Universal Usability (Accessibility)

Ethical, good business, the law
Topics

- Universal usability and software ethics
- Visually impaired
- Deaf and hard of hearing
- Dexterity and mobility impairments
- Section 508 – the law
Universal Usability – a Case of Software Ethics

“Universal usability can be defined as having more than 90% of all households as successful users of information and communications services at least once a week.”

-Ben Schneiderman

“In a fair society, all individuals would have equal opportunity to participate in, or benefit from, the use of computer resources regardless of race, sex, religion, age, disability, national origin or other such similar factors.”

—ACM Code of Ethics
Universal Usability for the Web

“The power of the Web is in its universality. Access by everyone regardless of disability is an essential aspect.”

Tim Berners-Lee, W3C Director and inventor of the World Wide Web

The UN Convention on the Rights of Persons with Disabilities recognizes access to information and communications technologies, including the Web, as a basic human right.
Accessibility – Accommodate Abilities

- **Ability** – (Oxford dictionary): “Possession of the means or skill to do something” …
- Therefore, **disability** means being unable to do something
  - Something one **experiences** rather than something someone has or is
  - A more **positive** view
- So everyone **experiences disabilities** in some circumstances
  - E.g., situational in the environment

Ability Based Design, Wobbrock, Gajos, Kane, Vanderheiden, CACM 6/18, P. 62
## Situational Factors That Impact Ability

<table>
<thead>
<tr>
<th>Factor</th>
<th>Impact</th>
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<tbody>
<tr>
<td>Vibration</td>
<td>Cold temperatures</td>
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<tr>
<td>Divided attention</td>
<td>Impeding clothing (such as gloves)</td>
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<tr>
<td>Distraction</td>
<td>Encumbering baggage</td>
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<tr>
<td>Diverted gaze</td>
<td>Rainwater</td>
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<tr>
<td>Device out-of-view</td>
<td>Light levels (such as darkness and glare)</td>
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<td>Intervening objects</td>
<td>Ambient noise</td>
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<tr>
<td>Bodily motion (such as walking)</td>
<td>Social behaviors (such as interruptions)</td>
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<tr>
<td>Vehicular motion</td>
<td>Multitasking</td>
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<tr>
<td>Uneven terrain</td>
<td>Stress</td>
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<tr>
<td>Physical obstacles</td>
<td>Fatigue</td>
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<tr>
<td>Awkward postures or grips</td>
<td>Haste</td>
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<tr>
<td>Occupied hands</td>
<td>Intoxication</td>
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Ability Based Design, Wobbrock, Gajos, Kane, Vanderheiden, CACM 6/18, P. 62
Design Challenges

User Diversity

Skills
Computer newbie to hacker

Knowledge
Domain novice to expert

Culture
Western, Eastern, developing, ...

Personality
Introvert versus extrovert
Thinking vs. feeling
Risk aversion
Locus of control
Planful vs. playful

Disabilities
Visual, auditory, motor, cognitive

Disabling conditions
Mobility, injury, noise, sunlight

Income
Impoverished to wealthy

Literacy
Fluent to illiterate
Multiple languages

Age
Gender
Race
Ethnicity
National Origin

Technology variety and velocity of change; the **digital divide**

http://www.internetlivestats.com/internet-users/
Constraints, Solutions, Innovation

- **User diversity**
  - Profile sub-categories of users to understand diverse needs; e.g. kids versus seniors
  - Segment and accessorize the design accordingly
    - E.g., provide baseline and accelerated options, auto localization, disability accessibility

- **Technology variety**
  - Innovate to exploit new technology but ....
  - Make interfaces more adaptable and malleable
    - E.g., use plug-ins, sense screen size and other device capabilities, factor network performance

Try Windows – Control Panel -> Ease of Access Center
# Ability Based Design Guidelines

<table>
<thead>
<tr>
<th>General design principles and guidelines, design thinking still apply</th>
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<tbody>
<tr>
<td><strong>Activity centered</strong> – focus on actions that apply to everyone</td>
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<tr>
<td><strong>Adaptable</strong> – configuration and usage patterns, user in control</td>
</tr>
<tr>
<td>Avoid making <strong>design decisions</strong> based on assumptions of your abilities or the average user</td>
</tr>
<tr>
<td>Avoid lowest common denominator design – less useful to mainstream users, limits innovation</td>
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<tr>
<td>Perceptible information</td>
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<tr>
<td>Error prevention and tolerance</td>
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<tr>
<td>Low physical effort</td>
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<tr>
<td>Size and space for approach and use</td>
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<tr>
<td>Evolutionary learning via help and tutorials</td>
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<tr>
<td>Be conscious of the “stigma problem” – user sensitivity to their condition</td>
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</table>
W3C Accessibility Design Guidelines

- Web Content Accessibility Guidelines (WCAG)
  http://www.w3.org/WAI/intro/wcag
  - “explain how to make web content more accessible to people with disabilities”; principles …
  - **Perceivable** objects and content
  - **Operable** objects and navigation
  - **Understandable** content and interactive operation
  - **Robust** – reliably interpretable by assistive technologies

- Accessible Rich Internet Applications (ARIA)
  http://www.w3.org/WAI/intro/aria
  - Guidelines for how to make dynamic web app functionality available to assistive technologies
Accessible Web Design Approaches

- Alternate Text
- Table Headings
- Forms
- Meaningful Link Text
- Captions and Transcripts
- Other File Formats
- Using Headings for Semantic Structure

- Keyboard & Navigation
- Never Rely on Color-Coding Only
- Readability Level of Text
- Cognitive Disabilities
- Conforming to Standards
- Site Maps, Site Search
Evaluate Your Project

- How well does it meet universal usability needs?
- Evaluate your design using the “Web Accessibility“ guidelines as a checklist.
- How would you need to change the design to improve it?
- Document your findings and submit to the dropbox “Web Accessibility” (team submission)
Discussion of Physical Accessibility Situations

- Age
- Visually impaired
- Deaf and hard of hearing
- Dexterity and mobility impairments
Age and App Design

- **Kids**
  - May be non-readers, limited interaction skills
  - Large targets and fonts, bright colors

- **Teens**
  - Tech savvy but ... may have lower reading skills, unsophisticated search skills, short attention span and patience
  - Simple designs, cool graphics, legible but limited text, interactive expression

- **Seniors**
  - Vision, mobility, computing mental models/experience
  - Larger buttons and fonts, good cognitive and physical affordances
Visually Impaired

- Visual impairments - **low vision, color blindness, and total blindness**
  - Tunnel vision, cataracts, peripheral visual field restrictions and loss of visual acuity.
  - Some visual impairments may cause difficulty seeing in low light levels, problems judging speed and distance, or painful irritation in bright light.
  - Only about 4% of people who have visual impairments are totally blind.
Visually Impaired

- Research shows that **most partially sighted people are able to read clear large print comfortably**.
  - Large print size - 14 point or above
  - So a simple way to increase accessibility to the visually impaired.

- When **print is not suitable, Braille or voice** is an option.
  - The actual number of fluent **Braille users** is small (less than **10% of the blind**)
  - But it is a useful medium and can also be used by deaf blind people.
Visually Impaired: Assistive Technology

- **Screen enlargers/magnifiers**
- **Screen readers** are software programs that present graphics and text as speech.
- **Talking / large print word processors**
- **Speech/Voice recognition** systems to give commands and enter data using voice.
- **Refreshable Braille displays** provide Braille output of information represented on the computer screen one line at a time.
- **Braille embossers** transfer computer generated text into embossed Braille output.
Visually Impaired: Assistive Technology

Screen enlarger  Braille display  Braille embosser
Deaf and Hard of Hearing

- Hearing difficulties range **from slight hearing loss to deafness**
- Hearing impaired might be able to **hear some sound**, but might **not** be able to **distinguish words**
- People **born profoundly deaf** may have difficulty in **acquiring a clear understanding of spoken and written language**
- **Many hearing impaired people** can **lip read** to some extent
  - Requires concentration and is tiring over long periods.
  - More popular with people who lost hearing later in life, or who have some residual hearing.
- **Sign Language** is a common communication method

https://www.youtube.com/watch?v=33krnU_juFE
Deaf and Hard of Hearing

- **Hearing aids** are often used in addition to other forms of communication
  - Hearing aids amplify all sounds, including background noise, and may not be suitable in some circumstances

- Technology considerations:
  - **Communicate information visually**, e.g., …
    - Flash when beep occurs
    - Video sign language
  - **Sound amplification**
    - Adjust sound options and volume
  - Translate **speech to text**
  - Research – ASL to and from speech using gesture recognition technology based on machine learning
Dexterity and Mobility Impairments

- Difficult to use a standard keyboard, mouse, or other peripherals
- Individuals experience pain, discomfort, loss of feeling
- Individuals may also have a reduced range of physical movement or complete loss of physical capability

- In their fingers, hands, wrists, or arms,
- Difficulties / impairments can be caused by a wide range of common illnesses and accidents such as carpal tunnel, arthritis, stroke, cerebral palsy, Parkinson's disease, multiple sclerosis, loss of limbs or digits, and spinal cord injuries, among others
- Can be stable, degenerative or intermittent, depending on the cause
- Manual dexterity impairments result in the loss of fine control of movement, affecting typing and the use of the mouse/peripherals
Dexterity Impairments: Assistive Technology

- **Keyboards may be altered** to make typing with the fingers easier, or can be adapted to be used by a (head) pointer.

- **Voice/Speech recognition systems**
  - Allow people to give commands and enter data using their voice.

- **On-screen keyboard programs**
  - Provide an image of a standard or modified keyboard on the computer screen.
  - The user selects the keys with a mouse, touch screen, trackball, joystick, switch, or electronic pointing device.

- **Keyboard filters**
  - Include typing aids, such as word prediction utilities.
  - These products reduce the required number of keystrokes.

- **Touch screens**
  - Devices placed on the computer monitor (or built into it) that allow direct selection or activation of the computer by touching the screen.

- **Alternative input devices**
  - Including alternative keyboards, electronic pointing devices, sip-and-puff systems, wands and sticks, joysticks and trackballs.
A Word About Ergonomics

“Ergonomics is the study of designing equipment and devices that fit the human body, its movements, and its cognitive abilities … two goals of health and productivity… relevant in the design of such things as safe furniture and easy-to-use interfaces”
Section 508

- Section 508 is a 1998 amendment to the United States Workforce Rehabilitation Act of 1973
- Mandates that all electronic and information technology developed, procured, maintained, or used by the federal government be accessible to people with disabilities
- Good accessibility design guidelines in general
- Latest version (01/2017) incorporates by reference the W3C WCAG 2.0 standard
Section 508

- The most applicable standards for electronic content are:
  - 1194.21 **Software applications and operating systems.**
  - 1194.22 **Web-based** intranet and internet information and applications. 16 rules.
  - 1194.24 Video and multimedia products.

- **Section 508 validators** available; e.g.,
  - WAVE
  - SortSite
<table>
<thead>
<tr>
<th>Original Section 508 Mandates</th>
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<tbody>
<tr>
<td>Use a keyboard for text interaction</td>
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<tr>
<td>Accessibility features must always be available</td>
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<tr>
<td>Provide indication of current screen focus</td>
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<tr>
<td>Sufficient information about user interface element operation should be available to assistive technology</td>
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<tr>
<td>Image representation of UI elements should also have explanatory text</td>
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<tr>
<td>The use of images should be consistent</td>
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<tr>
<td>Minimum text information should include content, input cursor location, attributes</td>
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<tr>
<td>Don't override individual display preferences</td>
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<tr>
<td>Information displayed as animation must also be available without animation</td>
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<tr>
<td>Color should not be the only means of communicating information</td>
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<tr>
<td>No flash or blink frequency greater than 2 Hz and lower than 55 Hz</td>
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<tr>
<td>Form interaction should support accessibility methods</td>
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Experience It

• Browse the list of accessibility related links under Accessibility Resources in myCourses
• Try the distraction and dyslexia simulations
• What did you learn?

• Note: this is just a sampling of web accessibility design resources
References

- See myCourses for some specific resources
- Ben Schneiderman, “Universal Usability”, CACM, May 2000
- Some overview material from:
  - http://www.shef.ac.uk/disability/adtrain/8_support.html
- Read about Learning Disability material at:
- US Government usability site: