Week 9-1
Designing for Various Abilities

SFWRENG 4HC3/6HC3 Human Computer Interfaces

* Slides adapted from previous instructors of COMPSCI/SFWRENG 4HC3/6HC3
and the COMPSCI 5115 course from University of Minnesota

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Week 9 Overview

- **Monday**
  - **Designing for Various Abilities**
- Wednesday
  - Designing for Various Populations
- Friday
  - Ideation and Prototyping

Challenges in Design

Designing for **various abilities**

- Sensory Impairments
  - Vision / Hearing
- Cognitive Impairments
  - Attention Deficit Hyperactivity Disorder / Learning Disabilities
- Physical Limitations
  - Mobility Impairments / Chronic Health Conditions

Designing for **broad usage**

- Older Adults
  - Physical and Cognitive Changes / Technology Comfort Issues
- Children
  - Literacy and Vocabulary / Physical Manipulation
- Socio-Economic Differences
  - Vast Differences in Technology Usage

Universal Design: Why

- **Accessibility as a Legal and Moral Imperative**
  - Accessible Canada Act
  - Various governing rules worldwide
  - Just the right thing to do

- **Universal Design as a Win-Win**
  - Closed Captioning
  - Auditory Plus Visual Alarms

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Universal Design: Goals

Identify designs that **increase accessibility while improving usage experience for all users**.

- Sometimes this requires making the universal design ubiquitous

- Sometimes this requires standard ways to invoke universal design features

- Some basic accessibility guidelines are part of commercial toolkits and usability standards.

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Design for: Sensory Impairments

- **Visual Impairments**
    - Blind or Low Vision
    - Color Blindness

- **Auditory Impairments**
    - Deaf or Hard of Hearing

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Blind and Low Vision

Challenges
- Invisible content; Accessibility of charts and graphs
- Navigation challenges: Need to be able to interact with device without visual sensing
- Lack of flexibility: Need to be able to magnify screen or increase font sizes
- Lack of proximity: magnification can be occluding

Approaches
- Captioning for visual material (images, videos)
- Use color redundantly; make data available in text
- Designs that support screen-reader interfaces
- Design that support magnification

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Deaf or Hard of Hearing

Challenges

- Audible Alerts
- Audio Content
- Interfaces that take away volume control

Approaches

- Option to signal audio through visual means
- Transcripts (or captions)
- Allow user control of volume

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Universal Design: General Benefits
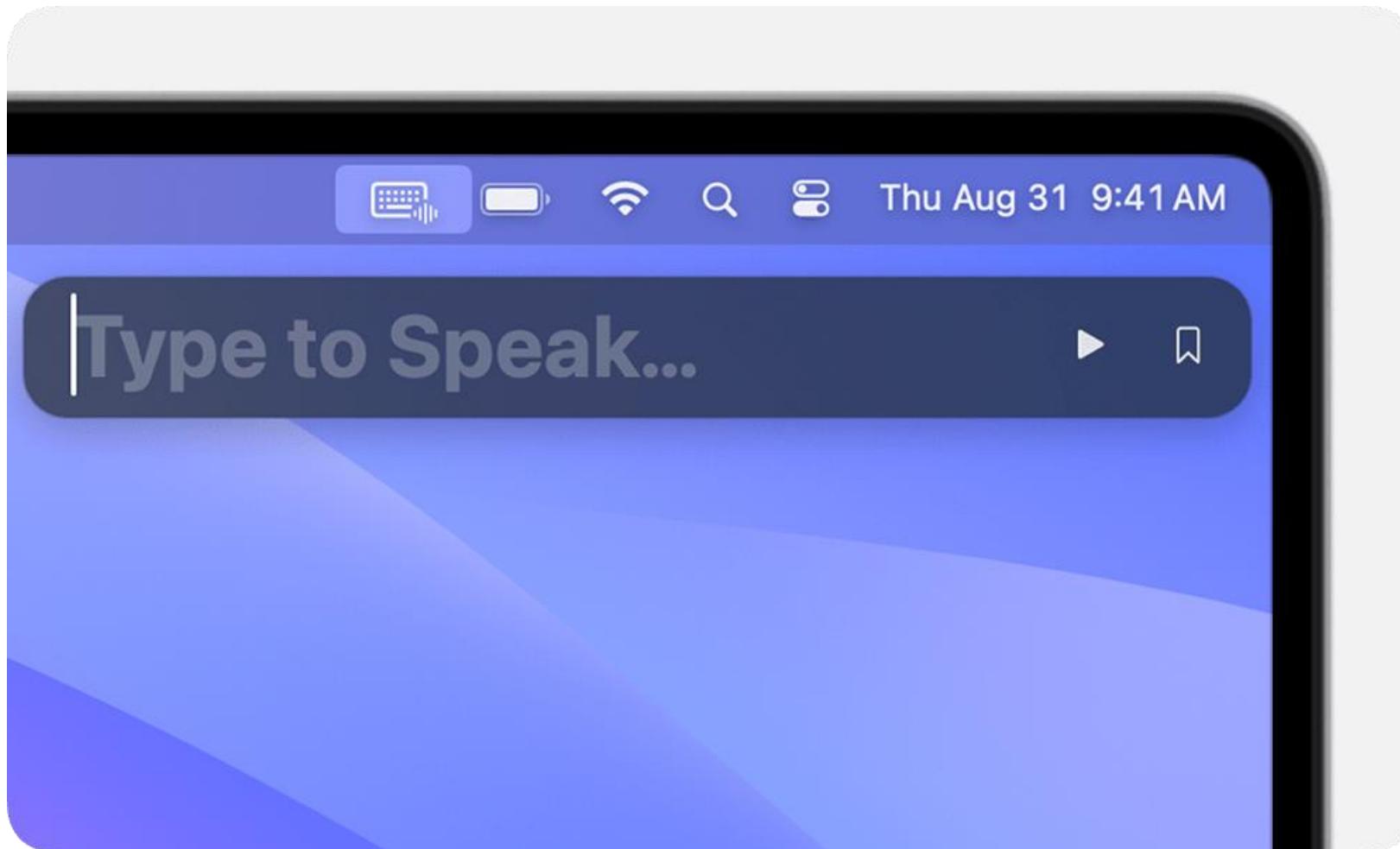
Well-designed interfaces for the blind are also well-designed for use:
- In the dark
- When eyes should be focused elsewhere
- Screen-reader support also helps with users with mobility impairments using speech recognition

Well-designed interfaces for the deaf are also well-designed for use:
- In noisy spaces
- In public spaces where sound is disabled
- When ears are otherwise

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Example: Live Speech

Type to speak

Example: Alt Text
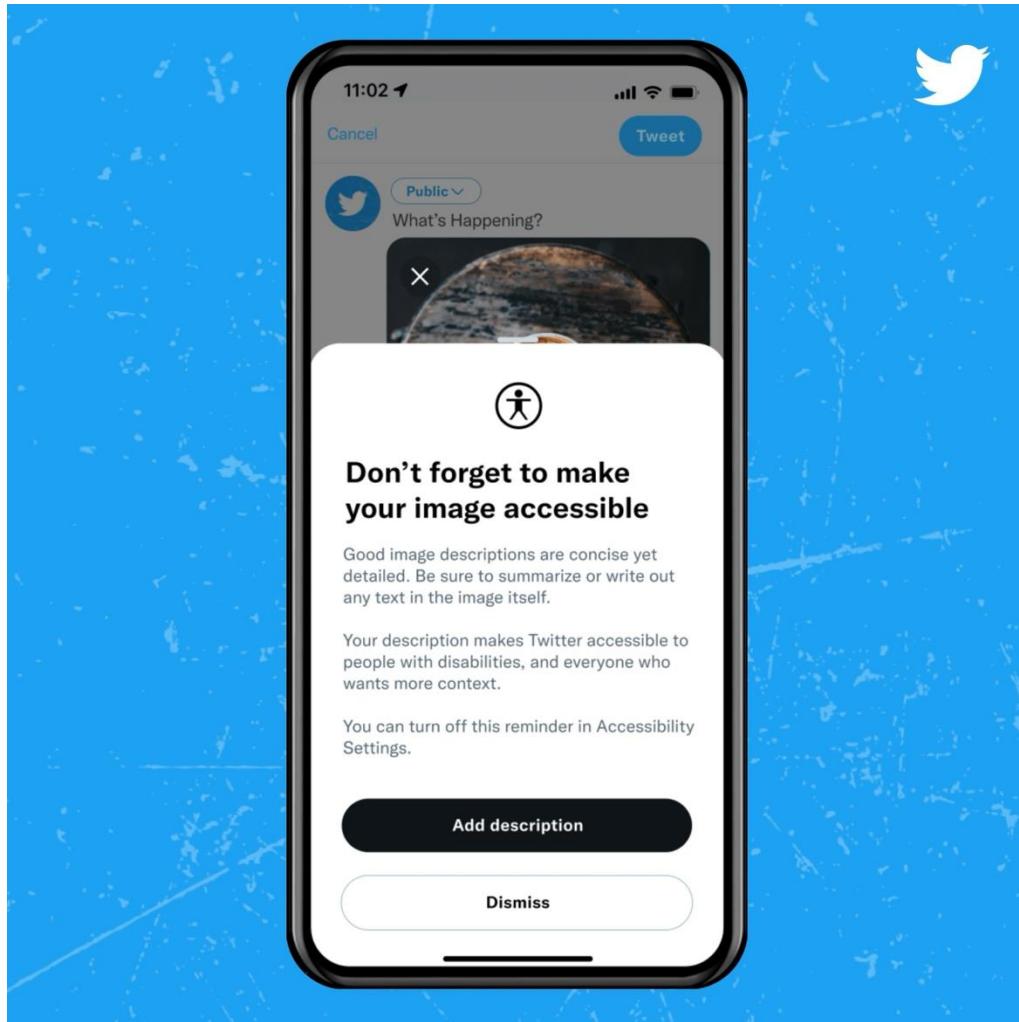
Image alt text reminder
for inclusive environment

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Example: Caption and Transcription

Zoom closed caption and live transcription

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Research Example: Wayfinding

Wayfinding app for blind travelers in a transit hub
(GPS, localization, tracking, voice and haptic feedback)

Experiments with RouteNav, A Wayfinding App for Blind Travelers in a Transit Hub:
https://dl.acm.org/doi/pdf/10.1145/3597638.3608428

Design for: Cognitive Impairments

ADD / ADHD

• Attention Deficit; Hyperactivity
  Distraction

Learning Disabilities

• Acquisition (e.g., Dyslexia)

• Storage

• Retrieval

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Attention Deficit Hyperactivity Disorder

Challenges:

- Distraction
- Lack of focus
- Identifying relationships

Approaches

- Simplify
- Clear visual grouping; clear distinct labeling
- Persistent Status Display

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Learning Disabilities

Challenges

- Complexity and overload
- Identifying relationships; Distinguishing alternatives

Approaches

- Keep language and design simple and straightforward
- Reduce information density (more bullets; less text)
- Make items distinguishable (and memorable)
- Redundant coding (color, proximity, label, speech)

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Universal Design: General Benefits
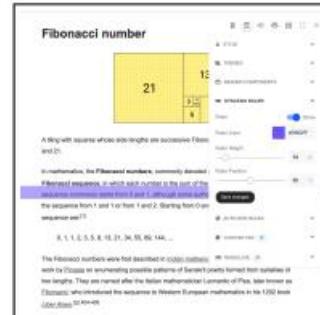
Well-designed interfaces for the cognitively impaired users are also just plain well-designed for use:

- Simpler
- Require less attention
- Easier to resume
- Easier to identify next steps
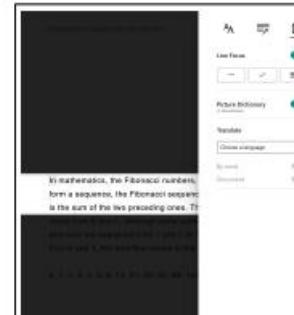
Research Example: Reading Ruler
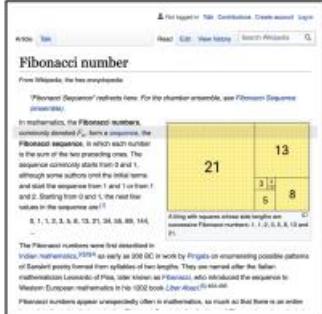
(a) BeeLine automatic text color gradient.
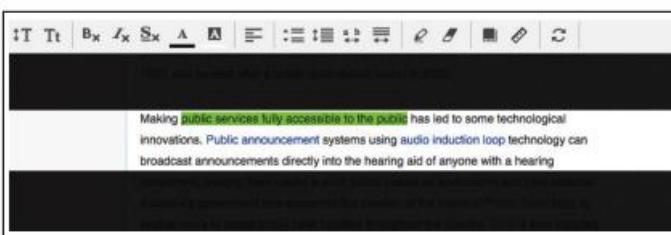
(b) ReaderMode ruler with configuration panel.

(c) Immersive Reader reading ruler to with configuration panel.

(d) ReadingLine grey bar ruler.
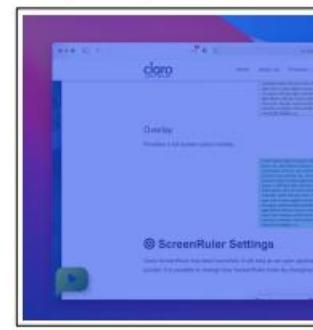
(e) Avelar et al. ruler and configuration panel.

(f) ClaroSoftware Underline ruler with shade below it.

(g) ClaroSoftware Ruler with shade above and below it.

(h) ClaroSoftware Overlay tool.

Designing reading rulers for people with dyslexia

Digital Reading Rulers Evaluating Inclusively Designed Rulers for Readers With Dyslexia and Without
https://dl.acm.org/doi/pdf/10.1145/3544548.3581367

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Design for: Physical Limitations

Mobility Impairments

- Motor Control

- Trembles, pointing accuracy

Motor Limitations

- Reach, dexterity, fatigue

- Two-handed coordination

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Motor Impairments

Challenges

- Low pointing dexterity
- Inability to use a pointing device
- Difficulty with distant movements
- Slow input and fatigue

Approaches

- Easily targeted controls
- Ensure operable by keyboard only (keyboard navigation); visual cue for keyboard focus
- Located related controls/operations in close proximity
- Avoid or allow override of short time-outs
- Don't override accessibility features of platform that support alternative inputs

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Universal Design: General Benefits
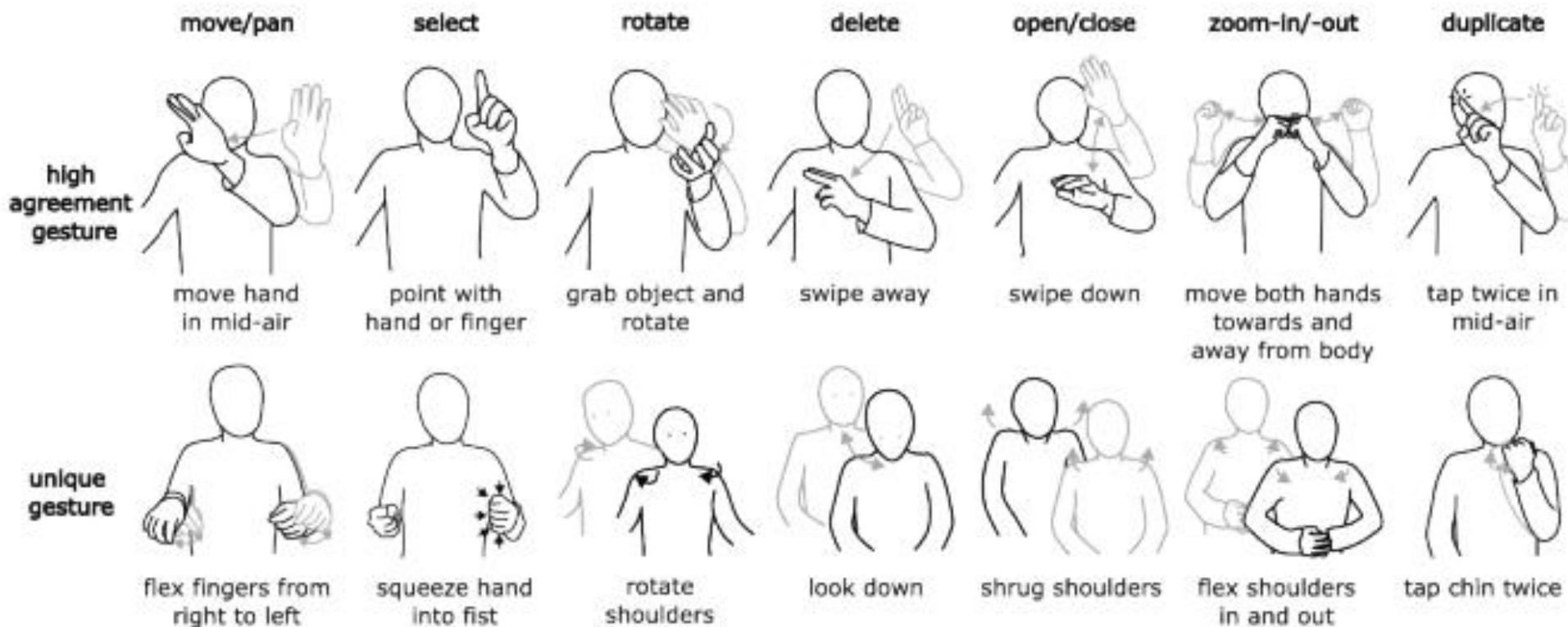
Well-designed interfaces for users with motor impairments are also well-designed for use:

- In motion

- With input device failure

- As a power-user with keyboard shortcuts
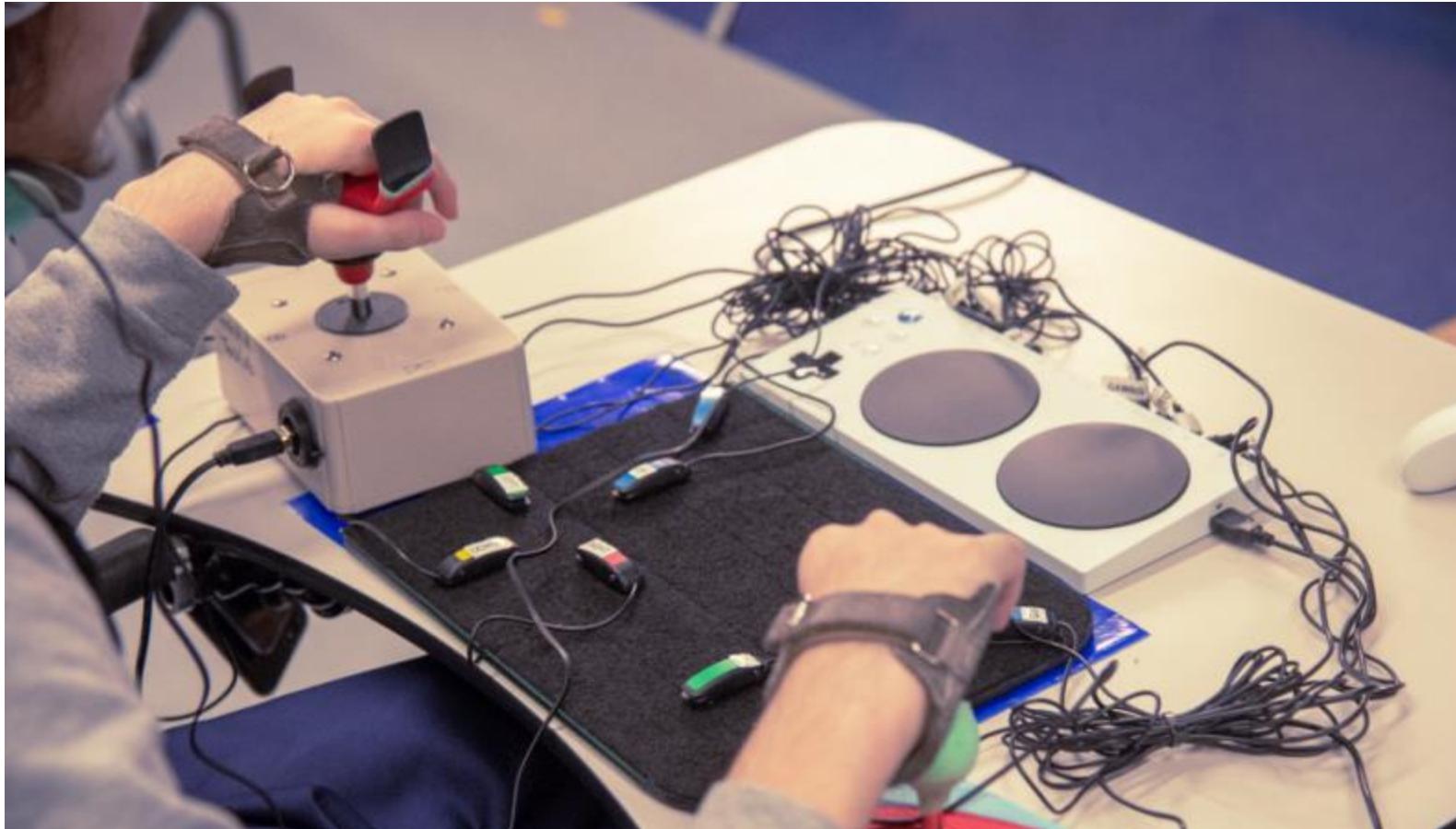
Research Example: Gesture Design

Personalized upper-body gestures for people
with upper-body motor impairments

How Do People with Limited Movement Personalize Upper-Body Gestures? Considerations for the Design of
Personalized and Accessible Gesture Interfaces: https://dl.acm.org/doi/pdf/10.1145/3597638.3608430

Example: Xbox Adaptive Controller

Physical limitations with hand movements

Example: TLOUS 2

Apply vision accessibility preset

Configures all the recommended settings designed for players who are blind or have low vision. This will enable settings across multiple menus, such as:

- **Options**: On or Off
- Text-to-Speech
- High Contrast Display
- HUD Scale > Large
- Lock-On Aim > Auto-Target
- Traversal and Combat Audio Cues
- Navigation and Traversal Assistance
- Ledge Guard
- Enhanced Listen Mode
- Invisible While Prone > Unlimited
- Skip Puzzle Option

Apply hearing accessibility preset

Configures all the recommended settings designed for players who are deaf or hard of hearing. This will enable settings across multiple menus, such as:

- **Options**: On or Off
- Awareness Indicators
- Pick-Up Notifications
- Dodge Prompts > Frequent
- Subtitles > Story + Combat
- Subtitle Names
- Subtitle Direction
- Combat Vibration Cues
- Guitar Vibration Cues

Apply motor accessibility preset

Configures all the recommended settings designed for players with a physical or mobility disability. This will enable settings across multiple menus, such as:

- **Options**: On or Off
- Lock-On Aim > Auto-Target
- Auto Weapon Swap
- Auto Pick Up
- Camera Assist > On
- Navigation and Traversal Assistance
- Ledge Guard
- Infinite Breath
- Repeated Button Presses > Hold
- Melee Combos > Hold
- Weapon Sway > Off

Motor related accessibility game setting (e.g., auto target, auto pick up item, button hold instead of repeated button press)

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Activity: Accessibility Settings (~5-7 mins)

Pair up with another classmate:

Pick a device (iPhone, Android Phone, Windows, MacOS, iPad) and go through **device accessibility settings:**

- Try activate different accessibility settings and see what the experience is like
- You can also compare settings between platforms
- Anything particular that you notice?

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Tools and Standards

- WCAG Guidelines: https://www.w3.org/TR/WCAG22/
- Apple Accessibility Guides: https://www.apple.com/accessibility/
- Android Accessibility Guides: https://developer.android.com/guide/topics/ui/accessibility/principles
- WAVE Tool: https://wave.webaim.org/
- Inspector Sidebar: https://ainspector.github.io/
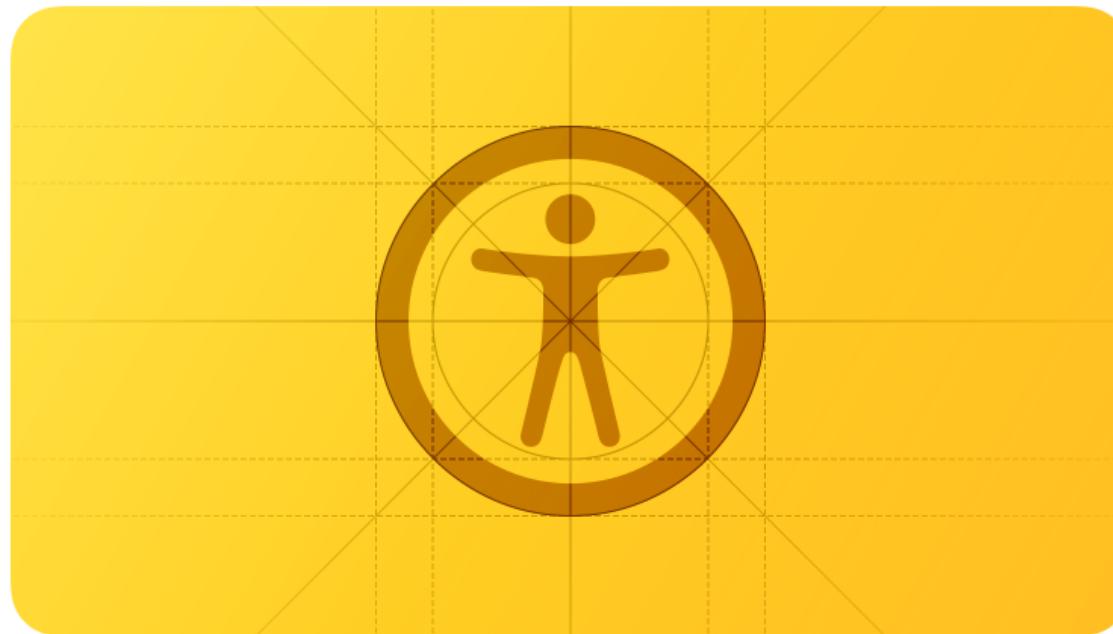
Guidelines: WCAG

- Has been developed over a couple of decades
- Four Key Areas (P-O-U-R):
  - **Perceivable:** how persons with sensory disabilities can access information
  - **Operable:** controls must be operable through a variety of means
  - **Understandable:** understand information in order to be able to use it.
  - **Robust:** make this compatible with not only current tools but potential future user agents including assistive technology

Guidelines: Apple Accessibility

Accessibility

People use Apple's accessibility features to personalize how they interact with their devices in ways that work for them.

Supported platforms

Accessibility
Best practices
Interactions
VoiceOver
Text display
Color and effects
Motion
Platform considerations
Resources
Change log

An accessible app or game supports accessibility personalizations by design and helps everyone have a great experience, regardless of their capabilities or how they use their devices.

Approximately one in seven people have a disability that affects the way they interact with the world and their devices. People can experience disabilities at any age, for any duration, and at

A top-level accessibility page as well as detailed guidelines in their design guide.

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