CS/Psych/EdPsych 770 Human-Computer Interaction

Accessibility

Yuhang Zhao
Computer Sciences, UW-Madison

Today's Agenda

- ASSETS 2022
- Topic overview: Accessibility
- Discussion

- ☐ ***SESSION: Paper Session 1: AR, VR and Games***
- ☐ ***SESSION: Paper Session 2: Representation and Inclusion***
- ☐ ***SESSION: Paper Session 4: Composition in Music, Programming and Design***
- ☐ ***SESSION: Paper Session 5: Communication***
- ☐ ***SESSION: Paper Session 6: Social Media and Media***
- ☐ ***SESSION: Paper Session 7: Tactile and Haptics***
- ☐ ***SESSION: Paper Session 8: Accessibility in Daily Living***
- ☐ ***SESSION: Paper Session 9: Safety, Rehabilitation, and Transportation***
- ☐ ***SESSION: Student Research Competition Abstracts***
- ☐ ***SESSION: Doctoral Consortium Abstracts***
- ☐ ***SESSION: Workshop Abstracts***

What are key challenges regarding accessibility?

Risks	Description
Inaccessible devices/services	Devices or services that cannot be used by people with special needs, even if they have adequately adapted equipment
Loss or privacy	When personal information stored and/ore transmitted without the authorization of the user
Loss of autonomy	When decisions about the user are taken by other than the user or the person(s) authorized by the user
Economic factors	Devices and services out of the financial capability of the users because excessive technology is used
Invasive and/or socially unacceptable location systems	Systems for personal location that invade personal freedom and/or devices for location that are socially unacceptable

Abascal & Nicolle, 2005, Moving towards inclusive design guidelines

What is accessibility?

- **Definition of Usability**: The effectiveness, efficiency , and satisfaction with which a specified set of users can achieve a specified set of tasks in a particular environment. – ISO 9241-11
- **Definition of Accessibility**: The usability of a product, service, environment, or facility by people with the widest range of capabilities. – ISO 9241-20

How is accessibility related to disability?

- *Accessibility* is the extent to which an interactive product is accessible to as many people as possible.
- The primary focus of accessible design is making systems accessible to individuals with *disabilities*.

What is disability?

- **Definition**: A disability is any condition of the body or mind (impairment) that makes it more difficult for the person with the condition to do certain activities (activity limitation) and interact with the world around them (participation restrictions).
- Disability can change over time with age or recovery, and the severity of the impact of disability can change over time. Fewer than 20% are born with a disability, although 80% of people will have a disability once they reach 85.

CDC

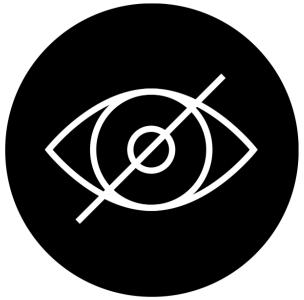
Three Dimensions of Disability

- **Impairment** in a person's body structure or function, or mental functioning (e.g., loss of a limb, loss of vision, or memory loss)
- **Limitation in activities** (e.g., difficulty seeing, hearing, walking, or problem solving)
- **Restrictions in participation** in activities of daily living (e.g., working, engaging in social and recreational activities, and obtaining health care)

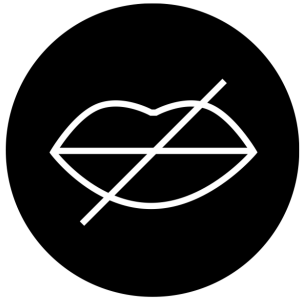
World Health Organization

Types of Impairments:

- **Sensory Impairment**: involves impairment in one or more senses, such as loss of vision or hearing.
- **Physical Impairment**: Involves loss of function to one or more parts of the body, e.g., congenitally or after stroke or spinal-cord injury.
- **Cognitive Impairment**: Includes cognitive deficits, such as learning impairment or loss of memory/ cognitive function due to aging or conditions such as Alzheimer's disease.



Can't see



Can't speak

Can't hear

Can't touch

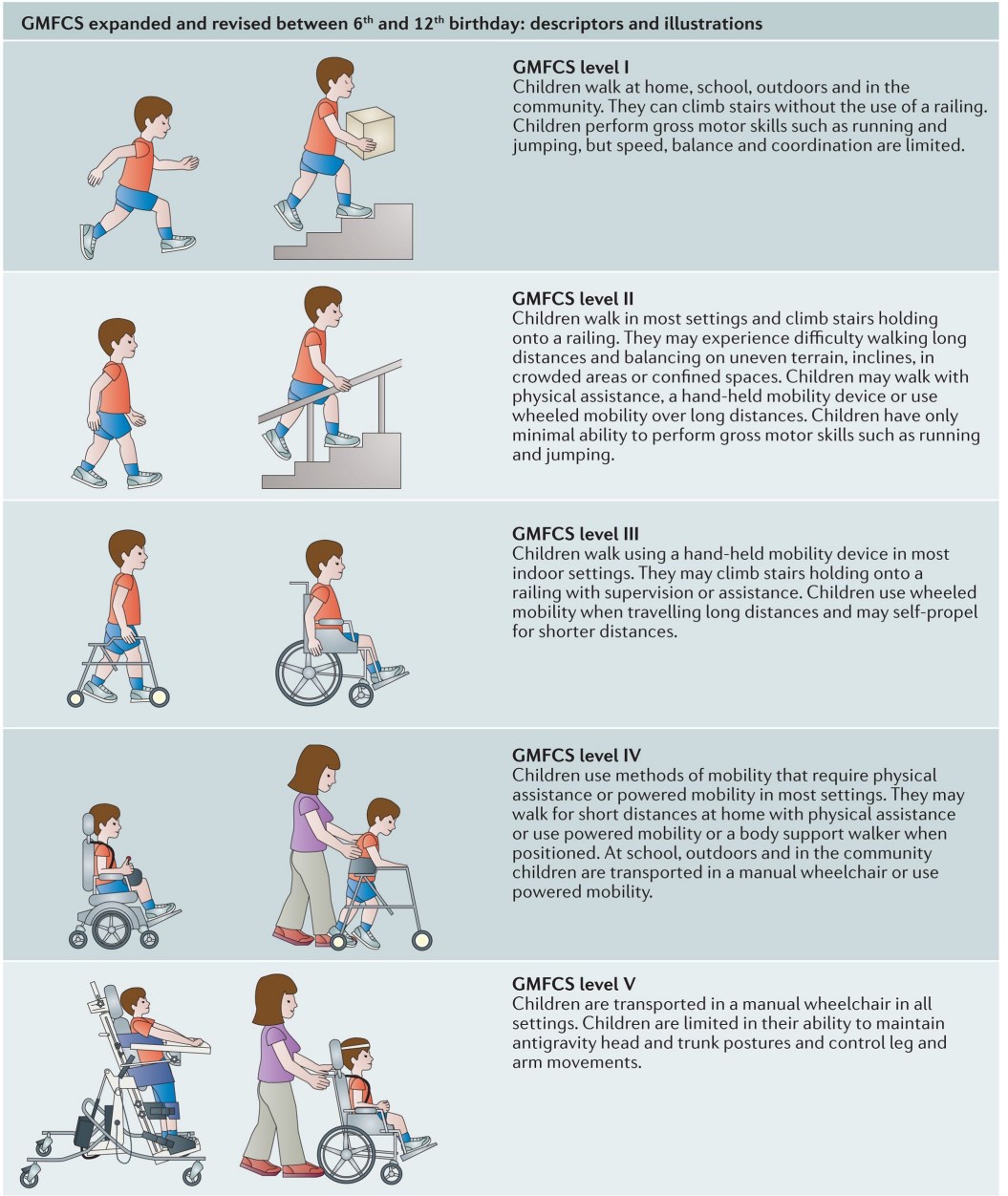
[Microsoft Inclusive Design Toolkit]

What are some common impairments?

- **Visual Disabilities**: Vision impairments, including blindness and low vision
- **Motor/Mobility**: Muscular or skeletal impairments in the hands, arms, or the whole body that affect user and mobility, e.g., users are in a wheelchair or bedridden.
- **Auditory**: Hearing deficits differing in severity, e.g., deafness.
- **Seizures**: Neurological impairments, e.g., photosensitive epilepsy, that result in sensitivity to light, motion, and flickering and trigger seizures.
- **Cognitive/Learning**: Limitations in mental functioning or in skills such as communication, self-help, and social skills, e.g., autism, ADHD, dyslexia

How do impairments vary?

- Impairments can vary in severity or structure depending on the source and nature of the impairment.
- **Severity**: Children with cerebral palsy can have basic mobility or completely depend on caretaker
- **Structure**: vision impairments can include central vision loss, peripheral vision loss, extreme light sensitivity, etc.



[Gross Motor Function Classification System (GMFCS)]

Cataract

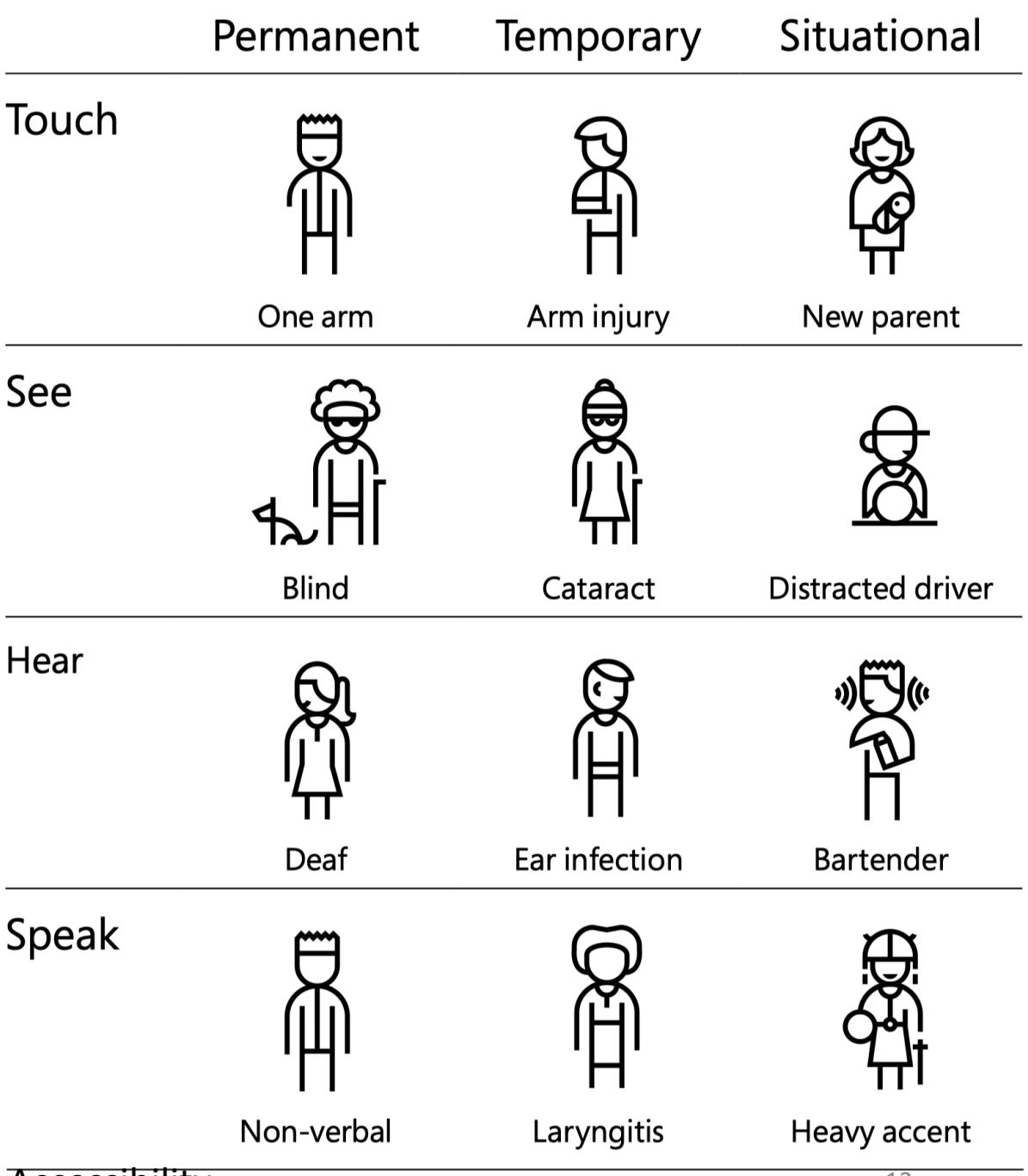
Age Related Macular Degeneration

Diabetic Retinopathy

Glaucoma

Are impairments permanent?

- **Permanent Impairment**: Congenital or long-term conditions, such as blindness, missing body parts, etc.
- **Temporary Impairment**: Impairments that improve over time, such as recovery after illness or accidents, e.g., a broken arm.
- **Situational Impairment**: Impairments introduced by context, such as environments with low light or noise.



How do we improve accessibility?

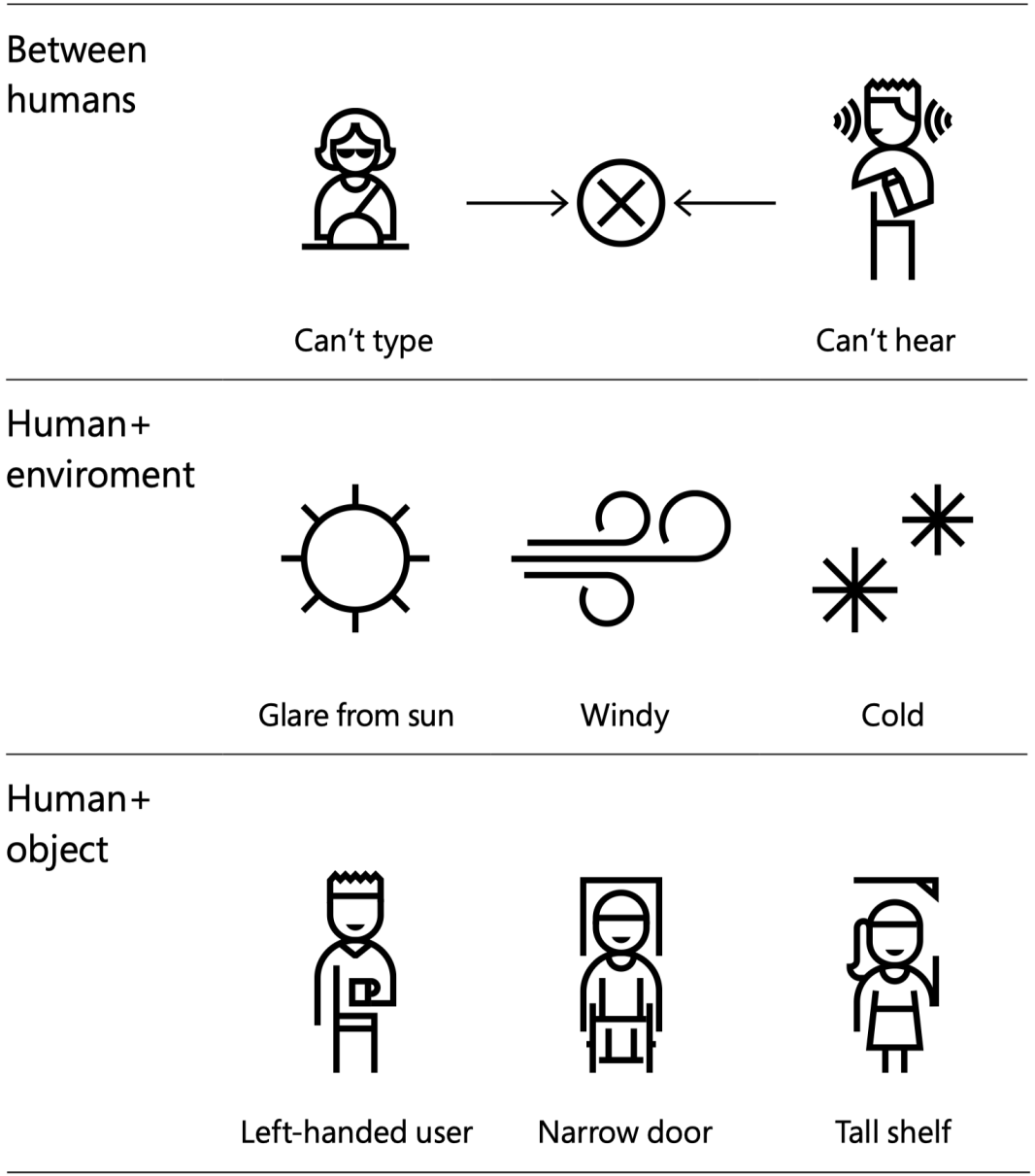
- Two ways to address accessibility problems:
  - Inclusive design
  - Assistive technologies

Social model of disability

Disability as **context dependent**:

- People are disabled by barriers in society, not by their impairments or differences.
- Context-dependent disability results from a mismatch between abilities and the environment:

  Ability + Context => Disability



Shakespeare, Tom. "The social model of disability." *The disability studies reader* 2 (2006): 197-204.

Universal (or inclusive) design

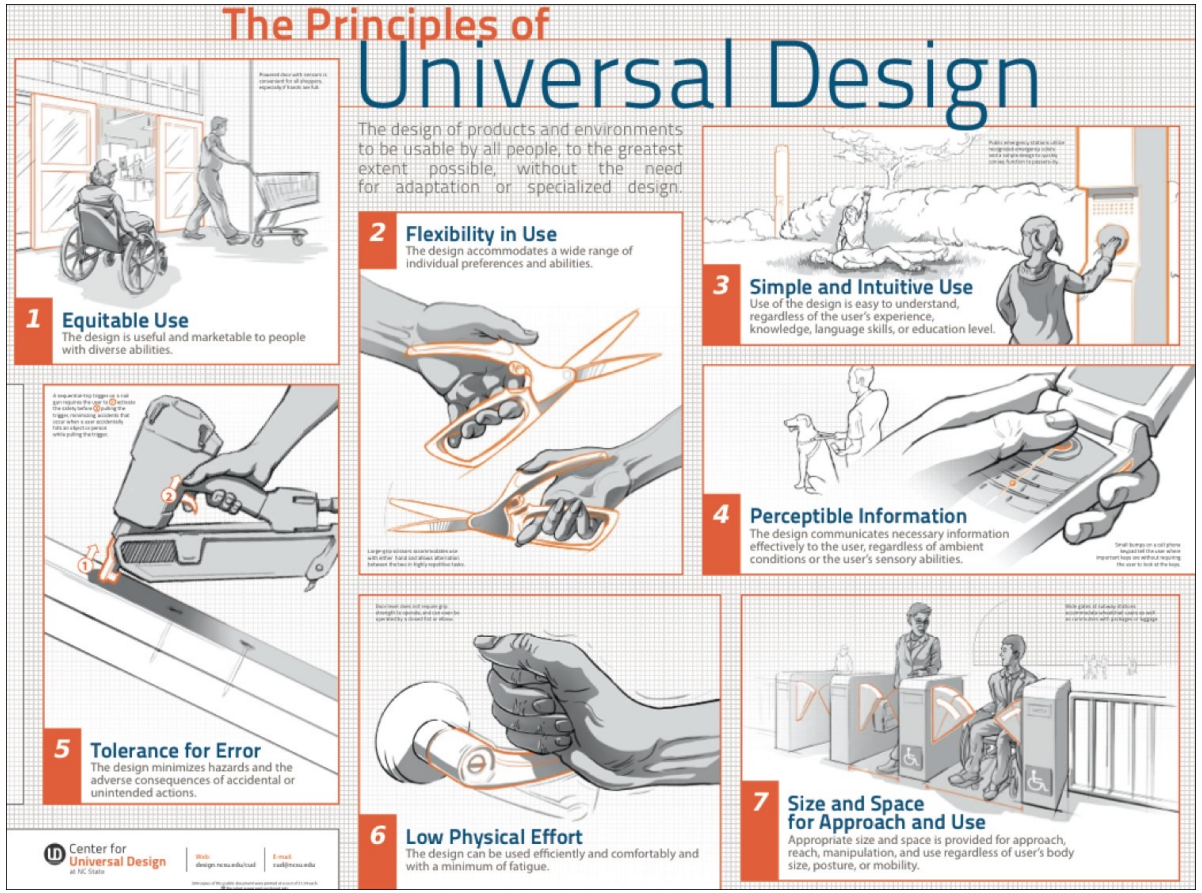
- **Definition**: The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.
- **The main premise**: Design solutions that benefit some individuals may benefit the whole society. E.g., in the US, only 26K people suffer loss of upper extremities. Designs that would benefit these 26K would also benefit another 21M people with temporary or situational disabilities.

Ron Mace, 1996

- **Closed Captioning**: Although closed captioning was originally developed for individuals with hearing impairments, they now also benefit reading in noisy environment and learning to read.

How do you do universal design?

- Equitable use
- Flexibility in use
- Simple and intuitive use
- Perceptible information
- Tolerance for error
- Low physical effort
- Size and space for approach and use

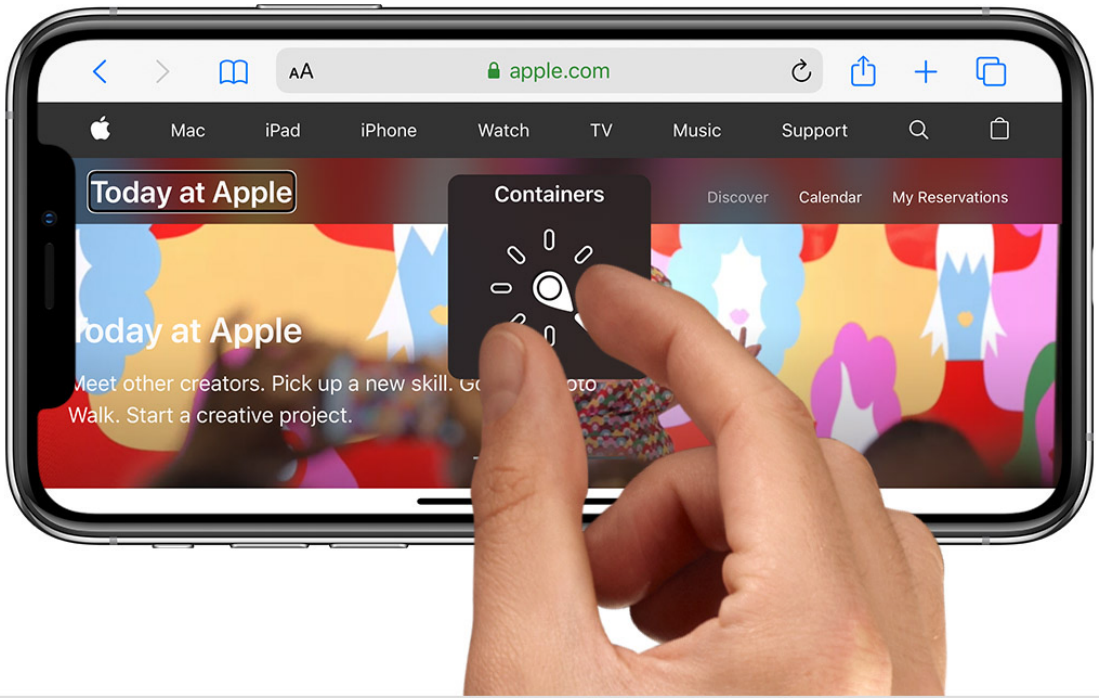


[Interaction Design Foundation]

What are assistive technologies?

- Definition: Specialized tools that close accessibility gaps.

Screen Reader: Software used by individuals with vision impairments to read screen content, e.g., VoiceOver in iOS.



Screen Magnifier: Enlarges text or graphics on screens to improve visibility of content for individuals with limited vision

Text Reader: Tools that read out loud text on screens to support vision and learning disabilities

Braille display: A mechanical device that translates textual content on the screen into Braille

Alternative Input Devices: Tools that help users with motor impairments who cannot use a mouse or keyboard with pointing. E.g., motion/eye tracking.

Alternative & Augmentative Communication: Tools that help individuals who are unable to use verbal speech to communicate.

What is the research space like?

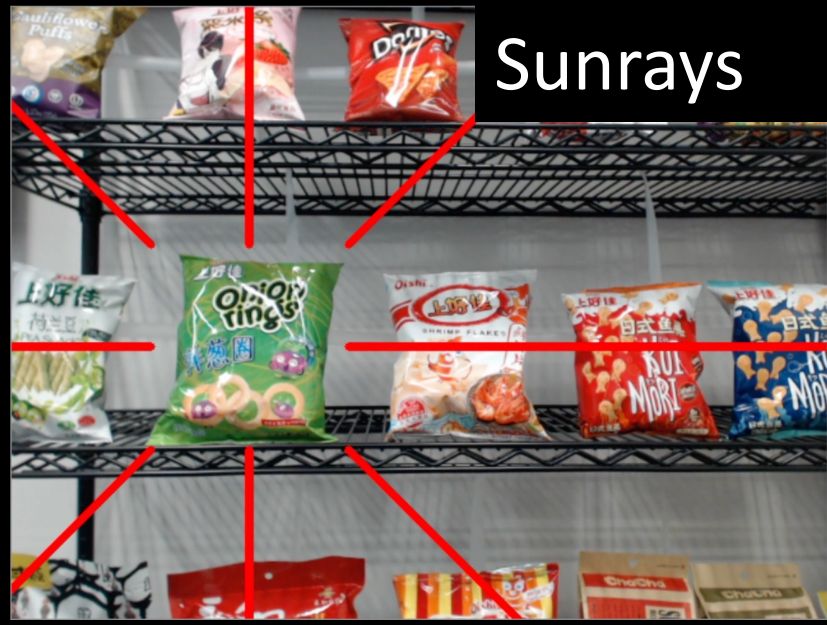
- Understanding people with disabilities
- Designing technologies for people with disabilities

Visual search is extremely challenging for people with low vision and there were no aids that can help.

[Szpiro, **Zhao**, Azenkot, UbiComp'16a]


Guideline


Spotlight


Sunrays


Flash


Movement

CueSee: an MR system for visual search

What denomination is this bill?

(24s) 20
(29s) 20

Do you see picnic tables across the parking lot?

(13s) no
(46s) no

What temperature is my oven set to?

(69s) it looks like 425 degrees but the image is difficult to see.
(84s) 400
(122s) 450

Can you please tell me what this can is?

(183s) chickpeas.
(514s) beans
(552s) Goya Beans

Bigham, Jeffrey P., et al. "Vizwiz: nearly real-time answers to visual questions." *UIST*. 2010.

Jain et al. ”Head-Mounted Display Visualizations to Support Sound Awareness for the Deaf and Hard of Hearing." *CHI*. 2015.

Discussion

- Google doc

Discussion Questions

- What are some other examples of universal design?
- What other disabilities have you encountered that might limit technology use?
- What assistive technologies have you used or encountered?
- What are grand challenges in designing assistive technologies?