Figure 1: A hiker takes a break to write or sketch. An important part of HCI Outdoors is to ensure that outdoor experiences such as this are not spoiled by the inclusion of new technology.

Envisioning HCI in Outdoor Recreation

Zann Anderson
Brigham Young University
Provo, UT 84602, USA
zann@byu.edu

Michael D. Jones
Brigham Young University
Provo, UT 84602, USA
mike.jones@byu.edu

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Abstract
The ubiquity of computing as ushered in by mobile devices leads to opportunities for computing to enhance, enable, and encourage outdoor recreation. In doing so, however, computing needs to respect the primacy of human-nature interactions above human-computer interaction in outdoor recreation activities. We present a vision describing how computing can accomplish both of these goals.

Introduction
Time spent outdoors, particularly in wilderness settings, is valuable and provides many benefits to individuals and society. But modern life, with its conveniences and comforts, pushes us farther from such valuable pursuits and towards more sedentary, urban, and indoor lifestyles. Even when individuals do spend time outdoors, mobile computing threatens to bring the civilized world into outdoor activities, distracting and subtracting from the enjoyment and benefits of such activities.

We believe that computing has the ability to enhance, encourage, and enable outdoor recreation. In order for us to build computing which meets these goals, we must first recognize the primacy of human-nature interaction over human-computer interaction in outdoor recreation. By human-nature interaction, we do not mean interactions with “human nature”—the thoughts, intentions, and actions seemingly

common to most people. Instead, human-nature interaction means the interactions which take place between individuals and the natural world during outdoor activities.

By recognizing the priority which should be given human-nature interaction in outdoor activities, we can begin to consider principles which allow computing to enhance, encourage, and enable such activities without detracting from the benefits which arise from being outside. In this paper, we set forth a vision for HCI in Outdoor Recreation which takes into account the principles and context outlined above.

We begin by outlining the vision in brief, then move to discussion of the specific ideas encompassed therein, including examples illustrating each. Finally, we give a brief discussion of related work.

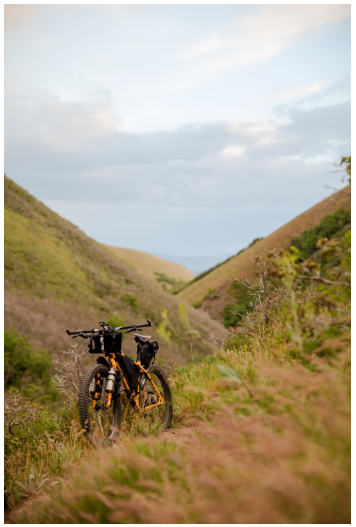

Figure 2: A mountain bike loaded for touring. Existing technology already seeks to augment such gear with useful technology, and we envision a future where perhaps almost all of the gear in this photo would be computing-augmented.

Our Vision

Principles

As outline above, our vision is guided by these principles and matters of context:

- Time spent outdoors is good for individuals and society
- Computing can play a valuable role in enhancing, encouraging, and enabling time spent outdoors
- In outdoor recreation activities, human-nature interaction holds priority over human-computer interaction

Brief Description

In our vision, computing exists all around us when we are outdoors, yet we are hardly aware of it. It observes us and the world around us, and responds in meaningful and useful ways, all while remaining largely at the periphery of our experience. Computing augments or is integrated with existing outdoor gear, fitting into the physical world around it. It does not demand attention, but is available when needed. It caters to individuals' human-computer interaction preferences while encouraging deeper human-nature interaction. Computing which follows these principles can enhance, enable, and encourage outdoor recreation without detracting from human-nature interaction.

Computing Enhances, Enables, and Encourages Outdoor Recreation

The following aspects of our vision focus on how computing can enhance, enable, and encourage outdoor recreation.

Computing is All Around Us in the Outdoors

Individuals already carry computers with them nearly everywhere they go, including outdoors. In our May 2017 survey [1] 95% of respondents (total 1002) indicated that they prefer to bring their cell phone when hiking. Work done which relates to HCI Outdoors and to organizing a community around this research area is largely a response to this. Our assertion that computing can enhance, enable, and encourage outdoor recreation is similarly so.

We envision the number of computing devices or compute-enabled pieces of gear rising in the future, until computing is literally all around an individual when they are outdoors. We note that this does not mean integrating computing into the outdoor environment itself. It is our desire that wilderness environments remain as they are, and any computing which takes place in the outdoors is brought in and back out by the individuals and groups who use it.

Instead, apps on smartphones, standalone devices, systems, and computing-enhanced or augmented gear will proliferate, driven by research and industry. Clearly this is

Figure 3: A mountain biker navigates a tight turn. A compute-enabled dropper seatpost could enable to rider to be more easily prepared to navigate this type of terrain.

already happening and we expect it will continue to do so.

Illustration
Figure 2 shows a mountain bike laden with touring gear. Such gear could easily be augmented with computing power, with devices using the rider's phone as a central hub for computing power, sensing, and connectivity.

Computers Observe and Act
Computing does not need our input in order to be useful. The computer in a modern car performs a vast array of functions in order to keep the car running efficiently and safely, all without any input from the driver.

Similarly, computing in outdoor recreation should entail devices, systems, and compute-enabled gear that observes the individual and the environment around it, including data gathered from the phone where applicable, and acts in helpful ways based on these observations.

Illustration
Figure 3 shows a mountain biker navigating a tight turn. Dropper seatposts make it easier for riders to switch from climbing or pedaling in flat sections to navigating twisty sections of a trail such as this by allowing the rider to drop the seat down and out of the way. A compute-enabled dropper seatpost could anticipate changes in terrain and respond by dropping or raising the seat automatically.

Smartphone as a Hub
Given that individuals are already carrying smartphones with them in outdoor activities, making use of the connectivity, sensing, and computing power of the smartphone makes sense. This can help to enable the sensing and acting as described above. It also allows individuals to carry less gear and less cumbersome gear, as external devices, systems, and gear can rely on the phone for many things, including only the sensing, computing, and communication power necessary for their specific functionality.

Illustration
A smart dropper post doesn't need to hold its own map data or sensors to determine when to raise and lower the seat. It can rely on the phone for these functions, allowing it to be simpler and lighter.

Computing Respects the Primacy of Human-Nature Interaction

These aspects of our vision discuss how computing can place human-nature interaction as the top priority in outdoor recreation activities.

Computing Fits the Physical Environment
In outdoor activities, selecting the right gear is very important. Individuals must consider weight, utility, safety, comfort, and other factors in deciding which gear to purchase and include in a given outdoor activity. Computing devices and systems need not become a separate entity which individuals must consider along with other gear decisions.

Instead, computing should, insofar as possible, augment or be integrated with existing gear, in ways that make sense. A piece of existing gear need not be given functionality which is not in line with its intended use. For instance, a water bottle that plays music does not make sense, but one that can notify an individual that they need to drink more does.

An enabling factor in this particular aspect is using an individual's smart phone as a hub, as discussed above.

Illustration
Figure 4 shows a hiker enjoying a mountain view. In our vision of the future of HCI Outdoors, this picture looks nearly identical: the hiker carries compute-enabled gear which re-

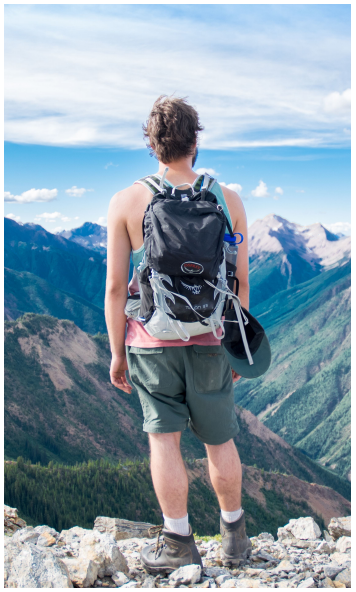

Figure 4: A hiker enjoys a mountain view. Compute-enabled gear need not add to the load which he is already carrying, but should insofar as possible fit in seamlessly, augmenting existing gear.

sponds to the hiker and the surrounding environment, but this gear blends seamlessly into the activity.

Computing Lives on the Periphery

Although at times it may be necessary for devices or systems to notify an individual of something important, computing in outdoor recreation should largely operate at the periphery, allowing individuals to attune to it, calling it into the foreground and dismissing it as needed [5].

Illustration

Our hiker's hydration pack learns from his phone that it is a hot and sunny day outside. It also knows that he has not had any water in 45 minutes. It lights an LED on the front of his shoulder yellow, indicating that he is beginning to get in a bad situation with his hydration. After a few minutes, the LED turns to orange. When the LED turns to red, the hiker notices it and drinks some water while resting in the shade.

Computing Encourages More Human-Nature Interaction

Computing in outdoor recreation should be designed to take into account the HCI preferences of individuals. In doing so, however, it should also encourage more human-nature interaction.

Illustration

Our hiker is interested in learning more about plants native to his local area. He downloads an app which notifies him when he reaches an area in which others have tagged plants which are of interest to him. When he reaches such an area, the phone notifies him there is a plant of interest nearby, as he has set it to do. The next time he enters this area, the app does not push a notification, assuming that he can now recognize this plant without its intervention.

Related Work

This vision rests at the intersection of a number of areas of research and industry interest, including Tangible and Embedded Interaction (TEI), Ubiquitous Computing (UbiComp), Internet of Things (IoT), the No-UI movement, wearables, smart textiles, and calm technology, among others. Researchers and practitioners should make efforts to learn from the ideas, practices, and output of these different areas. We would also do well to collaborate with and encourage work by individuals from these areas, which will serve to broaden and deepen the work done in HCI Outdoors.

We note that our vision is informed by ideas put forth by Weiser [4, 5] and Ishii [2], and those of Krishna in the book *The Best Interface is No Interface* [3].

Conclusion

We have outlined a vision of HCI in Outdoor Recreation, specifically recreation activities taking place in wilderness settings. We have discussed ideas relating to how computing can enhance, enable, and encourage outdoor recration while respecting the priority that human-nature interaction should have over human-computer interaction in the outdoors. We believe that this vision can serve as a guiding force for ourselves and the HCI Outdoors community as we seek to explore computing's place in the outdoors.

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