Crowdsourcing Accessibility: Human-Powered Access Technologies

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Editorial Scope

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Abstract

People with disabilities have always engaged the people around them in order to circumvent inaccessible situations, allowing them to live more independently and get things done in their everyday lives. Increasing connectivity is allowing this approach to be extended to wherever and whenever it is needed. Technology can leverage this human work force to accomplish tasks beyond the capabilities of computers, increasing how accessible the world is for people with disabilities. This article outlines the growth of online human support, outlines a number of projects in this space, and presents a set of challenges and opportunities for this work going forward.

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People with disabilities have always leveraged the assistance of people around them to help them get things done. Supporters are drawn from family members, friends, employees, or nearby strangers. This can work well when someone is available, but it breaks down if a supporter isn’t there when needed. Constant access to support has always been possible for those who could afford it, but the cost may quickly grow prohibitive because the supporter needs to be available at all times even if they are only occasionally needed.

Technology has changed this tradeoff because in the past few decades the people who provide assistance no longer need to be physically proximate for many critical tasks or services. This has opened a rich new era in technology design — creating tools that can incorporate human intelligence when and how it is needed to flexibly support people with disabilities, rather than relying on machine intelligence alone, which may be incomplete or limited to specific situations.

These crowd-powered systems, as they have come to be called [Bernstein, 2012; Lasecki et al., 2014b], address difficult problems, many of which are of particular and practical interest to people with disabilities, by combining human intelligence and computation in new ways. People
Figure 1.1: A diagram of the Faxcess system from the early 1990s for helping blind people interpret visual information. In this example, a blind person has taken a picture of the box for a frozen dinner with a digital scanner, and sent it to a human supporter who is reading the information to him over the phone. It is interesting to note that the supporter herself has a physical disability. While this was not called human computation or crowdsourcing at the time, it presaged many of these ideas.

with disabilities are some of the first true users of this technology, so understanding how they use it and manage their expectations around it can be more broadly informative. For instance, nearly 10,000 blind users have asked VizWiz a question about an image that they took, giving us insights not only into what visual information blind people would like to know about but also how they approach asking workers online for answers about what is around them.

In order to understand how to design these types of technologies, we draw from several successful systems utilizing the paradigm of human-powered access technologies. In this article, we first trace how people with disabilities went from being early adopters of technology for re-
mote support from other people to becoming some of the first users of technology powered by the crowd. We discuss methods used not only to obtain high-quality, reliable work with these systems, but also how people with disabilities have actively managed the work and workers to ensure that their expectations were met. We discuss who the people in the crowd are, how they are recruited, what incentives they receive, the ethics of crowdsourcing, and what connections (if any) they have to the people that they support. We explore these ideas through a set of examples of technology in this space, and then describe three case studies of human-powered access technologies, which we analyze through the lens of our design dimensions. The first, Social Accessibility, allows people with disabilities to request accessibility meta-information about webpages, which can then be reused by others visiting the website after them. The second case study describes a technology that we have developed called VizWiz that answers visual questions for blind people in nearly-realtime by sending them to sighted crowd workers. The third case study covers Scribe, a real-time captioning tool that combines novice transcriptions from multiple workers into a coherent stream of captioning. From these prior examples, we extract design dimensions that we believe can help characterize technology in this space, provide insights to designers of new technology so that their work can build on what has come before, and start a framework to allow new technologies to be compared and contrasted to prior work. We then conclude with a list of remaining challenges for work in this area.

1.1 Human-Powered Access Technology

The term human-powered access technology is intended to capture the broad range of technologies supporting access for people with disabilities by leveraging human intelligence, effort, and perception [Bigham et al., 2011]. This term is intended to cover a variety of different kinds of systems powered by humans that support people with disabilities by making something accessible that was not previously. Many of these systems include substantial computational aspects, but we purposefully exclude those technologies that rely only on computation.
1.1. Human-Powered Access Technology

Access technologies have often included human intervention to make content accessible to people. Initially, this was due to a lack of existing technologies to solve access problems. For instance, human readers were used by blind people to access text before optical character recognition (OCR) tools and audio books became common. While automated tools now exist to aid users with these access problems, many are in early stages and do not function perfectly. OCR works well for clear text, but does not perform well on handwriting; automatic speech recognition (ASR) similarly works well in ideal conditions if it’s been trained for a particular speaker, but is not sufficient for recognizing noisy fragments of speech. Because of these limitations, humans are often used to train, supplement, or replace automated solutions, as many tasks that are hard for a computer to do, e.g., visual tasks, recognizing and understanding human speech, are comparatively easy for people.

Human computation and crowdsourcing are two related terms used to discuss work that is performed by people and mediated by technology [Quinn and Bederson, 2011]. While the two concepts have some overlap, they take advantage of human labor in distinct ways. In instances of human computation, people are used to perform tasks too difficult for a computer to do, often in conjunction with the computer. One well-known example of this is CAPTCHAs, the “Completely Automated Public Turing Test to Tell Computers and Humans Apart” [Von Ahn et al., 2004], which use AI-hard problems that are easy for humans to solve as a way to distinguish between real users and automated bots. Two facets typically define human computation tasks: tasks are structured in a way that, if technology “caught up” and could solve them easily, the human labor could be replaced by computers; and a computational structure exists that distributes the tasks and aggregates the results intelligently [Quinn and Bederson, 2011].

Crowdsourcing is a paradigm of distributing jobs, which traditionally may have been completed by a fixed employee, to remote people online. While similar in nature to human computation, crowdsourcing is not limited to tasks that are hard for computers to do automatically, and in fact can serve as a replacement for technological solutions if they are expensive or unwieldy [Quinn and Bederson, 2011].
Though some tasks may have a single component and need only one worker, many workflows have been developed to allow crowdsourcing to be performed with multiple workers simultaneously or in sequence, allowing them to supplement or exceed a single worker’s output [Little et al., 2010]. Crowdsourcing is also related to collective intelligence. Generally, for human-backed access technologies we are interested in “directed crowdsourcing”, in which someone, e.g., the person with a disability, commissions the work to be done.

Human computation lets users access information that may not yet be accessible by technology, while crowdsourcing enables fast access to humans who can provide assistance. This article describes the advent of technologies that leverage the power of humans recruited to improve the support available for people with disabilities. Our focus is on crowdsourcing systems, those that rely on open calls to pools of workers, because this seems to be one of the better ways of recruiting workers improving accessibility support, but we include discussion of systems across the range of human-powered access technology to help fill out the space.

In the next sections, we discuss more about people with disabilities —the history of disability, accessibility, and access technologies —and the crowd —the people within it, their motivations, and how crowds composed of different people can be used for different purposes.
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