CIFellows 2020-2021

Computing Innovation Fellows

Abigale Stangl

astangl@uw.edu | abigalestangl.com

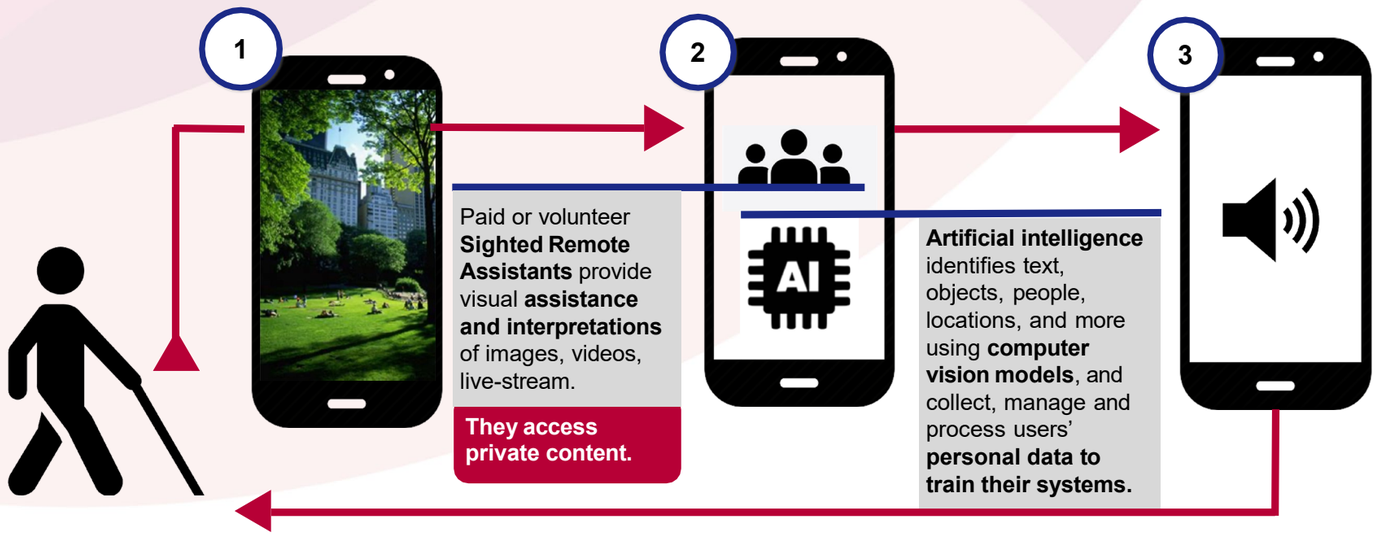
University of Washington, Human Centered Design and Engineering

Safeguarding Private Visual Information

Blind people face a trade-off between preserving their privacy vs. accessing information about their surroundings and visual media.

Visual Assistance- Interpretation and Description

People who are blind or have low vision use visual assistance technologies (VATs) to access information about their surroundings and images/videos.



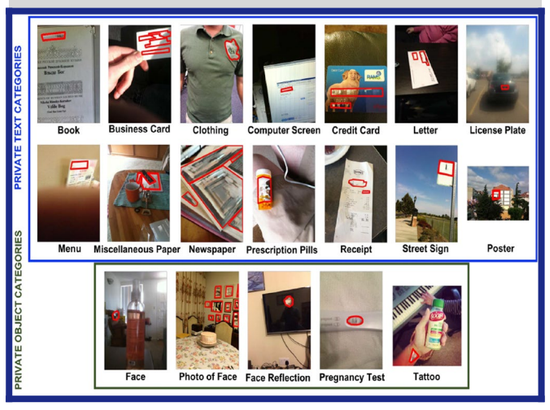
1. VATs take **images and videos as input**
2. Use humans or artificial intelligence to **identify and interpret the objects, people, text**
3. **Provide auditory descriptions** of that content

Private Visual Content

Our prior work has identified that blind people capture blind content in their images, the types of content that blind people consider to be private, and their visual privacy concerns.

Private Visual Content are text, objects, identity, and location data captured within images, videos, and live-feed that people consider to be personal, sensitive, and proprietary.

Object and text-based information found in blind people's images.



Danna Gurari, Qing Li, Chi Lin, Abigale Stangl, Jeffrey Bigham 2019. VizWiz-Priv: A Dataset for Recognizing the Presence and Purpose of Private Visual Information in Images Taken by Blind People. *2019 IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, IEEE, 939–948.

Concern rating for content considered to be private by blind people.

ID	PVC Types	Conditions				
		PU	*HK*	*HU*	*AK*	*AU*
	Financial					
1	Account Information	**4.6**	2.8	3.4	2.5	3.1
	Medical					
2	Medical Information (Any)	**4.2**	2.9	3.4	2.8	3.2
3	Pill Bottle w. Name, Address, Other.	**4.1**	2.1	2.5	2.1	2.5
4	Pregnancy Test Result	**3.8**	2.6	3.2	2.3	2.8
	People					
5	Naked Body	**4.1**	**4.0**	**4.1**	3.3	3.5
6	Face	2.6	1.7	2.1	1.8	1.9
7	Framed Photo	2.4	1.9	2.1	1.8	2.1
8	Tattoo	1.8	1.4	1.7	1.5	1.6
	Location					
9*	Letter w. Address, Name	**3.7**	2.1	2.7	2.1	2.7
10*	Misc. Papers w. Address, Name	3.0	1.9	2.1	1.9	2.1
11	Address	2.9	1.8	2.0	1.8	2.1
12	Location	2.2	1.4	1.6	1.2	1.4
13	Receipt with an Address	1.9	1.1	1.4	1.2	1.4
14	Local Street Sign	1.7	1.2	1.2	1.0	1.1
15	Library Book w. Branch Name	1.6	1.1	1.2	1.1	1.3
16	Newspaper with City Name	1.5	1.1	1.1	1.0	1.1
	Identification					
9*	Letter w. Address, Name	**3.7**	2.1	2.7	2.1	2.7
10*	Misc. Papers w. Address, Name	3.0	1.9	2.1	1.9	2.1
17	Name	2.7	1.8	2.1	1.7	2.0
18	License Plate Number	2.4	1.5	1.6	1.5	1.7
19	Business Card w. Contact Info.	1.6	1.1	1.2	1.2	1.3
	Computer/Online Access					
20	Computer Screen w. Username	2.8	1.5	1.9	1.6	2.0
	Affiliation					
21	Clothing with a Logo	1.3	1.3	1.4	1.1	1.3
	Average Score	**2.8**	**1.8**	**2.1**	**1.8**	**1.8**

Abigale Stangl, Kristina Shiroma, Bo Xie, Kenneth R. Fleischmann, and Danna Gurari. 2020. Visual Content Considered Private by People Who are Blind. *22nd ACM SIGACCESS Conference on Computers and Accessibility*, ACM, 1–12.

CI Fellowship Objectives and Outcomes

The aim of this work is to design visual assistance technologies that use computer vision algorithms to preserve blind people's visual privacy. We address the value-based trade-offs blind people encounter in this context using three user-centric approaches.

A — Identify the visual privacy safeguards currently provided and blind users expect

Privacy Policy Analysis

Analysis of 13 VAT companies' privacy policies showed that the collection, management, and processing of users' data **rarely and inconsistently specified** in companies' privacy policies.

	Collect			Retain		Train AI		Third Party		Delete		Opt-Out	
	1	*2*	*3*	*4a*	*4b*	*5a*	*5b*	*6a*	*6b*	*7a*	*7b*	*8a*	*8b*
	Any	*Video*	*Image*	*Any*	*Visual*	*Any*	*Visual*	*Any*	*Visual*	*Any*	*Visual*	*Any*	*Visual*
Company													
Aira	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Be My Eyes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	No	No	No
BeSpecular	Yes	No	Yes	Yes	No	No	No	Yes	No	Yes	No	No	No
LookTel	Yes	No	No	No	No	No	No	No	No	Yes	No	Yes	No
OrCam	Yes	No	No	Yes	No	Yes	No	Yes	No	Yes	No	No	No
Sensotech	Yes	No	No	Yes	No	No	No	No	No	Yes	No	No	No
TapTapSee	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	No
Google	Yes	Yes	Yes	Yes	No	Yes	No	No	No	Yes	No	No	No
Microsoft	Yes	Yes	Yes	No	No	Yes	No	Yes	No	No	No	Yes	No
Adobe	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Amazon	Yes	**Yes**	**Yes**	No	No	No	No	Yes	No	No	No	Yes	No
Apple	Yes	No	No	No	No	Yes	No	Yes	No	Yes	No	Yes	No
Facebook	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	No	No	No
Totals													
Yes	13/13	8/13	9/13	8/13	0/13	9/13	2/13	10/13	2/13	10/13	1/13	6/13	0/13
No	0/13	5/13	4/13	5/13	13/13	4/13	11/13	3/13	11/13	3/13	12/13	7/13	13/13
Inter-rater Reliability Measures													
Cohen's kappa	1.0	.92	.84	.84	.77	1.00	.77	.92	.77	.61	.77	.84	.84

Abigale Stangl, Kristina Shiroma, Nathan Davis, Bo Xie, Kenneth R. Fleischmann, Leah Findlater, and Danna Gurari. 2022. Privacy Concerns for Visual Assistance Technologies. ACM Trans. Access. Computing. Just Accepted (February 2022).

User Interviews

Blind people's values and expectations for visual privacy center on transparency of communication of the handling of their visual data when using VATs. Yet, they do not commonly know about what happens to their visual media when they use camera-based technologies. This leads to high levels of concern, and a mismatch between their expectations. All the while, control and ownership of their visual data is of utmost importance, yet users of visual assistance technologies experience limited choice over how their visual, private personal data is handled.

B — Co-design datasets and visual assistance interfaces with blind people

Dataset Curation

Construction of a **dataset of images and videos** captured by blind people that contain **prop private data** to **train computer vision learning algorithms = representation through data.**

Prop Creation and Delivery

Team creates and distributes 15 props with instructions via braille and QR code.

Prop Capture with VizPriv App

Participants capture a foreground and background image and video of each prop using the VizPriv Application.

Prop Annotation

Team validates that no real private data is captured in the images/videos before annotation and public release of the dataset.

Collection of real private information from images/videos is ethically complicated. We instead use **prop private data**, which is not private to any individual. The props are demonstrative of information that blind people consider to be private.

30 blind participants take two images/two videos of 15 props that contain private visual content using a **novel and accessible data collection tool**.

C — Develop and evaluate AI-powered prototypes with blind people

Technology Development and Evaluation

Development of **few-shot learning algorithms** that inform users if their pictures contain such private content categories.

Step 1. Train algorithms using **base classes** of objects from existing datasets of images taken by blind people.

Few-Shot Model

Step 2. Generalize algorithms using **novel classes** of **private objects** (the focus of the co-design of datasets).

Step 3. Evaluate the predictive abilities of the few-shot model to identify **additional types of private objects**.

Step 4. Test the system to see if it **provides users with choice** over what happens to their private visual data while still delivering visual assistance.

CRA Computing Research Association

CCC Computing Community Consortium Catalyst

NSF

This work is done in collaboration with Leah Findlater, Danna Gurari, Yang Wang, Pardis Emami-Naeini, Tanusree Sharma, and Lotus Zang. Additional support comes from CREATE at UW.