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

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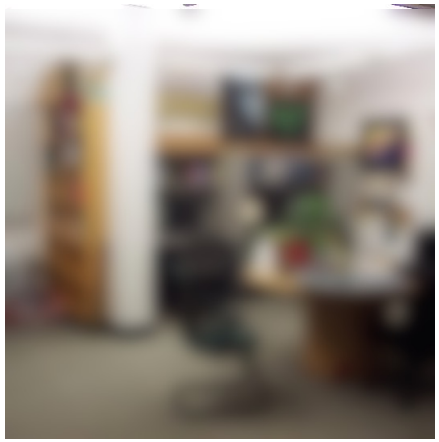
Bloomington

# Visual impairment is not total blindness

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



Source: cs.utah.edu

Low Vision/Cataract

Source: Wikipedia

Retinitis Pigmentosa

Source: Wikipedia

Macular degeneration

Source: CNIB

Diabetic Retinopathy

Source: ACBVI

Glaucoma


Source:visionsimulators

Hemianopia

# Sighted people can monitor their surroundings easily


# Previous studies revealed concerns about (physical) privacy

## Device Privacy and Security Concerns

*Kane et al (2009), Azenkot et al (2012), Ahmed et al (2015), Dosono et al (2015), Sauer et al (2010)*


*Shoulder Surfing*

*Eavesdropping*


*Device Security*


*Web Security*

## Physical Privacy and Security Concerns

*Ahmed et al (2015)*

*Eavesdropping*

*Lack of Independence*

*Home Security*

***Tousif Ahmed, Roberto Hoyle, Kay Connelly, David Crandall, and Apu Kapadia, "Privacy Concerns and Behaviors of People with Visual Impairments" In The Proceedings of ACM SIGCHI Conference on Human Factors in Computing Systems (CHI '15)***

# Previous studies revealed concerns about (physical) privacy

## Device Privacy and Security Concerns

*Kane et al (2009), Azenkot et al (2012), Ahmed et al (2015), Dosono et al (2015), Sauer et al (2010)*

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**Physi**

### Technology Ideas

*Count the **number of people** nearby*

*Detect and specify specific **faces** nearby*

*Detect **shoulder surfing***

*Read private **documents***

getnarrative.com

Life Logging Cameras


www.orcam.com

Wearable Glasses


www.fubiz.net

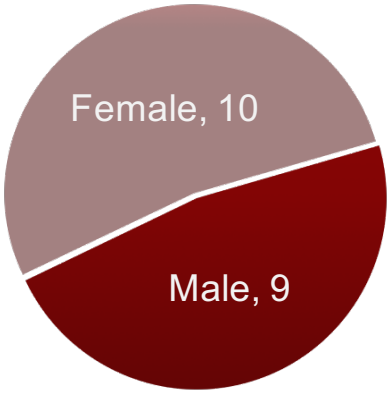
Smart Watches

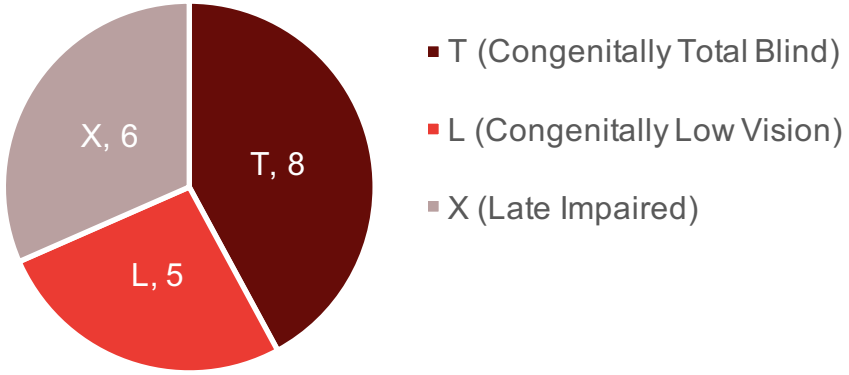

*Tousif Ahmed, Roberto Hoyle, Kay Connelly, David Crandall, and Apu Kapadia, "Privacy Concerns and Behaviors of People with Visual Impairments" In The Proceedings of ACM SIGCHI Conference on Human Factors in Computing Systems (CHI '15)*

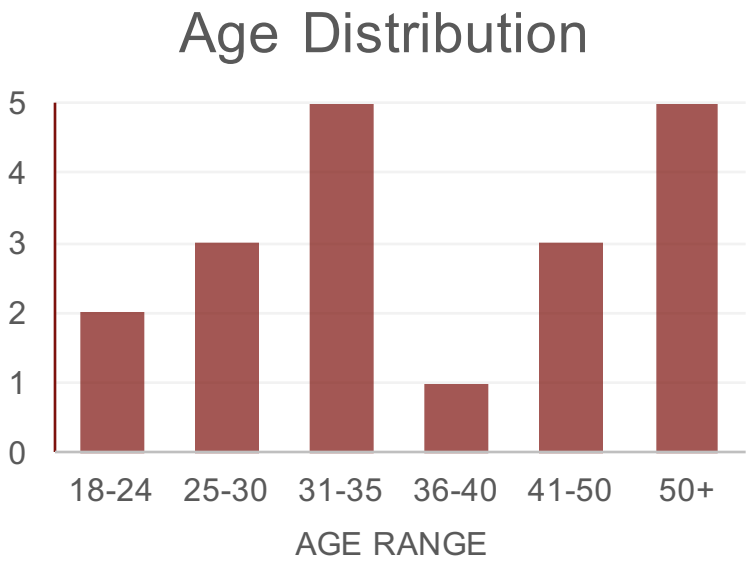
# Our Goal

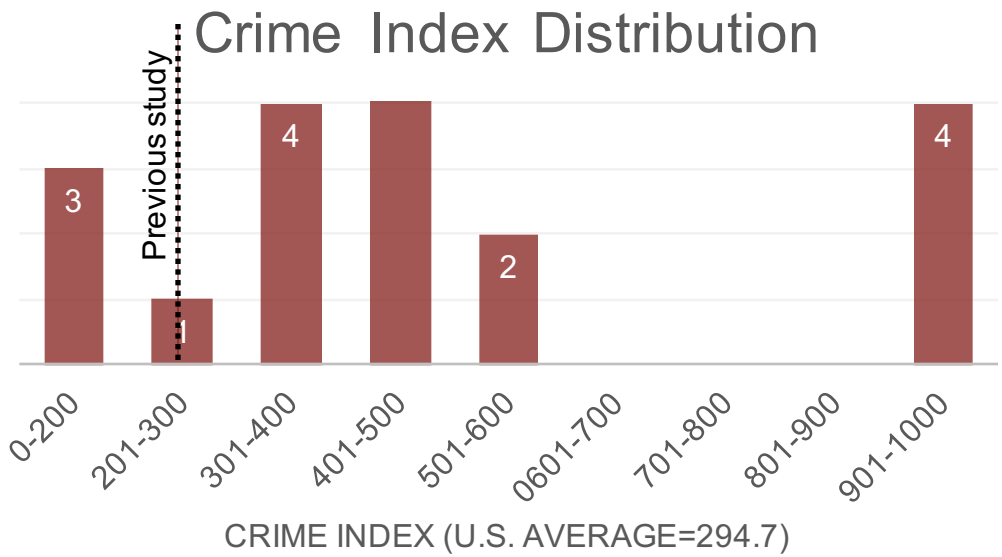
RQ: How can wearable devices address the privacy and security concerns of people with visual impairments?

# We interviewed an urban population of people with visual impairments (N=19)



# 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

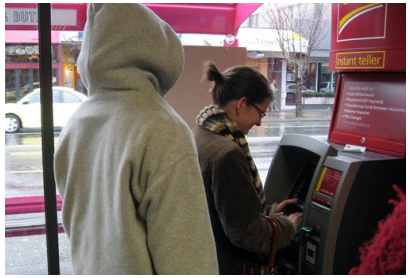
On the Street

magneetmedia.com

Public Transit

www.israelnationalnews.com

ATM Booths

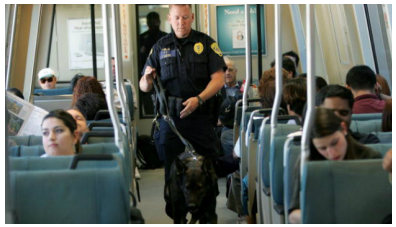



www.bcliving.ca

Private Spaces

thehomeworksgroup.com


www.freep.com



sanfrancisco.cbslocal.com


newsblogs.chicagotribune.com

www.smartfoxsecurity.com

# It is not safe to walk on the streets

On the Street | Public Transit | ATM Booths | Private Spaces

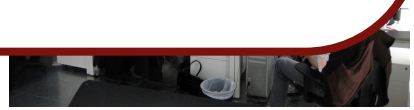
magneetmedia.com


www.freep.com

*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)*

sanfrancisco.cbslocal.com



www.smartfoxsecurity.com

# Taking public transit can be risky

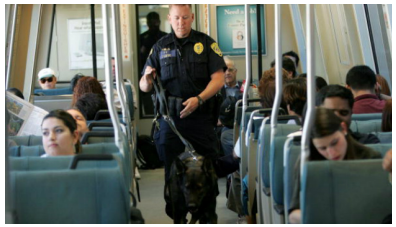
On the Street

magneetmedia.com

www.freep.com

Public Transit

www.israelnationalnews.com



sanfrancisco.cbslocal.com

ATM Booths

Private Spaces

*I was in a **waiting spot** to get a paratransit van, and some-body 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)*

www.smartfoxsecurity.com

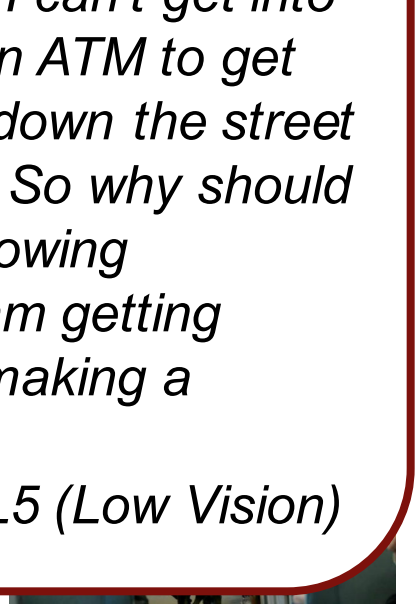
# Attackers can easily shoulder-surf in ATM Booths

On the Street | Public Transit | ATM Booths | Private Spaces

*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)*


www.freep.com



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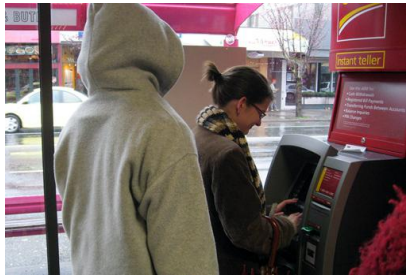


www.bcliving.ca


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thehomeworksgroup.com

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

# People with visual impairments adopted several coping strategies

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

# Avoid certain situations or devices

**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)*

Relocation

Mitigation

Acceptance

# Relocate to a different place

Avoidance

**Relocation**

Mitigation

*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)*

Acceptance

# 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)*

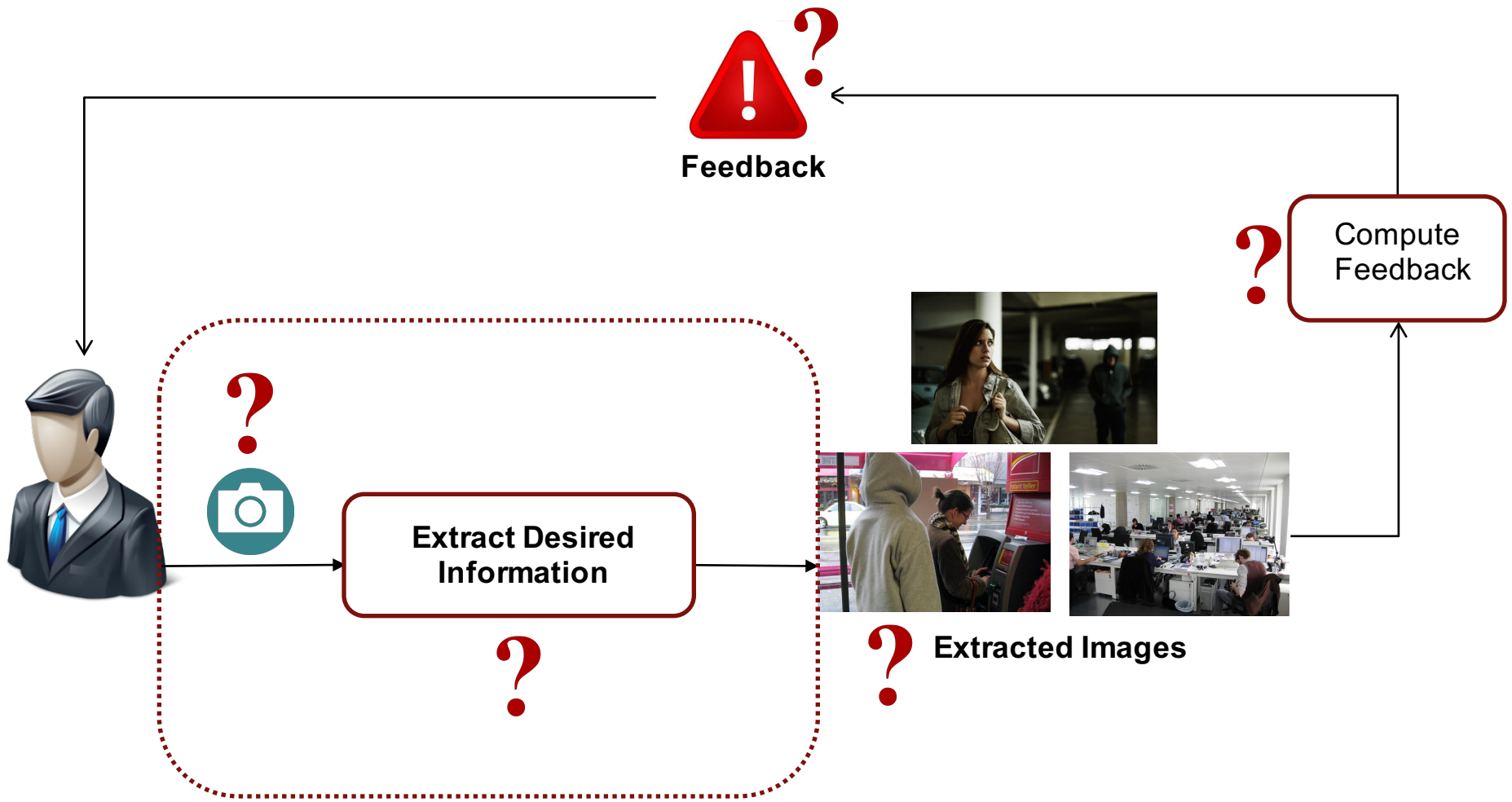
Help from others

Adaptation

**Acceptance**

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

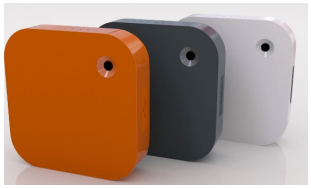
iON SnapCam


YoCam

# People prefer ‘Wearable’ and ‘Discreet’ cameras







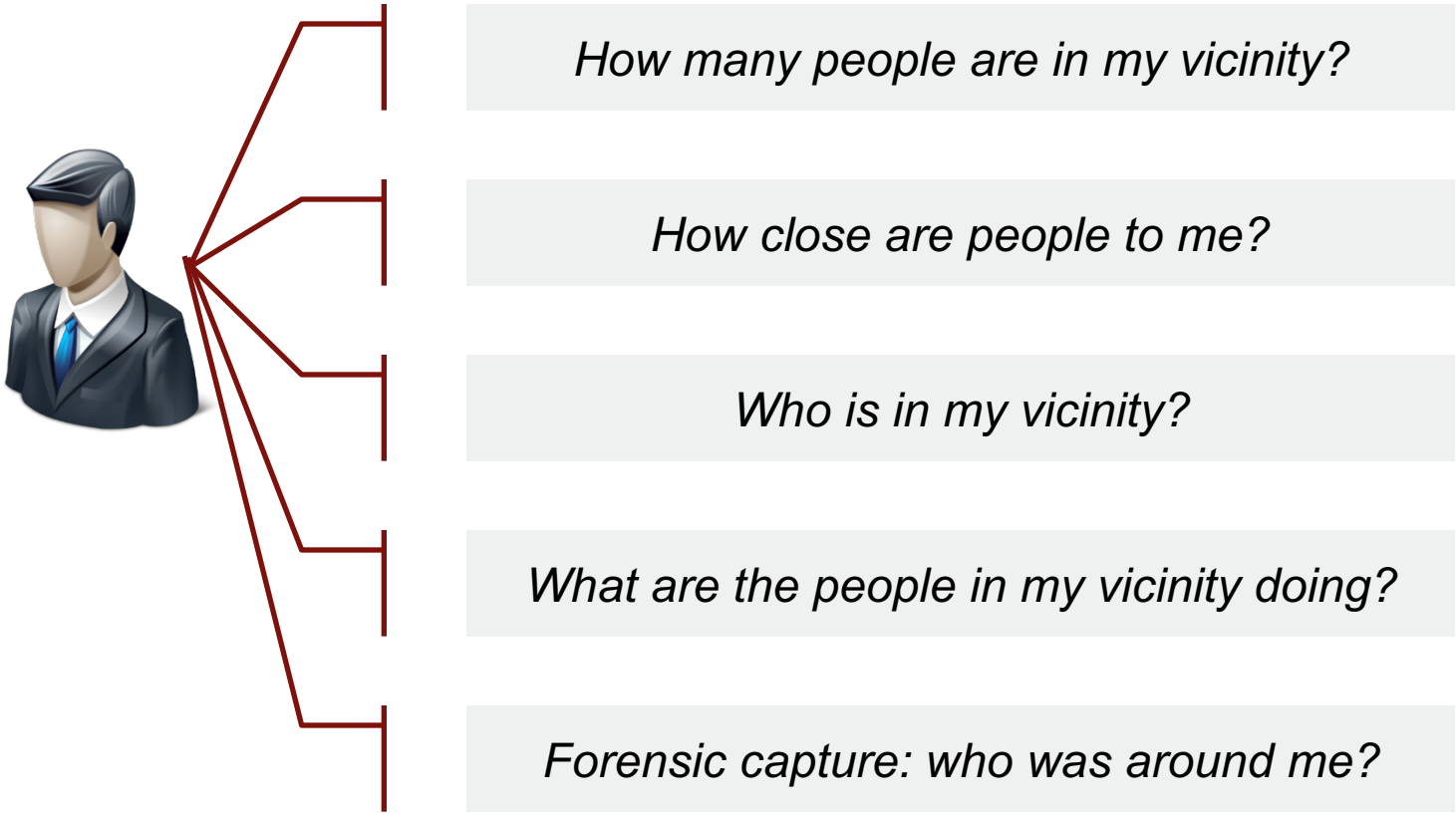

*I like the idea of having something on your clothes because it is **less noticeable**... because people will start to wonder why is he wearing this **weird** eyeglass thing. If you want to do stuff low key, then you do it that way.*

*-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?*

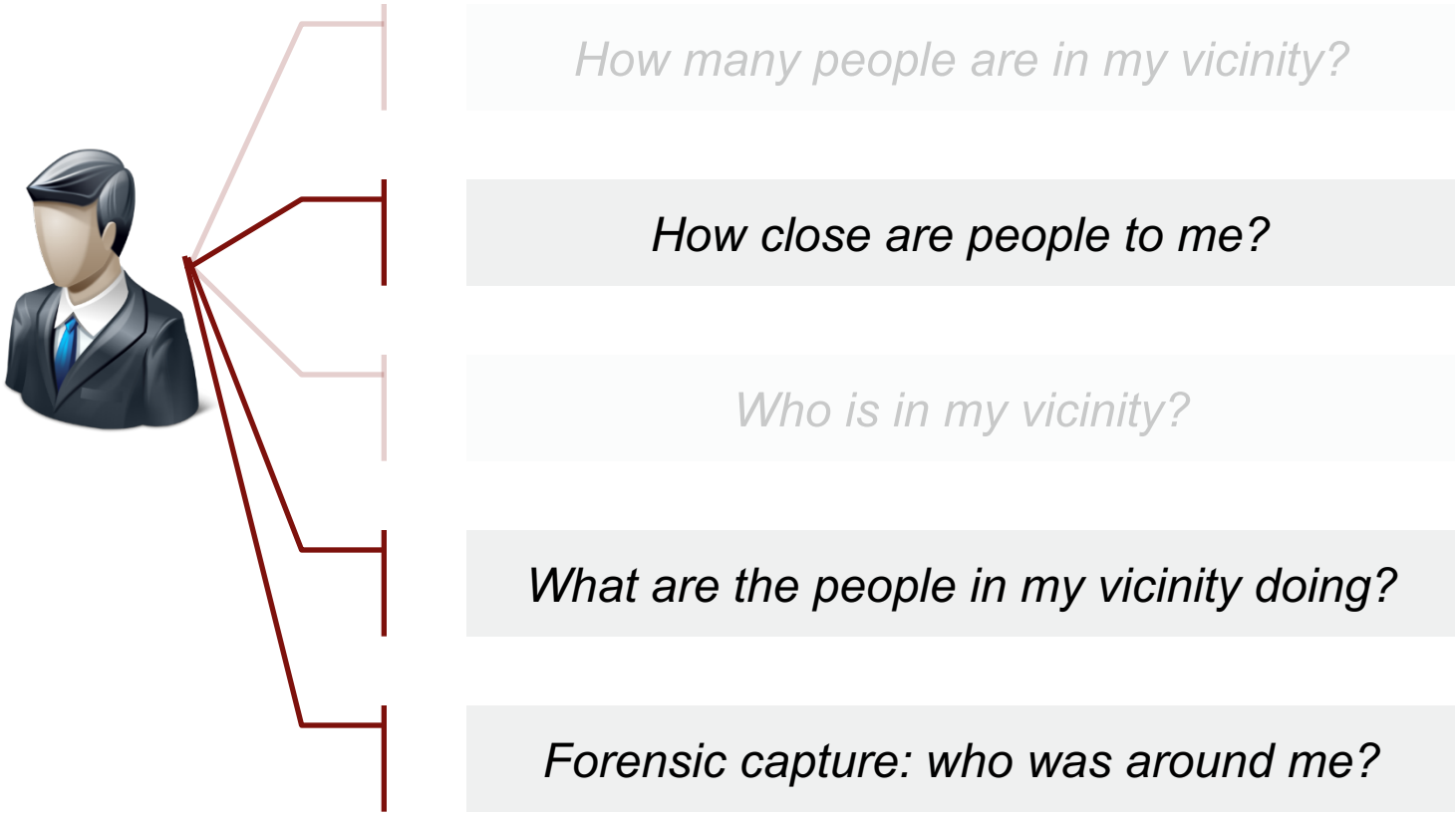
*How close are people to me?*

*Who is in my vicinity?*

*What are the people in my vicinity doing?*

*Forensic capture: who was around me?*

# What information is desired?



# 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.*

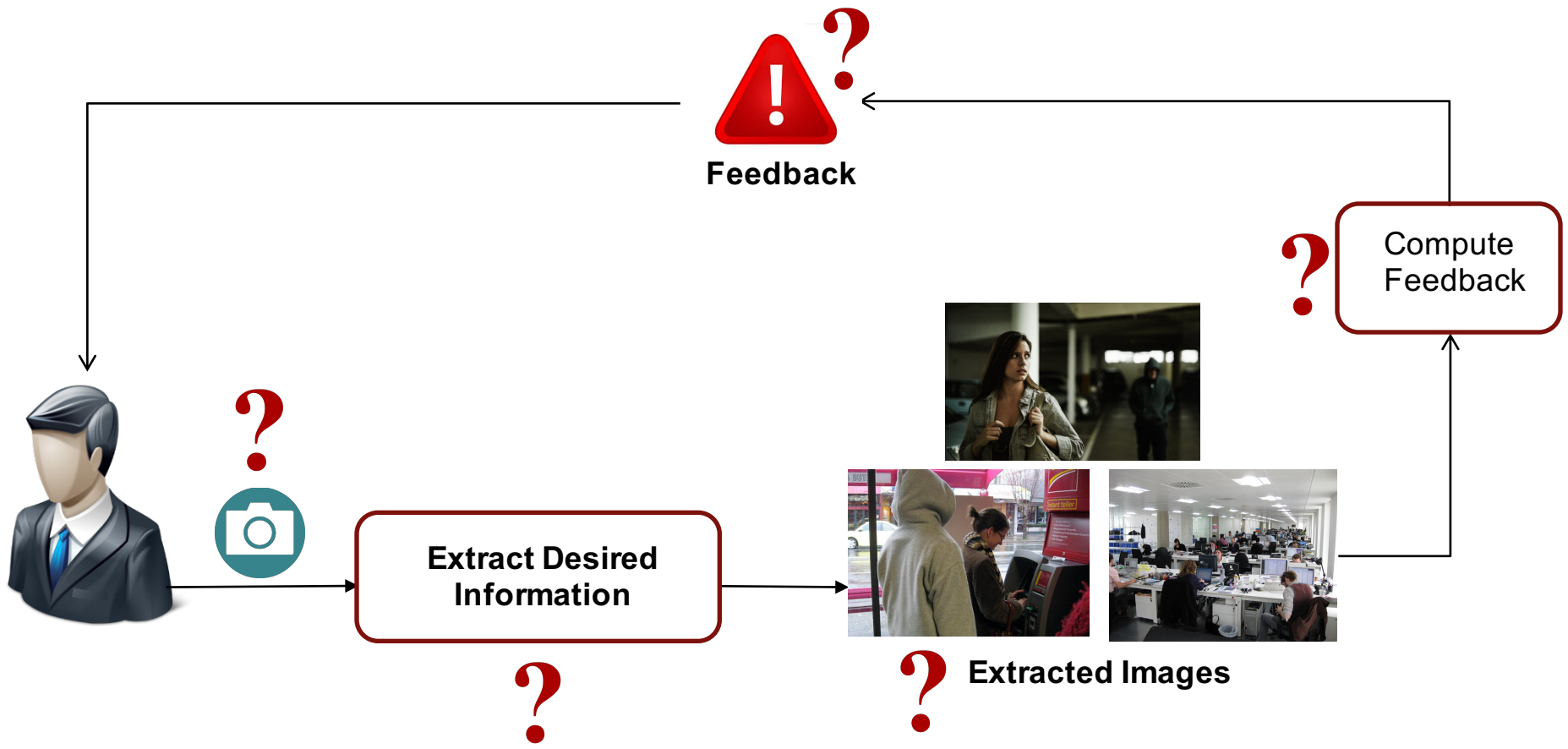
*-T5 (Totally blind)*

# Forensic capture: who was around me?

*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

Feedback

?

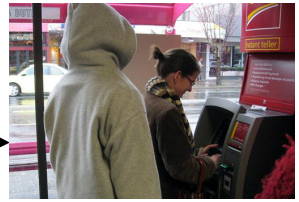
?

Compute Feedback

Wearable

**Extract Desired Information**

How many people?
How close are they?
What are they doing?
Who are they?
Who was around me?



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**Extracted Images**

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This material is based upon work supported by the National Science Foundation (NSF) under grants CNS-1408730 and IIS-1253549. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation

# 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