
Between Technology and Nature: Blurring Boundaries in Outdoor HCI

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Abstract

'Nature' as it exists today is not completely 'natural': in many countries, wildernesses are defined as political entities, protected by human laws; parks require extensive maintenance and upkeep. Humans even require certain technology to interact with nature, especially on a longer-term basis. Yet we draw a distinction between acceptable technology in nature, and unacceptable. Where do those bounds lie? How do we respect and blur them, bringing the benefits of technology and nature together to enhance the experience of both? We draw from our own work in wearable computing, citizen science, and ethnographic inquiry to frame a research agenda around deep-dive data collection and an annotated portfolio of critical devices that explore this boundary between the natural world and the technological.

Author Keywords

wearables; hiking; solitude; critical design.

ACM Classification Keywords

H.5.m. [Information Interfaces and Presentation (e.g. HCI)]:
Miscellaneous

Introduction

'Nature' as it exists today is not completely 'natural': in many countries, wildernesses are defined as political en-

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Workshop on HCI Outdoors: Understanding Human-Computer Interaction in the Outdoors at CHI 2018, April 21, 2018, Montréal, Canada

tities, protected by human laws. Both large protected wildernesses and local urban parks often require extensive maintenance and upkeep. Humans even require certain technology to interact with nature, especially on a longer-term basis – from compasses, stoves and water filters, to wearable technology such as Gore-Tex and carbon fiber. Bringing speakers that blast music may be widely considered a violation of the ‘natural experience’, but some even balk at others’ use of personal headphones. Where does the distinction lie between acceptable technology, and unacceptable?

Technology is increasingly embedded in and often essential to modern day life, and trips into nature are frequently seen as an escape from our increasingly interconnected world. The body of evidence showing the many mental and physical health benefits of interacting with ‘natural spaces’ continues to grow. Engaging with nature has been shown to improve affect and cognitive processing [3], especially for children with attention deficit disorders [20, 15] and those who suffer from depression [2]. However, even human-created structures – such as monasteries, museums, or fountains – may elicit the same beneficial effects as an experience in nature [14]. It seems that the experiences that elicit these benefits are not exclusively natural, but may be deliberately constructed.

In designing technology for the outdoors, it may be easy to stay ideologically trapped within these perceived boundaries between the purview of *technology* and that of the *natural world*. But a broader view that acknowledges the artificiality of these divisions may guide designers to create transformative experiences that leverage the benefits of both nature and technology in useful, engaging, appropriate, unique, respectful ways.

Scenarios

Scenario 1: A child on a school trip from her inner city school is disappointed that the nature trail has no exciting animals. Now she would rather play games on her phone, uninterested in the plants and squirrels that surround her. On approaching a trail cam, a movement triggered camera commonly maintained by the park staff, her teacher suggests she place her phone against its weatherproof case. Photos from the past day are streamed seamlessly to her phone, turning the screen into a window into the trail’s past. She sees a family of deer pass down the same trail, a coyote sniff for food, and a curious crow inspect the lens.

This interaction reveals a technological tool of distraction as a conduit for insights and connection to the natural world.

Scenario 2: A spontaneous garden of cairns has been growing in a secluded grove deep down a hiking trail. Often, hikers take pictures of the garden, or add a stone or two themselves. Some of the stones are constructed, made of cast resin around biodegradable electronics, and flicker to life with dancing lights when a hiker presses her phone to the back. This momentary transference of electricity creates a magical experience that fades back to the darkness and stillness of the forest when the hiker leaves.

This subtle spectacle enhances the beauty and awe of the natural world without disrupting the experience for those who choose not to interact.

Scenario 3: Zipping up for the night, a hiker places his phone in the special pocket of his sleeping bag. As he sleeps, the flexible electronics embedded in the bag wake up once an hour, harvesting power from his cell-phone in order to take a reading of the current temperature and humidity, updating an e-ink display. In the morning, the hiker has a visualization of how cold it got during the night, and

when he gets home he uses this data for future planning.

A highly practical low-power hyper-personalized data collection technique provides insight into the natural environment without disrupting it.

Scenario 4: A hiker walks up to the trail marker, tapping her waterproof e-ink display to the sign. A solar-powered system automatically updates the map on the e-ink display, showing her current location on the map, as well as weather information, and logs the time to a remote server. The hiker continues on, confident of her current location, but free of the burden to check her GPS regularly. At home, the hiker can view her checkpoints on a digital map. The forest rangers also see information about which trails are used frequently, at what speed, and by whom, providing valuable usage information to prioritize trail maintenance.

A careful subset of technological capabilities affords deep connection with nature, and emphasizes safety and clarity.

Prior Work

Understanding and navigating the complex and highly contextual experiences of technology and nature is crucial to developing interfaces that support both. The authors have experience with designing technologies that can be embedded in complex cultural situations: in HairIO [5] (Forthcoming, TEI 2018), we leverage the cultural acceptability and signaling of hair styling and gestures to create a subtle, embodied interface (see Fig: 1). The deep cultural history and norms of nature experiences similarly have their own influences on the form factors and design of affordances of technological artifacts.

One author designed interactions for battery-free bi-stable passive e-ink displays [19]. The range of interactions afforded by battery-less wearable devices are a particularly



Figure 1: Left: Alternail circuit with microcontroller, e-ink display, and inductive coil for data and power transfer encased in resin. This fingernail-sized, battery-free interface is waterproof and hardy. Right: HairIO, an on-body system leveraging natural physical interactions for embodied interfaces [19, 5].

relevant consideration in the context of wilderness computing. Similarly relevant are considerations of wear, durability, and seamless integration (see Figure 1 for an image of our custom hardware encased in waterproof resin).

In extensions to MyPart [18, 17], a portable air quality sensor, one author constructed an evaluation system for accurate data collection in uncontrolled environments, developing an understanding of challenges and opportunities in citizen science and sensing of natural data (Fig. 2).

In an ethnography of creative practices, the authors extracted insights on social norms and behaviors around the sensitive subjects of failure and error, extracting and synthesizing themes for supporting the development of healthy social norms in emerging makerspace practices [4] (Forth-



Figure 2: MyPart: a pocket-sized air quality sensor for personal, portable use in the outdoors with multiple form factors [18, 17].

coming, DIS 2018). These methodologies have a purpose and a home in HCI for the outdoors because of the way they extract rich qualitative experience, generating design guidelines that may be applied to other disciplines.

We also bring the perspective of two serious outdoor enthusiasts and educators to our agenda as research technologists. We draw insight and motivations from our personal experiences with leadership and teaching in the backcountry, handling backcountry medical crises, both communal and solo journeys in the wilderness ranging from single days to six months in duration, and involvement in outdoors-focused K-12 education.

We plan to build on all of these experiences as we pursue a research agenda in line with HCI for the Outdoors.

Related Work

Our primary motivation comes from insights from the field of cognitive psychology, as well as more recent HCI work by leading practitioners. Due to space limitations, we simply outline them briefly here.

The growing field of HCI in the Outdoors has begun questioning how technology and nature should and will interoperate in the near future. A recent survey found that 95% of hikers prefer to bring their cell phones with them on hikes [1]. Other work delves into specific groups' attitudes towards technology in their recreation through focus groups and participatory design, such as backcountry skiers [6]. Technological norms may be inverted in outdoor contexts, for instance tools for sociality becoming tools for antisociality [16]. An ongoing discussion about the design of unobtrusive interfaces in natural settings, was recently explored by Häkkinen et al in a workshop at CHI [8]. We propose to build on this existing foundation, further clarifying existing cultural expectations and relationships around how technology fits into outdoor contexts.

Sensor data provides a rich source of information for understanding behaviors and developing tools for outdoor recreation [10]. Technology that supports safety, planning, and enjoyment in outdoor sports and recreation encourage use and time spent in nature. Such work also respects the existing materiality of technologies associated with the outdoors, such as augmenting rather than replacing paper maps, or situating a wearable map on the form factor of existing pack or harness straps [22, 21]. Kuznetsov et al. introduce a re-framing of ubiquitous computing to include living organisms, providing another framework for conceptualizing the interaction of technology and nature [12]. Paulos et al. have done work on introducing children to the use of sensors to explore, interrogate, and investigate their world in creative and playful ways [13]. Kuznetsov et al. demonstrate the importance of spectacle to public participation and activism in the outdoors with large, glowing balloons that communicate sensor information tracking air quality [11].



Figure 3: (Left) An example of the type of interaction afforded by a bistable e-ink display. (Right) The shoe prototype we designed and constructed. The e-ink display is embedded into the shoe [19].

In cognitive psychology, the classic work by Kaplan and Kaplan identifies features of ‘restorative’ experiences (both natural and human-made), emphasizing the importance of *fascination*, *being away*, *extent*, and *compatibility* [9, 14]. Any new technological creation may benefit from a consideration of this existing framework describing the “restorative effects” of natural experiences [7].

Philosophy

Throughout this proposal, we have explored the value in transcending perceived boundaries between the technological and the natural in contextually appropriate ways. In particular, we have described scenarios that prompt critical reflection on the role of technology in nature, and suggested technical solutions to some of the identified challenges.

We argue that deeply engaging with existing cultural and social expectations suggests rich opportunities for the development of contextually-appropriate technological artifacts that blur, subvert, or transcend boundaries.

As seen above, much related work supports this, but we see value in explicitly framing the overall future course of our work in this area through the frame of trans-boundary

interface design.

Future Work

Specifically, we propose an expansion of the dataset work done by Anderson et al. [1], with a particular focus on longer-term natural engagements. We hope to understand existing cultural norms around divisions between nature and technology, their origins, and their manifestations. Leveraging our expertise with ethnographic and contextual inquiry methods, we hope to generate a collection of qualitative data that enriches this earlier dataset-driven exploration. Using critical design methodologies, we propose to create an annotated design portfolio of artifacts embodying these philosophies. Finally, we suggest embedding these artifacts in natural settings to probe initial reactions to the blurring of these familiar and established boundaries.

Conclusion

We consider the technology in the outdoors as a partner in the human experience of the natural world, and present a frame of inquiry for pursuing a new family of passive, non-emissive interactive electronic devices.

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