Figure 1: First author ending his section hike of the AT with technology

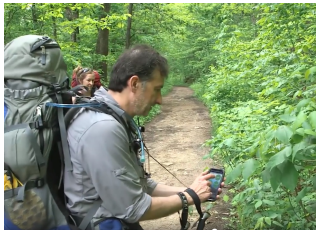

Figure 2: Third author using a mobile app to collect data on poison ivy

Figure 3: Close up of third author's phone.

Bringing Technology to Trails in Support of Citizen Science

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Abstract
Utilizing citizen science to solve problems out in the wild seems to be an unexplored area. Technology is becoming more mobile and ingrained in our daily lives. Outdoor communities are facing an interesting crisis where technology is found to be useful in practice but has yet to establish a place among each of these communities. One major benefit is being able to collect useful data from the trail through citizen science to create knowledge repositories. This paper presents a wide array of questions on how we can understand what technologies citizen scientist would take on the trail, craft mobile interfaces and notification structures, understand what the mobile platform can offer for citizen science, and assessing the usefulness of our interfaces (both single and multi device) for citizen scientists [9].

Author Keywords
Mobile, interaction, notifications, citizen science, nature, hikes, design

Introduction and Related Work
Hikers, rock climbers, distance walkers, and other outdoor enthusiasts value their time in the wild away from technology, yet they increasingly bring mobile devices such as smartphones, GoPros, smartwatches, biometric sensors, GPS devices, and more on their adventures. An unexplored opportunity exists to leverage these mobile devices to help

researchers and public officials collect needed data for domains such as habitats of ticks and pine beetles, spread of invasive plants like poison ivy and garlic mustard, recovery of wildfire-ravaged areas, and damage to bridges, roads, trails, shelters, and other structures near the trail. Citizen science, a form of crowdsourcing where volunteers help generate and process research data, has great promise when paired with mobile technology [4, 5, 6]. Yet there is danger for failure if we overburden people who are seeking to escape from technology with tech-based tasks [7, 8]. This opportunity begs the following research questions:

1. What technologies do outdoor enthusiasts use on their adventures, and how willing are they to bring novel technologies and applications on the trail?
2. How can multi-device interfaces capture data useful for scientists? How can the interfaces notify users of trail-based information needs while not overburdening them with excessive or intrusive tech interventions at moments of solitude?
3. How can we assess the quality of our mobile interfaces, in particular to determine the value of citizen science? Are the interfaces acceptable to users; indeed, do they engender a sense of contribution to a greater good? Is the input from citizen scientists of sufficient quality to advance the science?
4. How do we design for a citizen science community to facilitate collaboration on the trail without affecting the user experience? What are the best practices we can create to facilitate motivation, community, and a sense of accomplishment?

Hiking the Appalachian Trail

The first author hiked a section of the Appalachian Trail (AT) with a predetermined set of technology based informal discussions with self-identified hikers, weight, cost, power needs, quality, durability, data collection and exporting [9]. The hike exemplified the three core concepts of technology on the trail (TotT) preparation, experience, and reflection [1]. Each phase has a critical piece to understanding how a hiker begins and ends their hike (including my own).

Discussion

Why citizen science

With the emergence of technology citizen science is having an identity crisis. Organizations like Zooniverse and eBird are taking control on what citizen science and is utilizing web technology to create knowledge repositories for short term problems [2, 3]. This past two years there were two workshops in theories, methodologies, and platforms [6] and defining principles for mobile apps and platform development in citizen science [10] in the last year. The objective of these workshops show that citizen science is making a transition to the digital technologies, especially for mobile platforms. There lies an opportunity to tap into already established outdoor communities where citizen scientist projects can thrive and help support trails for all.

Understanding the citizen scientists

Reaching out to local hiking groups in person as well as national and international groups through social media is a great start to understanding users. The information that is collected will provide an in depth look to understand user experience, notification impact, user interaction, and critical incidents for current technologies like mobile phones, cameras, and GPS devices. Potential results can help us understand key personas and affinities to inform what appropriate and acceptable mobile technologies and interfaces can

support citizen science.

Crafting mobile interactions
In a world where bluetooth and Wi-Fi exist, the idea of connecting mobiles devices isn't far-fetched. An interesting concept to explore would be creating multi-device mobile applications in support of citizen science along trails. This can support citizen scientist interaction, notification, awareness, community, and collaboration to best provide a means to collect quality and verifiable data. The primary user population will be hikers along the AT, one of three North American long distance Triple Crown trails, to include both day and weekend hikers as well as hikers who seek to hike the entirety of the trail.

User experience evaluation for citizen science
Choosing the correct evaluation techniques is essential to understand the impact of our technologies and interfaces on the hiking experience. While some lab testing will be important to ensure usability, the primary focus will be on user experiences in real or realistic situations. Comparing short-term hikes of only a few hours (for which we will be able to have a large number of participants) as well as weekend and longer hikes (for whom tech use may become burdensome as time goes on during the trip). Analysis of results will include both HCI researchers and scientists with invasive plant expertise to ensure quality and validity of results.

Conclusion
This paper presented ideas about bring technology to the trails in support of citizen science. Potential benefits are creating new knowledge repositories to benefit society and local outdoor communities for the public, report on damaged trails or shelters, recovery of damaged woodland areas, and more. But we need to be cautious of potential consequences for pursuing these ideas like encroaching on disengaging the user from nature, conflicts within the communities, . A topic of discussion for the workshop can be about how we design mobile applications for outdoor activities and how we can collect data when power consumption and data validity are some constraints. How does this data help inform the communities, solve problems, inform public officials for government agencies? Can we take an urbanized device and redesign it for rural use? Does citizen science fit as a focus group for the above questions? What other user of these ideas comes to mind? It would be exciting to see such question debated upon.

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