Accessible mHealth: Opportunities and Challenges for Mobile Devices to Support the Health of People who are Blind or Low Vision

Kyle Rector
Computer Science and Engineering
University of Washington
Seattle, WA 98195 USA
rectorky@cs.washington.edu

Julie A. Kientz
Human-Centered Design & Engineering
University of Washington
Seattle, WA 98195 USA
jkientz@uw.edu

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Abstract
We outline a research opportunity for mobile accessibility: Accessible mHealth. This will aim to encourage the design using mobile devices to achieve four goals identified in the United States Surgeon General's Call to Action to support the health of those with disabilities: 1) the general public understands that people with disabilities can lead healthy lives, 2) health care providers can treat those with disabilities with dignity, 3) people with disabilities can promote their own health, and 4) health care providers can promote independence for those with disabilities. For each goal, we discuss the opportunities and challenges involved for mobile devices to help meet these goals for those who are blind or low vision. We conclude by discussing the scope of new research in this area. The key contribution is motivating a research initiative for the community that encourages collaboration between researchers and designers focusing on those who are blind or low vision and health.

Introduction
Accessibility research is popular in the Human-Computer Interaction (HCI) community, resulting in accessible input and output to mobile devices and applications. The HCI community has also been involved

in technologies for health behavior change or support for health care providers and hospitals. However, the explicit design of health technologies for those who are blind or have low vision has not received nearly as much attention, despite the opportunities for significant impact. This demonstrates the need to pursue research in mobile health accessibility, or Accessible mHealth. In this paper, we outline this research agenda. We conducted a comprehensive search with the ACM Digital Library under the keywords health, accessibility, mobile, exergames, barriers to health care, audio, tactile, and primary care. Blind and low-vision were included as options in every search. We conducted an additional search by reviewing the proceedings of CHI, UIST, ASSETS, PETRA, Pervasive, Ubicomp, MobileHCI, IHI, UbiHealth, MobileHealth, MobiHoc, and PervasiveHealth from 2008-2012. Upon investigation, we only found two full papers [4][7] and one newsletter [6] centered on improving health for those who are blind or low-vision.

There is great potential for impact for research in this space. Individuals with significant vision loss report being less satisfied with their health care providers [8]. Health care providers report not knowing how to teach people with disabilities to perform prevention exercises such as self-assessments for breast cancer [15] or skin cancer. Providers are also less likely to serve those with sensory impairments than those with chronic illness, mobility, cognitive, or psychiatric impairments [1]. Finally, there is a higher percentage of obesity among those who are blind or low vision than those with no disability [17]. We believe the HCI community needs to be involved for technology in this space to be thoughtfully and carefully designed. There is some existing work [7], [16], but it remains a very young field. The HCI community has shown that technology can empower patients, improve communication between doctors and patients [16], and encourage healthy lifestyles. With a special focus on the goals for eyes free interactions with mobile devices and an awareness of the opportunities and challenges that lie ahead, we can extend these benefits to be more inclusive.

Surgeon General Goals:

1. The general public understands that people with disabilities can lead healthy lives.
2. Health care providers can treat those with disabilities with dignity.
3. People with disabilities can promote their own health.
4. Health care providers can promote independence for those with disabilities.

Goals, Opportunities, and Challenges

We use four goals listed by the 2005 U.S. Surgeon General's Call to Action (USSG CTA) to improve health and wellness for those with disabilities [15] as a framework (see sidebar on left) to outline Accessible mHealth. In the subsequent sections, we discuss how technology designers have an opportunity to help achieve the USSG CTA goals and challenges that blind or low vision people may face. We reviewed relevant literature to generate and code into different themes based on the four goals. We recognize that there are general challenges with assistive technology that also apply to health technologies [13]; however, we focus on issues that are specific to mobile accessible health.

Goal 1: Public Understanding

The primary opportunity for technologies here center on increasing the public's awareness that those who are blind or low vision are fully capable to their maximum potential. Applications that allow blind or low vision individuals to engage in publicly visible healthy activities are a good first step. For example, an accessible produce aisle that allows notification of the ripeness of vegetables using crowdsourcing (e.g., using VizWiz [2]), could improve food choices. Because gym access is a barrier to exercise [9], a mobile device could scan and read the weight selection on a weight machine or state information about their position on a running track [10]. There are many applications supporting

outdoor navigation for people with disabilities [e.g., [11]] and these might be extended to help with fitness walking or running. Deploying accessible health technologies for mainstream use can also have some challenges. The USSG CTA states that exercise facilities often do not have adaptive equipment [15] and thus may require retrofits or adaptations. However, adding accessible labels to equipment is low cost and noninvasive. A tradeoff between public education and possible stigmatization of those with disabilities needs to be considered. Mobile health technology should help raise awareness but not draw unwanted attention.

Goal 2: Support Healthcare Providers

Communication and respect between people who are blind or low-vision and healthcare providers have been identified as barriers to improving health [8], which may be remedied with new technology. One approach is audio descriptions of visual charts and diagrams using tactile graphics or a mobile QR code scanner. Patients may also benefit from syncing real time appointment agendas or documents to their already accessible mobile device, such as the approach taken in [16]. One challenge is that it may require change to health provider education and hospital regulations, which can be difficult due to politics, funding, or precedent. Some providers who feel it is their job to "cure" a disability may even distance themselves from their patients [15]. The current medical model defines disability (http://www.who.int/topics/disabilities/en/) as "an umbrella term for impairments, activity limitations, and participation restrictions."

Goal 3: Promoting Own Health

Physical exercise is important for people who are blind or low vision because they may have a harder time finding forms of recreation. One opportunity is in developing accessible exergames, such as VI-Bowling [7]. New ideas may include a Kinect-based yoga or strength training coach that gives audio feedback on form. There has been work in developing modifications of exergames for those who are blind or low vision [3]. Making medicine accessible like in [4] and help with health screening is another step toward good preventive care. Computer vision might be used to scan the body for skin abnormalities that should be checked by a medical professional. Obesity affects a large percentage of people who are blind or low vision [17]. Learning an accessible health technology in addition to being out of shape may decrease motivation further. As vision loss increases in children, the thought that physical activity is important or useful decreases [5]. Because obesity and disabilities can both be stigmatizing [13], protecting a person's dignity is important.

Goal 4: Promoting Independence

Because information access is viewed as a barrier to health care [8], gaining access may improve independence. Giving a blind or low-vision patient independence in a provider's office may increase privacy and help reduce stigma. For example, accessible personal health records linked to a mobile device could remove the need to ask others to read documents aloud. In fact, it is recommended that the "efficacy of personalization technologies for improving accessibility" be a research direction [12]. Because 85% of patients do not ask a general practitioner for health materials in an accessible format [14], technology could also enable anonymous requests for accessible formats. Patients with visual impairments reported receiving inaccessible paper-based mail correspondences about upcoming appointments [8]. These could be replaced with accessible

shared calendars between health care providers and patients or through a personal health record. In addition, appointments might be automatically transcribed to allow patients to review provider recommendations. One challenge includes the health industry being slow to adopt information technology. Also, blind or low vision patients may not ask for the accessible health information they need. Technology that mitigates these challenges can lead to more success.

Conclusion

Using the U.S. Surgeon General's Call to Action [15], we have outlined opportunities for the HCI community in Accessible mHealth. Opportunities for design include technology to help people who are blind or low vision make healthy choices, and designing tools with health care providers to improve treatment and promote independence. It will be important to involve those who are blind or low vision in the development process and engage with stakeholders in the medical community. This field can bridge different areas of the HCI community with those in health fields. The impact of research in Accessible mHealth may lead to better outcomes for those with disabilities and, if universally designed, could be of benefit to all. In future work, we will work with people who are blind or low vision to develop more ideas and refine our existing ideas.

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