Addressing Physical Safety, Security, and Privacy for People with Visual Impairments

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Visual impairment is not total blindness

It is sight loss that cannot be fully corrected using glasses or contact lenses.

Low Vision/Cataract

Retinitis Pigmentosa

Macular degeneration

Diabetic Retinopathy

Glaucoma

Hemianopia
Sighted people can monitor their surroundings easily
Previous studies revealed concerns about (physical) privacy

Device Privacy and Security Concerns


Physical Privacy and Security Concerns


Previous studies revealed concerns about (physical) privacy

Device Privacy and Security Concerns


Technology Ideas

Count the **number of people** nearby

Detect and specify specific **faces** nearby

Detect **shoulder surfing**

Read private **documents**

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Our Goal

RQ: How can wearable devices address the privacy and security concerns of people with visual impairments?
We interviewed an urban population of people with visual impairments (N=19)

Age Distribution

Crime Index Distribution

Previous study
Our interviews shed light on safety and security concerns and behaviors

RQ1: What are the privacy, safety, and security concerns of people with visual impairments?

RQ1: How can wearable devices address privacy, safety, and security concerns of people with visual impairments?

RQ2: How do people with visual impairments manage their privacy, safety, and security?

RQ3: How can wearable devices address privacy, safety, and security concerns of people with visual impairments?
Structure of the interview

Demographics and history
age, level of visual impairment, history of impairments

Privacy and Security Scenarios
related to sharing health information, reading email and withdrawing money from ATM

Design Considerations
what types of information, which device, how to interact and how to provide feedback
Two researchers identified key concepts

Recorded and transcribed audio

Coding procedure
iterative process using open coding, created a codebook

Seven groups of concepts
e.g. safety concerns, privacy concerns, feelings, coping behavior, design attributes, desired information and feedback
What are the physical safety and security concerns?
We identified four groups of safety and security concerns

- On the Street
- Public Transit
- ATM Booths
- Private Spaces
It is not safe to walk on the streets

When I go for walks, I have been followed. And so basically because of how society is today, I don’t go for walks with my guide dog because I don’t know who is around me and I think that is much more debilitating for me than anything that we have discussed. Not knowing my environment, not knowing who is around me and if something happened to me I would not be able to tell anyone.

-T7 (Totally Blind)
Taking public transit can be risky

I was in a waiting spot to get a paratransit van, and somebody came into this area. I thought there was someone there but I wasn’t sure, and then someone else came up and said: “Did he do anything?” And I was like “What?!” And so I was right and there was someone there.

-T7 (Totally Blind)
I don’t think it is safe to use ATM. We walk so I can’t get into a car, so if I use an ATM to get $20, I could walk down the street and get mugged. So why should I go to an ATM showing everybody that I am getting money or if I am making a deposit?

-L5 (Low Vision)
How do people with visual impairments manage their privacy, safety and security?
People with visual impairments adopted several coping strategies

- Avoidance
- Relocation
- Mitigation
- Help from others
- Adaptation
- Acceptance
Avoidance

I only use the devices when I feel safe... When I have reservations about the safety of my behaviors, my default choice is just turn the device off. That way no one can have access to it. Because I am not even really using it.

-X6 (Late Impaired)
Relocate to a different place

Relocation

Usually I talk and then stop and go to a corner by myself and send it. Before doing screen magnification I usually sit somewhere or won’t take [the text] right away – I will wait until I am by myself and at the same time put myself back-against-the wall, so that I am holding my cell phone when I read the text.

-L3 (Low Vision)
Accept the risks

Whenever we have difficulties we have to call someone in and that *invades our privacy*. We can’t read my mail, don’t even know who it is from. Most of the time [automatic scanning] doesn’t work… So our privacy… we *don’t have any privacy*.

-T7 (Totally Blind)

I guess over my lifetime I have *developed an assumption* that someone is there. I kind of say to myself, “if I walk out my front door someone can hear me.”

-T6 (Totally Blind)
How can wearable devices address privacy, safety, and security concerns of people with visual impairments?
Monitor surroundings to provide privacy, safety and security feedback
Many options for monitoring surroundings

Regular Cameras

Smartphone Cameras

Surveillance Cameras

Web Cameras

Head Mounted Cameras

OrCam

Google Glass

HoloLens

Life Logging Cameras

Narrative Clip

iON SnapCam

YoCam
People prefer ‘Wearable’ and ‘Discreet’ cameras

I like the idea of having something on your clothes because it is less noticeable... because people will start to wonder why is he wearing this weird eyeglass thing. If you want to do stuff low key, then you do it that way.
- L2 (Low Vision)

Clip on camera, something I could clip on my glasses or clip on to my cap or collar. Not too visible because it would make me an easy target to someone who might want to steal my camera. They might try to get my camera and knock me over.
- X4 (Late Impaired)
What information is desired?

- How many people are in my vicinity?
- How close are people to me?
- Who is in my vicinity?
- What are the people in my vicinity doing?
- Forensic capture: who was around me?
What information is desired?

- How many people are in my vicinity?
- How close are people to me?
- Who is in my vicinity?
- What are the people in my vicinity doing?
- Forensic capture: who was around me?
Are people too close to me?

**Privacy Bubble**
Several participants used the term “bubble” to mark the territory of their private space.

**Radius of the Bubble**
Radius of the bubble varied between 5 - 10 feet
What are the people in my vicinity doing?

Maybe a lot of people aren’t paying attention to me at all. The device could say that you have a person two feet away from you watching TV or texting on their cell phone.

- T4 (Totally Blind)
Forensic capture: who was around me?

I’d like a notification tone and at that point, maybe when it gives that tone, start **taking thirty or 15 second interval pictures** of who is around. When the police do decide to help, they ask “oh well you didn’t see them,” we **can’t describe** them. We’d have these pictures in every five, ten, fifteen or thirty seconds intervals of **who was around** at that point.

-T5 (Totally blind)
I would like to know as a blind person, when other cameras (surveillance cameras) are about. I would like to know where those cameras are because, for example, if I thought I was in kind of an icky neighborhood and I need to make a phone call or do something on my phone, if I know there is a camera up ahead at the corner, I would do whatever I did by the camera so that a cop could – if I was robbed – have a chance of figuring out who that person was. I will use those cameras as my friend.

- X2 (Late Impaired)
Monitor surroundings to provide privacy, safety and security feedback
Monitor surroundings to provide privacy, safety and security feedback

Extract Desired Information
- How many people?
- How close are they?
- What are they doing?
- Who are they?
- Who was around me?

Wearable

Feedback

Compute Feedback

Extracted Images
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In conclusion

We found that people with visual impairments have significant concerns about their **physical safety** in the context of crime

As a result they develop several **coping mechanisms** including the complete acceptance of risk

We derive design suggestions for a **camera based assistive tool** for improving the safety, security, and privacy of people with visual impairments