Accessibility

Abilities

- How are people different from you?
- How will you be different from yourself in the future?
- How do your abilities change as a function of your environment?
- People differ from one another across a range of dimensions

- ✦ Cognitive abilities
- ✦ Physical abilities
- ✦ Age
- ✦ Gender
- ✦ Culture
- ✦ Personal history
- ✦ Language
- ✦ Emotional, physical, spiritual needs

Abilities

- The “average person” is nothing more than a statistical notion
  - No one person is “average”
  - If you build software for someone else, they will differ from you in some way
- Each one of us has permanent and/or temporary disabilities
  - Temporary disabilities can arise due to nature of our environment or our health
  - What forms of “temporary” disabilities are there?

Temporary Disabilities

- Sick, injured
  - Temporarily impaired cognitive capabilities
  - Temporary loss of motor capabilities
- Driving a car
  - Limited attentional bandwidth

- Making dinner at home while attending to children
  - Limited attentional bandwidth
- Underwater diving
  - Impaired sight, hearing, mobility
- Using an ATM late at night in an unfamiliar surrounding
- Skydiving! Being in space!

Disability Statistics

- 10-20% of population estimated to have a disability
  - 3-6 million Canadians
  - 30-60 million Americans
- 1 in 10 have a significant hearing impairment
  - 1 in 125 are deaf

- 1 in 100 have a visual disability
  - 1 in 475 are legally blind
  - 1 in 2000 are totally blind
- 1 in 250 are wheelchair users

- Source: Handbook of Human-Computer Interaction, chapter by Newell & Greg, 1997

Aging Population

- By 2030, estimated that nearly 25% of US population will be 65 years or older
  - Compare to 10% from 1991
- Aging adults prefer to be autonomous as long as possible
  - Don’t want to be institutionalized, reliant on others
- Aging has impact on cognitive, physical capabilities
  - 1 in 4 adults of age of 80 has some form of dementia
  - Motor skills, senses decline

Day-to-Day Machines

Legal Obligations

- United States' Disabilities and Rehabilitation Acts
  - All government facilities, services, and communications must be accessible to individuals with disabilities
  - 1998 amendment to Rehabilitation Act, Section 508, explicitly includes access to electronic and information technology
  - If you plan on selling software or electronic services to a US government body, it must be accessible to those with disabilities
- Canada
  - Currently, no federal accessibility legislation pertaining to electronic and information technologies

Curb Cut Phenomenon

- Designing to accommodate users with disabilities can benefit everyone
  - Dubbed the “curb cut phenomenon”
- Sidewalk curbs must be “cut” to allow wheelchair access
  - But benefits more than just wheelchair users
  - Easier to roll luggage, use strollers, carts, etc.
- Many technologies designed for those with disabilities have had this positive effect

Curb Cut Examples

- Cassette tape
  - Developed as an alternative to reel-to-reel tape so visually impaired individuals could use books on tape more easily
  - Engineers didn't think average user would buy it because of inferior audio quality
- Text readers, voice recognition technology
- Etc.

Designing for Disabilities

- Visual impairments
- Hearing impairments
- Motor impairments
- Disabilities associated with aging

Visual Impairments

- Color blindness
  - 8-12% of European males have red-green color blindness
  - Other forms of color blindness
    - Green-yellow-red (deuteranopia)
    - Decreased sensitivity to red (protanomaly)
    - Decreased sensitivity to green (deuteranomaly)
- Near/far sightedness
- Decreased sensitivity to contrast, light levels
- Legal blindness
- Many others

Visual Impairments

- Shift to GUIs was extremely problematic for those with visual impairments. Why?
- Prior to GUIs, interfaces were text based
  - Relatively easy to create screen readers, Braille output
  - Primary mode of input was keyboard
- GUIs break these conventions
  - Information represented in many ways
  - Even if it is text, locating text to read not trivial
  - Pointing devices important for interaction in a GUI
- GUIs require additional “hooks” to support those with visual impairments

Visual Designs Guidelines

- Use principles of perceptual organization (e.g., Gestalt principles)
  - Helps aging adults navigate information structure
- Don't encode information using hues alone
  - Color-blind, aging adults may not be able to distinguish them
- Don't encode information using contrast
- Avoid small targets (e.g., icons) and fonts
- Present information using high contrast
- Use system-wide fonts, if possible
- Don't hardcode layouts and font sizes

Hearing Impairment

- Partial or complete loss of ability to hear
- Impact on graphical user interfaces felt less than visual impairments

Motor Impairments

- Use larger controls with more space between them.
- Allow alternate input choices
  - Keyboard only
  - Alternative pointing devices
  - Voice control

Motor Impairments Research

- The Angle Mouse is a pointing facilitation technique that runs quietly in the background and improves the efficiency and ease of mouse pointing, especially for people with motor impairments. The Angle Mouse is a target-agnostic pointing facilitation technique that works by continually adjusting the control-display (C-D) gain based on how coherent (straight) or divergent (angular) the mouse movement is. When the mouse moves straight, the gain is kept high, but when the mouse corrects abruptly, often near targets, the gain is dropped, making targets bigger in motor-space.
- Video @ dub

Age-Related Disabilities

- Decreased sensitivity to light
- Problems with low levels of illumination
- Reduced ability to distinguish colors, especially in short wave lengths (blue, green)
- Decreased contrast sensitivity
- Glare becomes more problematic
- Visual search is harder, takes longer
- Pattern recognition more difficult
- Tracking and processing moving targets harder
- Reduced spatial abilities

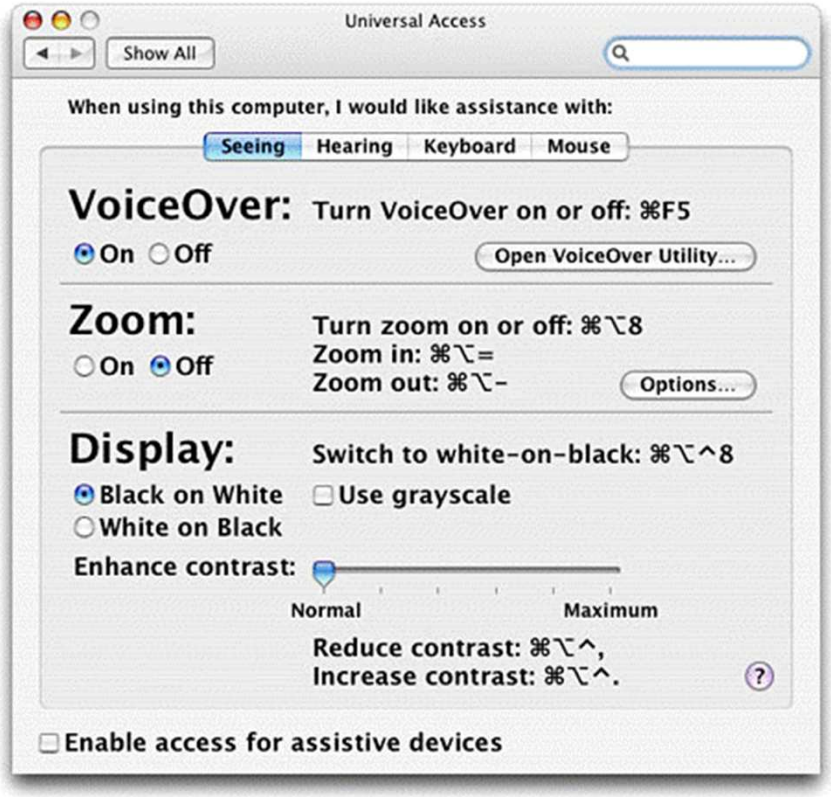
Source: Czaja, in Handbook of Human-Computer Interaction, 1997.

Tools and Techniques

- Designing to accommodate those with disabilities often termed “Universal Access”
- Modern operating systems have a lot of built-in support
  - Set of end-user tools/capabilities
  - Set of toolkits to help create an application that is more universally accessible

Operating System Support

- Typical support includes:
  - Ability to
    - control interface using only keyboard
    - magnify portions of screen
    - increase contrast of screen
    - increase cursor size
  - Built-in screen readers
- Fonts
  - People also adjust system-wide font size for minor visual impairments



Designing for Accessibility

- Basic ideas:
  - Ensure users can accomplish same task with multiple input devices
  - Create visual designs with expectation that users with visual impairments will be using your application
  - Test software under conditions of those with disabilities
  - Use accessibility API's/toolkits to encode information about interface and its use within the components themselves.

Accessibility Toolkits

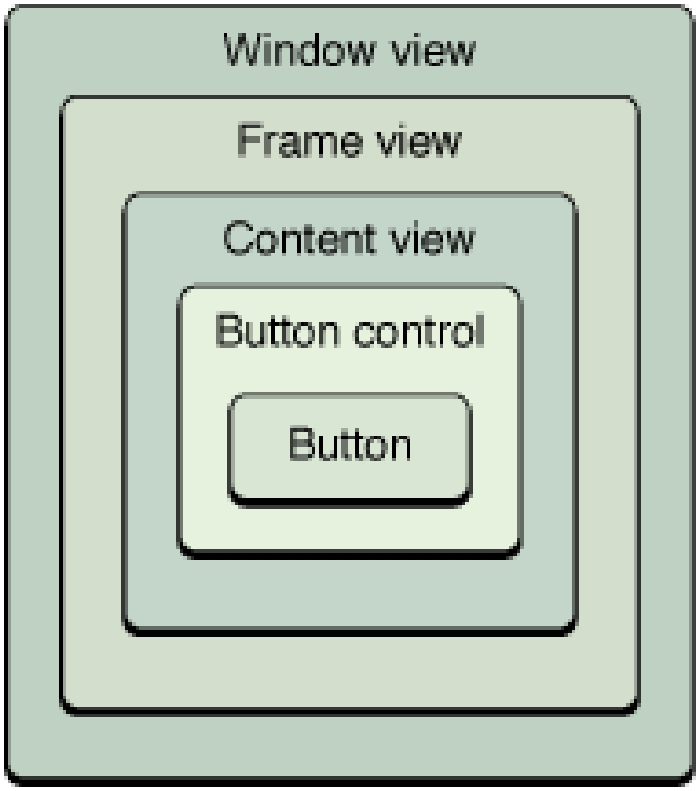
- GUI toolkits like Java, Cocoa, and those for MS Windows provide hooks to integrate with accessibility functions
- Toolkits provide features that allow you to provide additional information about your interface, individual components, and the functions they serve
  - This information allows accessibility software to expose your interface to users using different output modalities (e.g., screen readers)
  - Also allows accessibility software to control your software using alternative input methodologies (e.g., voice command)

Example: Mac OS X

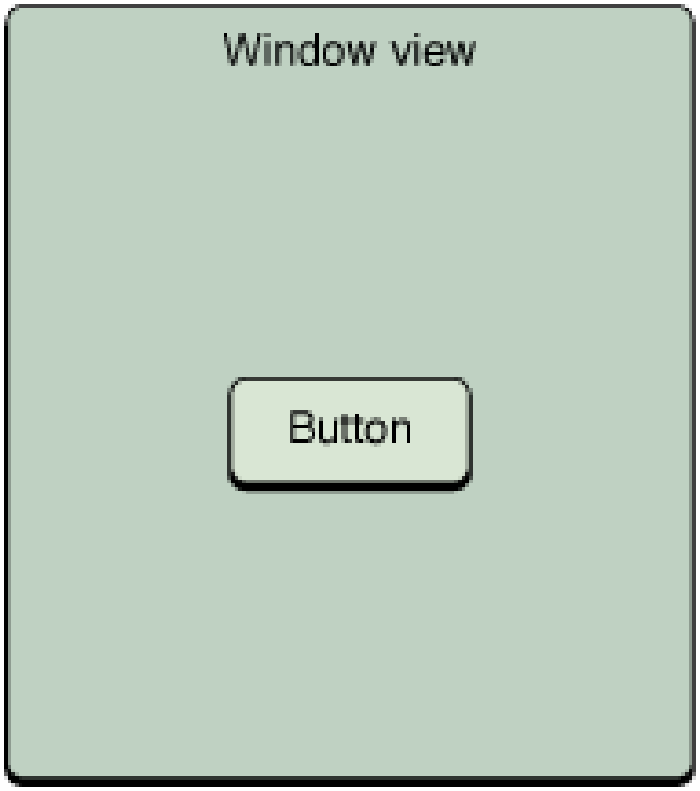
- Mac OS X's accessibility hooks allow developers to:
  - Provide a description of a component, its name, and its type
  - Indicate what interface objects are contained within an interface object
  - Receive accessibility events imitating input device events
    - An event that increments/decrements a control's value
    - A cancel event
    - A "return key" event
    - A simulated mouse click
    - Ability for user to switch control focus
  - Remove extraneous views from view hierarchy

View and Accessibility Hierarchy

Complete Hierarchy



Accessible Hierarchy



Source: https://developer.apple.com/library/mac/#documentation/Accessibility/Conceptual/AccessibilityMacOSX/OSXAXModel/OSXAXmodel.html

Designing for Input

- Users may not have ability to use a keyboard or mouse well
  - Provide ability to manipulate interface using both input tools
- Ability to use only keyboard is essential
  - Enables keyboard-based navigation aids for those with visual impairments

Accessibility Testing

- Test your application out using conditions similar to those experienced by those with disabilities
- Use your application:
  - Blindfolded
  - When the screen is zoomed in
  - With large system fonts
  - With no sound
  - With high contrast output
  - With only a keyboard
  - With only a mouse
  - With a screen reader
  - In black and white, and reversed
  - Try with sunglasses
  - Try with blinders on

Accessibility Testing

- Under testing conditions, consider:
  - How easy is it to navigate the application?
  - How is interaction flow affected?
  - What effects are there on efficiency?
  - Were layouts maintained correctly?

Resources

- Trace Center, University of Wisconsin
  - http://trace.wisc.edu/
- W3C's website accessibility
  - http://www.w3.org/WAI/
- Apple
  - http://developer.apple.com/library/mac/#documentation/Accessibility/Conceptual/AccessibilityMacOSX/OSXAXIntro/OSXAXintro.html