Universal Design

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Agenda

- Universal design notions

- Overview of Assistive Technology issues
  - Different types of limitations

- Non-speech audio

- HW 4 discuss

Universal Design

- Design for inclusion

- Anyone, anywhere, anyhow

- If you design for everyone, then:
  - More usable by "average" users
  - Usable (or manageable) by "non-average" users

Examples

- I'm having trouble reading smaller print

- Lefties have trouble with scissors

- Someone with arthritis can't open a bottle

- Chair that a child can't sit in properly

- ...

Different Environments

- "Non-average" can mean different environments, context, locations, modalities

- May require different interaction methods, rules, models

Different Users

- Not just about "special" populations like those with particular physical or perceptual challenges

- Also about users not part of the original specification, new users, late adopters

Users with Disabilities

- Visual impairment
  - Not just about blindness, from age, color issues, limitations
- Hearing impairment
  - From birth, environment, noise
- Physical impairment
  - Wide range, unavailable vs. limited, injury
- Speech impairment
  - Permanent, temporary, noise
- Dyslexia
- Autism

… plus …

- Age groups
  - Older people e.g. disability aids, memory aids, communication tools to prevent social isolation
  - Children e.g. appropriate input/output devices, involvement in design process

- Cultural differences
  - Influence of nationality, generation, gender, race, sexuality, class, religion, political persuasion etc. on interpretation of interface features
  - e.g. interpretation and acceptability of language, cultural symbols, gesture and colour

Principles of Universal Design

- Equitable use

- Flexibility in use

- Simple and intuitive to use

- Provide perceptible information

- Tolerance for error

- Low physical effort

- Size and space for approach and use

Discuss

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

Comments? Where have we seen some of these?

Design Processes

- Take a look around

- See things in new ways

Example

Example

Turn on with up or down push?

If turn on by pushing down, can be accidentally turned on by falling objects

Happened at 1995 Kobe Japan earthquake, wasting lots of water

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"Designing for Diversity"

- Requires really understanding the way diverse types of users interact with a system
  - (examples later)

- Imagine how your interface is "translated"
  - Different language
  - Modality (screen reader, touch, Braille)
  - Cognitive filter
  - Etc.

Terminology

- Ability

- Impairment

- Disability

- Handicap

- Policies, Laws, Regulations, Guidelines

- People, persons with…

- Populations vs categories of abilities

Multi-Sensory Systems

- More than one sensory channel in interaction
    - e.g. sounds, text, hypertext, animation, video, gestures, vision

- Used in a range of applications:
    - Particularly good for users with special needs, and virtual reality

- Will cover
    - general terminology
    - speech
    - non-speech sounds
    - handwriting

- Considering applications as well as principles

Usable Senses

The 5 senses (sight, sound, touch, taste and smell) are used by us every day
- each is important on its own
- together, they provide a fuller interaction with the natural world

Computers rarely offer such a rich interaction

Can we use all the available senses?
- ideally, yes
- practically – no

We can use   • sight • sound • touch (sometimes)

We cannot (yet) use   • taste • smell

Multi-modal vs. Multi-media

- ## Multi-modal systems
  - Use more than one sense (or mode) of interaction

    e.g. visual and aural senses: a text processor may speak the words as well as echoing them to the screen

- ## Multi-media systems
  - Use a number of different media to communicate information

    e.g. a computer-based teaching system:may use video, animation, text and still images: different media all using the visual mode of interaction; may also use sounds, both speech and non-speech: two more media, now using a different mode

Visual Impairments

- How to deal with GUIs?
  - Keyboard vs. mouse use
- How do they know it is there?
  - "Talking Braille"
  - ATM phone jack
- Sound output
  - Screen readers, rates, voices, quality
  - Non-speech audio
  - Equipment issues
- Math, graphs
  - Equations, graphs, tables

Visual Impairments, cont'd

- What about these?...
  - Equitable use
  - Flexibility in use
  - Simple and intuitive to use
  - Provide perceptible information
  - Tolerance for error
  - Low physical effort
  - Size and space for approach and use

Hearing Impairment

- Does access for the blind mean no access for the deaf?

- Consider how truly multimodal interfaces can work for everyone
  - e.g., Sonification Sandbox

Physical Impairments

- A wide variety of "handicaps"
  - Tremor, dexterity, grip, mobility, balance, strength

- Solutions need to vary, too
  - Eyegaze control
  - Blinks
  - Text entry like EdgeWrite
  - Brain-computer interfaces

Aging

- All of the possible difficulties arise:
  - Perceptual, cognitive, motor

- There are fewer and fewer "low tech" alternatives; forcing seniors into tech

- Designers often have little experience in the realities of the older (or handicapped or deaf or...)

Audio

- Let's return to examining non-speech audio
  - Often useful for visually impaired users
  - Very useful for others too!

Non-Speech Sounds

boings, bangs, squeaks, clicks etc.

- Commonly used for warnings and alarms

- Evidence to show they are useful
  - Fewer typing mistakes with key clicks
  - Video games harder without sound

- Language/culture independent, unlike speech

Non-Speech Sounds: Useful?

- Dual mode displays:
  - information presented along two different sensory channels
  - redundant presentation of information
  - resolution of ambiguity in one mode through information in another
- Sound good for
  - transient information
  - background status information

e.g. Sound can be used as a redundant mode in the Apple Macintosh; almost any user action (file selection, window active, disk insert, search error, copy complete, etc.) can have a different sound associated with it.

Uses of Non-Speech Audio

- Beeps 'n' Bops

- Peripheral Awareness

- Sonification

- Audio Interfaces, Audio Menus

- Navigation

Beeps 'n' Bops

- Warnings, alerts, status messages
  - Status indicators
  - Error messages
  - Alarms

- Will they be heard, identified, and understood?

Peripheral Awareness

- Using sound to communicate information about the environment

- Compare to information visualization
  - Web server traffic
  - Weather outside
  - Traffic
  - Activity level of colleagues
  - Status of resources (printers, etc.)

Audio Aura

- Audio Aura
  - Mynatt, Back, & Want
  - Xerox PARC, 1997
  - "The goal of Audio Aura is to provide serendipitous information, via background auditory cues, that is tied to people's physical actions in the workplace."

StockScape

- StockScape
  - Walker & B. Mauney
  - Georgia Tech, 2004
  - Continuous soundscape that maps stock price <u>change</u> onto sounds. Deviation from baseline means more sounds. Change up means adding animals; changes down means adding rain, thunder.

Sonification

- "Auditory display of quantitative information"

- Compare to visualization
  - Weather data
  - Stock market data
  - Election results
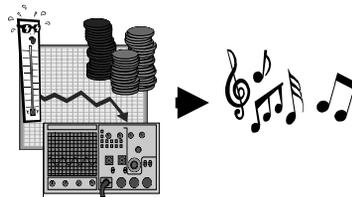
Sonification Design Issues

- Mapping
  - Data dimension --> Display
    - Dollars --> pitch (or distance from x-axis)

- Polarity
  - Increasing pitch = increasing or decreasing $?

- Scaling
  - Double the pitch = double the $?

- Context
  - Equivalent to tick marks, axes, trend lines

- Interaction techniques

Audio Interfaces & Menus

- Audio-only or audio-enhanced interfaces

- IVRs (phone-based, like airlines)

- Complete operating systems (Curo)

- Menus

- Earcons, auditory icons, spearcons

Auditory Icons

- Use natural sounds to represent different types of object or action

- Natural sounds have associated semantics which can be mapped onto similar meanings in the interaction
  - e.g. throwing something away
    - ~ the sound of smashing glass

- Problem: not all things have associated meanings

- Additional information can also be presented:
  - Muffled sounds if object is obscured or action is in the background
 - Use of stereo allows positional information to be added

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SonicFinder for the Macintosh

- Items and actions on the desktop have associated sounds

- Folders have a papery noise

- Moving files – dragging sound

- Copying – a problem …
  - sound of a liquid being poured into a receptacle
  - rising pitch indicates the progress of the copy

- Big files have louder sound than smaller ones

Earcons

- Synthetic sounds used to convey information

- Structured combinations of notes (motives) represent actions and objects

- Motives combined to provide rich information
  - compound earcons
  - multiple motives combined to make one more complicated earcon

Create	File	Create file
note, getting louder	high-low note	create icon followed by file icon

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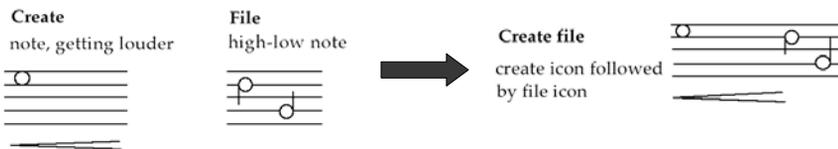
Earcons (ctd)

- Family earcons

  similar types of earcons represent similar classes of action or similar objects: the family of "errors" would contain syntax and operating system errors

- Earcons easily grouped and refined due to compositional and hierarchical nature

- Harder to associate with the interface task since there is no natural mapping

Navigation

- Getting around, for those who cannot look or cannot see
    - Persons with visual impairments
    - Military applications

Resources

- http://sonify.psych.gatech.edu/~walkerb/classes/assisttech/index.html
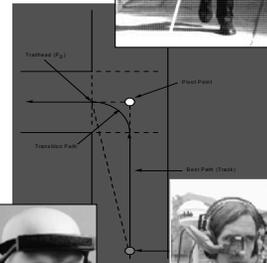
- www.webaim.org
- http://www.webaim.org/info/asdvideo/asd.htm
- www.w3.org
- http://www.metroplexvoice.com/demos.htm
- http://www.catea.org/

HW 4

- Observing interactions at the ATM

Upcoming

- WWW design and evaluation

- Information visualization

- Embodied agents