Privacy Implications of Artificial and Human Intelligence Assistive Tools for Visually Impaired People

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ABSTRACT

Camera-based assistive technologies have the potential to empower people with visual impairments to obtain more independence. People with visual impairments are adopting artifical intelligence (AI) and human intelligence (HI) based technologies in their daily lives to overcome their accessibility barriers.

We focus on the privacy concerns experienced by visually impaired people while using HI-based assistive technologies and report their preferences on AI versus HI-based assistive technologies in different situational contexts.

CCS CONCEPTS

• **Human-centered computing → User studies**.

KEYWORDS

Assistive Technology, Artificial Intelligence, Human Intelligence, Privacy, Trust

INTRODUCTION

Multiple camera-based solutions are currently available to assist visually impaired people with tasks such as recognizing objects,[1] identifying colors,[2] and reading text.[3] Currently, these applications use either computer-vision algorithms or send the captured images to human agents for answering questions pertaining to their required tasks. Although such camera-based applications are helpful, using cameras for assistive purposes can be risky as they may capture objects that reveal personal information—such as prescription medication or credit card numbers—in the background. Since most applications share their data with third parties, such personal information can be leaked or misused by their human agents. Another major risk of using cameras is that users may share private or embarrassing information inadvertently. For example, previous work has reported the sharing of a naked picture with crowd workers while trying to recognize an object [1]. Nevertheless, the extent of such inadvertent sharing and the privacy concerns of using such services is not well understood.

To gain an understanding of the various possible privacy leaks, we explored the VizWiz[4] dataset [3], which comprises 20,000 image-and-question pairs. This dataset is derived from a natural visual question-answering system, in which visually impaired users took images and recorded spoken questions, and then sent them to crowd workers. While exploring this dataset, we observed four major privacy violations as the primary object or background object: address information, medicine labels, credit card information, and the presence of the face or body parts of the user (as well as of bystanders). Based on these findings, we conducted a first round of semi-structured qualitative interview study with visually impaired participants (N=6) to gain a deeper understanding of their privacy concerns for HI-based assistive technologies. The participants were at least 18 years old and

(a) Body Parts   **(b) Medicine**

Figure 1: Images retrieved from VizWiz

[1]http://www.looktel.com

[2]https://www.microsoft.com/en-us/seeing-ai

[3]https://knfbreader.com

[4]A crowd-powered question-answering application for people with visual impairments

Concerns with Primary Objects:
"*I wouldn't want them [Be My Eyes] to read a credit card number to me.*" [P6]

"*I would always prefer artificial intelligence to a stranger, I would. Because if it can give me the information that I need, if AI can become stronger enough that it gives me all the information that I need, I don't think I would call a stranger who I don't know.*" [P1]

"*My experience so far has been okay, but as I said, do I think they're trustworthy 100 percent? No, and that is exactly why I don't share pictures of personal stuff with them. Like as I said, if I need something off an ID card, I wouldn't call any of them. I probably don't trust them enough.*" [P1]

Concerns with Background Objects:
"*Let's say I use my couch to let out clothing. I know that there's nothing in that picture but my couch or maybe an end table with a lamp on it, but I never have anything sensitive around.*" [P6]

[5]https://www.bemyeyes.com/

[6]https://aira.io/

were users of both AI and HI-based assistive technologies. We first report on various privacy leaks that may occur while using HI-based assistive technologies and then discuss the limitations participants faced with AI-based assistive technologies.

HI-Based Assistive Technology: Privacy, Trust, and Beyond

In our interviews, participants talked about two popular HI-based assistive technologies for visually impaired people: Be My Eyes[5] and Aira.[6] The caregivers in Aira are trained professional agents, whereas those in Be My Eyes are global volunteers. Participants mentioned several privacy concerns with HI assistive technologies and preferred AI-based technology to protect their privacy.

Concerns with Primary Objects. All participants mentioned privacy concerns to some extent and expressed unwillingness to share information with the volunteer or agent. Participants (N=4) explicitly expressed their concerns for sharing sensitive objects such as credit cards, social security numbers, or medicine labels with volunteers or agents. P1 usually made a judgment call and opted to not send any personal information when using Be My Eyes. P3 trusted a human who was physically present in proximity more than a virtual volunteer. Among the HI-powered technologies, P4 and P5 trusted Aira over Be My Eyes because of the professionalism of Aira agents. P1 and P5 consistently preferred AI over HI-based technology if they could access the appropriate information they needed. Though HI involved privacy risks, users have different levels of privacy concerns for volunteers and agents.

Concerns with Background Objects. In the VizWiz dataset, we found several sensitive background objects in the images captured by visually impaired people. Our participants also expressed concerns with the background objects and people that may be present in the image and cause privacy risks for themselves and others. Some participants were unaware of the leakage of the sensitive objects in the background. P6 shared her strategy to avoid privacy violations for the background object. Participants also mentioned trying to avoid the use of technology in public places to protect the privacy of bystanders. Though the concerns about the background object are often ignored by visually impaired people, it may pose more privacy risks.

Why Preference for Human Intelligence?

Despite the privacy concerns with HI-based systems, participants still preferred humans in several situations because of the shortcomings of AI. In the interviews, participants stated the reasons for preferring HI over AI.

Inaccurate Answers by AI. Participants mentioned instances when the AI technology failed to provide them with an accurate answer. This often drove them to trust a sighted person more than AI. P5 stated that AI still needed improvement and believed such technology would be more reliable in the

Inaccurate answers by AI:

"*Some of the time it [AI] has definitely been inaccurate, that I've noticed. It's obviously the wave of the future, but it does have a long way to go in terms of its limits. I think in a few years it'll be much better than it is now.*" [P5]

"*TapTapSee is a good product, but I've found that a lot of times when you want a description of something, you're not getting the full description. You're just getting a general couple of sentence description, and sometimes, I want more information than that. I think I want as much information as I would have if I could see. So having a sighted volunteer really is the best.*" [P6]

Interacting with a Human:

"*I actually prefer Be My Eyes the best out of all of them [AI and Human], and that's only because I actually get to talk to a real person.*" [P6]

"*If I were going to take pictures, I would really prefer the app to actually describe to me what was going to be in the picture before I took it. Not only to give me directions on which way to aim, but to say what I was taking a picture of. I would feel more comfortable taking pictures that way [P06]*"

future. P1 and P6 discussed situations when AI-based applications provided only a general description of an object although they wanted more description and context. Both participants favored a sighted volunteer help in such conditions. It is the right of individuals to have the privacy and integrity of data describing them by ensuring the accuracy of the data [2]. For example, the implications of providing incorrect information about bystanders could violate the privacy of bystanders.

Interacting with a Human. Even with the advancement of AI, people still prefer human over AI in some situations. P4 and P6 preferred HI only because they can directly interact with a human in such technologies. People with visual impairments often fail to capture a quality photo or aim the primary object. Therefore, AI often fails to provide an accurate answer as it requires high-quality well-framed photo [4]. In addition to the direction for aiming the object, P6 also demanded to know the contents in the image. Hence in HI-based assistive technologies, the person can give users live direction to aim the camera properly and thus answer their question successfully with more context.

CONCLUSION

Both AI and HI-based assistive technologies have the potential to improve the quality of life of people with visual impairments. However, each of them has its own limitations and concerns. We discussed several situations where people with visual impairments expressed concerns with both AI and HI-powered systems. Future designs of assistive technology may consider combing both AI and HI to give a better experience to the visually impaired people, balancing privacy concerns with the need for accurate information.

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