one is a source of solace for many individuals. In this respect visitors prefer the experience to be rather solitary and often engage in talking aloud to the dead e.g. to chat or to ask advice on worldly matters [19]. In a less somber context, [15] has presented work in the context of hiking that guides individuals towards a solitary experience. This approach may also provide beneficial for those seeking undisturbed time in a graveyard setting.

Graveyards as a Design Context for Unobtrusive Interaction
In this section, we propose and discuss potential design directions for the graveyard design context.

Enhancing the View to Local History and Genealogy
Whilst wandering in a graveyard typically one can see gravestones with the same family name, yet the possible connection between these is often unclear and forgotten over the times. An interesting approach would be to visually overlay the family connections onto the physical gravestones, identifying e.g. the links between parents and children. Rather than do this based on physical markers such as QR code or NFC.
tags that must be physically attached to the grave area, we propose to use a location based Augmented Reality. We find this design approach more unobtrusive and aesthetical, as it would leave the physical environment untouched. Although location based AR has limited registration accuracy, the scale and layout of graveyards is such that 2 m positioning accuracy is sufficient. The concept is illustrated in figure 5.

Figure 5: Example graveyard AR view, showing family connections between physical gravestones.

Enhancing the Individual Mourner Experience
One common practice in graveyards is the lighting of candles in memory of the deceased. Although modern technology has bought the possibility for electronic candles that mimic the play of a natural flame [1], such devices do not fit well in this use context. The act of lighting the candle, the fragility of the natural flame and its natural warmth and movement are essential experiential factors.

Thus, we propose a concept of a connected candle, whereby the nuances of movement of a live candle flame placed at a graveyard, are captured and recreated in a second live candle flame placed, e.g. in a house living room, see figure 6. Whilst we acknowledge that the concept is clearly potentially rather complex to implement, we believe it serves as a useful start point forconcepting, from which other less demanding ideas may emerge.

Figure 6: Illustration of connected candles concept. The nuances of a real candle flame places at a graveyard are reconstructed to a live candle flame in a house living room.

Discussion and Future Work
In this paper we have framed our initial thoughts of graveyards as a design context for unobtrusive interaction. We see this context as a particularly interesting for design because of its delicacy related to traditions and meanings connected to the place. As future work we plan to conduct a survey on the motivations and desires of current visitors to graveyards. Issues to be explored include the reasons and practices in visiting graveyards, the experiential aspects graveyard visitors perceive essential, and technology and media use at the graveyards.

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Reflections on Plants as Interaction Material

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Abstract
This paper addresses plants as part of human-computer interaction. First, I discuss the role different qualities of ephemeral materials like plants can play for interaction. Second, I introduce the “physicality representation spectrum” using the example of plants as interaction material, a structural approach that includes direct and metaphorical applications of plants to HCI. Finally, the paper concludes with emerging themes for nature-based and nature-inspired user interfaces that evolve from this work.

Author Keywords
Human-plant interaction; materiality; material perspective; tangible user interface; ephemeral user interface; physicality representation spectrum; nature; metaphor.

ACM Classification Keywords
H.5.2 Information interfaces and presentation (e.g., HCI): User Interfaces – Input devices and strategies, Interaction Styles.

Introduction
Experiencing nature is important for human wellbeing and usually evokes joy and recreation, especially for people who live in urban environments (e.g., [3]). Thus, from a ubiquitous computing standpoint, which interweaves computing into all areas, it is desirable to explore unobtrusive ways to integrate technology into
nature environments. Furthermore, it is valuable to integrate natural elements into human-computer interaction (HCI) also in domestic or other contexts. In previous work, we have explored the use of natural materials and elements like water, plants, fire, or soap bubble as part of ephemeral user interfaces [6]. It is important to understand the different levels on which materials like these unfold, and how they can be used to shape interactions with technology [7]. Next to properties, form factors or the human senses a material addresses, the material meanings in certain use contexts and the users’ emotional responses play important roles (e.g., see also [10]). In this workshop contribution, I focus on the use of plants as part of human-computer interaction (for an overview of human-plant interaction see e.g., [23] and [19]). First, I discuss the role different qualities of ephemeral materials like plants can play for interaction. Second, I introduce the “physicality representation spectrum” using the example of plants as interaction material, a structural approach that discusses direct and metaphorical applications of plants to HCI. Third, I conclude with emerging themes for nature-based and nature-inspired user interfaces that evolve from this work.

**Using the Ephemeral Qualities of Plants for Interaction**

Integrating ephemerality, e.g., in form of ephemeral interaction materials, into HCI has a number of potentials, which have to date not been explored sufficiently. The notion of the ephemeral (literally meaning "lasting only one day" or "daily") comes along with a number of meanings and associations. First of all, it refers to *transience*, to temporary phenomena that disappear after a while. Bringing this to HCI offers new ways to deal with the ever-growing amount of data and interfaces around us. A circuit printed on a banana leaf presents an example for a design exploration of a plant-based decaying computational element [9]. Connected to this is the aspect of *changing-over-time*. Ephemeral materials naturally grow, age, get patina or traces, decay and disappear. These behaviors make them valuable and meaningful. Nevertheless, digital artifacts generally do not have these aspects integrated into their design in a meaningful way. In the case of plants, e.g., the reaction to light and water has been applied to use them as ambient displays (e.g., [11],[12],[17]). Third, natural ephemeral materials provide a certain and unique *aesthetics*, often naturally evoking a multi-sensual experience and a strong emotional response. Especially for plants it has been shown that people emotionally respond to them, which has suggested human-plant interaction application contexts like the creation of companions for older adults [1] or social interaction for patients and their loved ones [22]. A fourth interesting aspect of the ephemeral is a natural "spirit of *vagueness*" [4] due transient states and limited controllability of the materials. In contrast to conventional computing approaches, this offers interesting and often beautiful approaches for novel input and output strategies. For example, the above mentioned ambient display plants (e.g., [10],[11],[16]) might not present the data very precisely but focus more on aspects of meaning and emotion. This ambient approach to present data through ephemeral materials also makes use of another aspect of ephemerality: its connotation of *triviality of everyday life and the mundane*, which makes ephemeral user interfaces so well suited to present information unobtrusively at the periphery. Human-plant interfaces are a very good example for this. In the following section, I will discuss strategies to directly or metaphorical...
cally include these qualities of plants into user interfaces along the physicality representation spectrum.

**The Physicality Representation Spectrum: From Physical to Digital Representations**

To use and apply certain properties, meanings and emotional connotations of a material in a user interface, interaction designers have a wide spectrum of options from directly applying material aspects physically by integrating the material itself to including only selected aspects metaphorically. It offers an interesting perspective to start thinking from a physical material and then explore different representations of the material aspects as part of a user interface. The physicality representation spectrum starts from a physical material, in this case plants, and incorporates different ways to apply material aspects directly or metaphorically within HCI. Inspired by the distinction between metaphor by verb and metaphor by noun as applied to tangible user interfaces by Fishkin [8] my spectrum includes metaphorical applications by verb and noun within physical as well as digital representations. Overall, the spectrum is subdivided into three categories of material application: direct application, metaphorical physical application and metaphorical digital application.

**Direct Application: Physical Representation**

The direct application of properties, meanings and evoked experiences of a physical material means that it directly becomes part of a user interface, be it for output, input or both. In the case of plants as interaction materials quite a number of works exist that have explored this design space, many presented in arts contexts. One of the first works using plants as input device is “Interactive Plant Growing” by Sommerer and Mignonneau, realized in 1993 [21]. Here, approaching and touching plants triggered projected virtual plants to grow. Other works have explored touching plants to generate music (e.g., Akousmaflore [14], Botanicus Interacticus [18]). Using real plants for output primarily can be found in the form of ambient display applications, for example presenting the amount of communication (PlantDisplay [12]), trash disposal vs. recycling (Infotropism [11]) or stock market rates (Yucca Invest Trading Plant [17]). While these works use plants in indoor environments, the project “The singing trees of Tremough” [20] is an example for using trees for output in a nature outdoor environment. This installation realizes a real time sonification of environment data through distributed sensors and speakers in the trees. Using plants for input and output at the same time has been explored by Kuribayashi et al. who presented the I/O plant toolkit and discussed a number of patterns for using plants as sensors and actuators [13]. Angelini and colleagues focused on the emotional relationship between plants and older adults [1]. They sensed touch interactions and the plant’s state and communicated this via emoticons on a display located at the plant.

Integrating real plants into interaction is an interesting direction in HCI that broaches issues such as expressiveness, emotional response and bringing joyful nature into the context of user interfaces. Nevertheless, starting from real plants as interaction material, there are further and more conventional ways to bring human associations and impressions about plants into HCI. In the scope of the physicality representation spectrum, we look at other physical instantiations representing plants as well as graphical representations.
Metaphorical Application: Physical Representation
Tangible user interfaces are often physical representations that apply aspects taken from other physical materials in a metaphorical way, e.g. by applying aspects of shape or typical manipulations for example. I call this category metaphorical application with physical representation. If aspects like properties, form factors, or meanings of an original material are metaphorically applied to another physical material, I speak about a metaphor by noun. In case a handling or manipulating a material that is physically represented or realized in an embodied way in a user interface without integrating the original material itself, I speak about a metaphor by verb. Of course, UIs can also integrate both kinds of metaphorical applications in one physical representation. This is for example done in the work of Wallbaum et al. [22], who designed an artificial flower plant as communication device for patients. It includes controllable LED lights for output and several direct interaction techniques for input (e.g., removing a blossom, touching a leaf). Three other prototypes, infotropism [11], LaughingLily [2] and Follow the Grass [16] focused on metaphor by noun and realized robotic plants that mimic the behavior of real plants in order to communicate information in an unobtrusive way.

Metaphorical Application: Digital Representation
Similarly, and with a longer tradition in HCI, plants, or aspects of plants have been applied metaphorically within graphical user interfaces, i.e., in digital representations. Similar to using real plants or mimicking them through other physical representations, unobtrusiveness, visual appeal and handling information overload were reasons to apply plant or flower metaphors in the digital. In People Garden [25], for example, the authors applied a flower metaphor to present a user's data portrait based on his or her past activities on an online message board. E.g., for posted messages the digital flower representation gets novel petals and thus grows and changes over time. A further example that explored plant and garden metaphors to represent data is Wilkens’ Mail Garden [24], a tree visualization representing mails in an inbox (e.g., the height of a tree reflects the length of an email). A further email visualization tool for email is Bloom [15]. It applies metaphor by noun and verb and explores, next to the presentation of emails by blooms of a flower, also interactions like plucking flowers (which removes items from a task list) via touch interactions.

Discussion and Conclusion
Designing for unobtrusiveness is a major theme throughout all different instances of representations of plants in UIs (i.e., by integrating plants directly or metaphorically). Especially plants as ambient displays can be found in all categories of the physicality representation spectrum, generally bringing aspects of nature into domestic or artistic indoor environments and presenting information in the periphery. One emergent theme in the interaction between humans and real or robotic plants explores the emotional relationship between humans and plants, e.g., by encouraging touch interactions, an aspect that is less likely to be as strong and expressive in digital presentations. A further theme when taking real plants as interaction material focuses on an amplified sensory experience of plants, especially by giving the plants a voice and creating sound. In future, further sensory experiences could be explored. In HCI, most examples of human-plant interactions have taken place in indoor environments, yet not so much embedded in real nature environments, whilst there is much potential of applying it outdoor as well.
References


