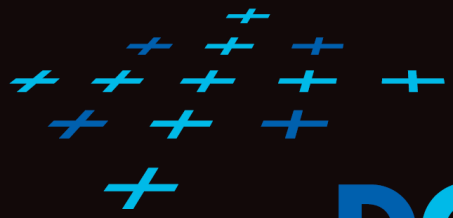

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DEPARTMENT OF COMPUTER GRAPHICS AND INTERACTION

AST
LECTURE 5

HOW TO

(MAKE USER INTERFACES SUITABLE FOR IMPAIRED USERS) – SOME EXAMPLES

UI guidelines that help with accessibility

- Provide undo
  - Disabled may be more prone to do things that need undoing
- Allow increasing font and image size, and font family
  - Also allow for zooming in / magnifying
- Enable of return of settings to defaults
  - Needed if fonts have been set to small
- Reduce memory load
  - Allow taking notes, multiple clipboards, etc.
  - Recognition, not recall

UI guidelines for accessibility - 2

- Provide easy keyboard access to everything
  - Some users have trouble with the mouse
  - Ensure the user can tab around all elements in a logical order
  - Provide a way around the need to hold down multiple keys at once
  - For keyboard shortcuts, given precedence to keys where ‘control/command’ and a letter key can be held together without too much reaching
  - Ensure that there is always an alternative to drag and drop
  - Use ESC uniformly to get out of any mode

UI guidelines for accessibility - 3

- Don’t make mouse targets too small
  - Allow a preference to make them larger
  - E.g. places to drag in a graphics application
- Provide descriptive text for all visual components
  - E.g. ‘alt’ html text in an image
  - Provide an option to hide the graphics entirely
- Test call colored elements for accessibility to the colorblind

UI guidelines for accessibility - 4

- Allow colors to be changed through a preferences pane
- Increase colour contrast beyond the bare minimum needed for sighted people
- Assume the user will hear no sounds
  - Don’t use audio as the sole communication method
- Allow users to configure the volume and frequencies of sounds

UI guidelines for accessibility - 5

- Use animation and movement with care
  - Flashing and blinking or repeated animation can bring on seizures or migraines
    - 2-55 Hz is the problem range
    - If some form of blink is needed, do it in a small area only
    - Other problem movement
      - ‘shaky camera’ videos
      - Certain PowerPoint like ‘transitions’
    - Allow all movement to be turned off
      - Provide alternatives (e.g. text)

UI guidelines for accessibility - 6

- Don’t rely on timing
  - Automated slide slows
    - Some people read too slowly
  - Timeouts after no interaction detected
    - Some people write too slowly
  - Automated scrolling when dragging
    - Extremely difficulty for some people to control

- Don’t rely on mousing over certain areas to get popup information

- Test your software for use with assistive devices

Assistive Technology solutions to physical impairment

- Stephen Hawking
  - Professor at Cambridge university
  - International icon for science and intelligence
  - One of the world's most recognizable disabled people
  - Has been suffering from ALS for three decades
  - Published a lot of papers and books

Stephen Hawkins Utilizing Assistive Technology

- 1970's
  - Dictating letters to a secretary
  - Gave seminars through an interpreter
- 1985
  - Could only communicate using his eyebrow
  - Equalizer software
    - Uses menus of word
- 1990's
  - He receives a copy of "EZ keys" software
  - Program is based on word prediction
  - Converts text to speech
  - Speeds up communication
  - A laptop and voice synthesizer was installed on his wheelchair
  - He is able to speak in seminars, write papers and books
    - "The only trouble is that it gives me an American accent !"

IMPORTANCE OF UNIVERSAL DESIGN

Designing for “average” users

Some of us are just a little more average than others

Age, disabilities, and situations make each of us unique…

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Remember that you are unique – Just like 300 million others

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15% of us have disabilities

American Community Survey, 2004

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5% of us have cognitive disabilities

American Community Survey, 2004

DCGI 4% of us have sensory disabilities

American Community Survey, 2004

9% of us have physical disabilities

American Community Survey, 2004

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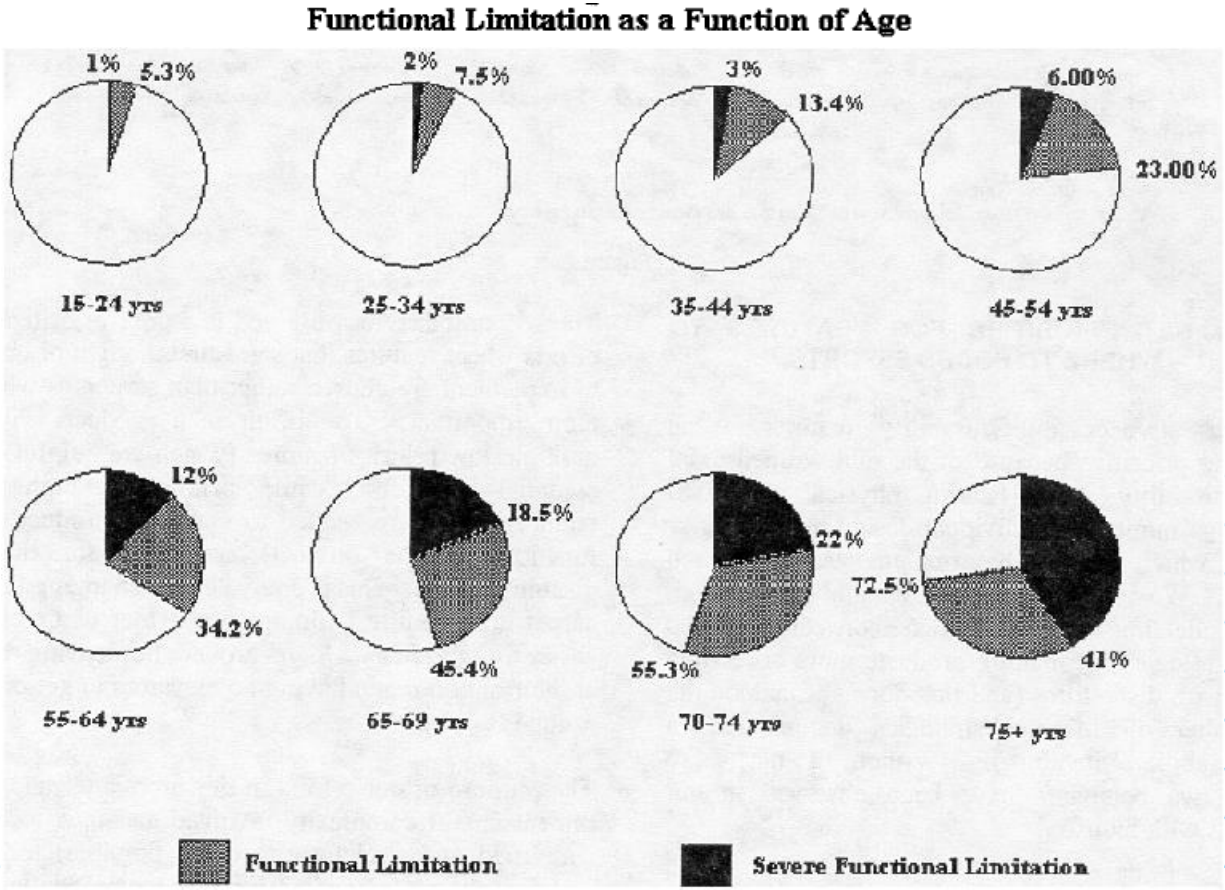
11% of us live with someone with a disability

Sooner or later we will all need it



Source: Bureau of the Census, Series P-70, #8
Survey: SIPP, 1984

What is universal design?

Universal Design is the design of all products and environments to be usable by people of all ages and abilities, to the greatest extent possible.

- Ronald L. Mace, 1991

Accessible vs. universal

- Accessible Design: for people with disabilities
- Universal Design: for everyone, *including* people with disabilities

USABILITY and UCD

The 7 Principles of Universal Design

1. Equitable Use
2. Flexibility in Use
3. Simple and Intuitive Use
4. Perceptible Information
5. Tolerance for Error
6. Low Physical Effort
7. Size and Space for Approach and Use

Usability for all ages and abilities:

The 7 Principles of Universal Design

Usability

What is Usability?

- Ease of learning
- Ease of use
- Ease of remembering
- Subjective satisfaction
- Efficiency of use
- Effectiveness of use

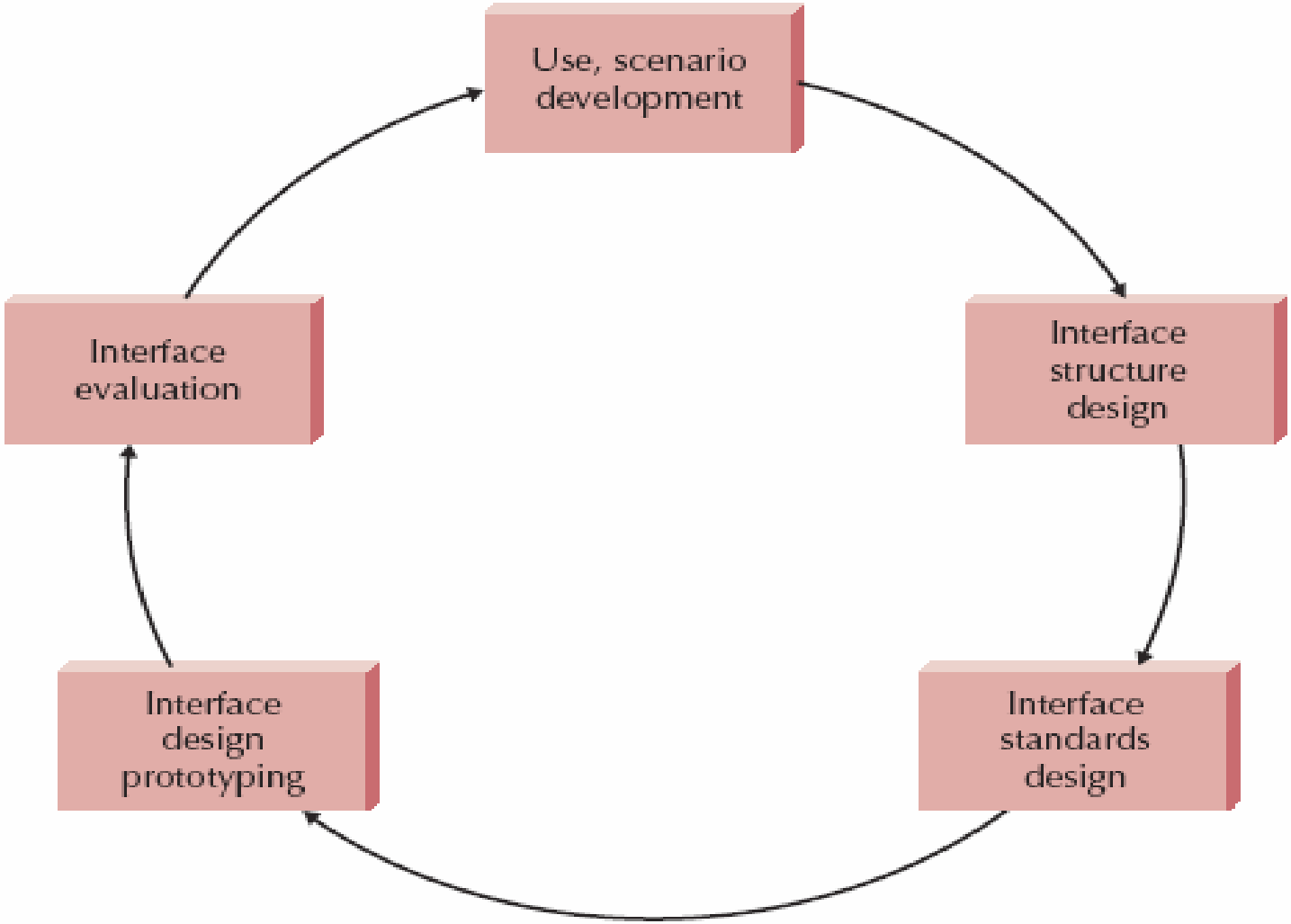
Usability Engineering

- Usability Engineering (UE):
  - Processes to build “Usability” into products
  - Various methods can be used throughout the design lifecycle
  - Methods can be incorporated into design process easily
  - Methods maintain focus on user throughout design

User Centered Design

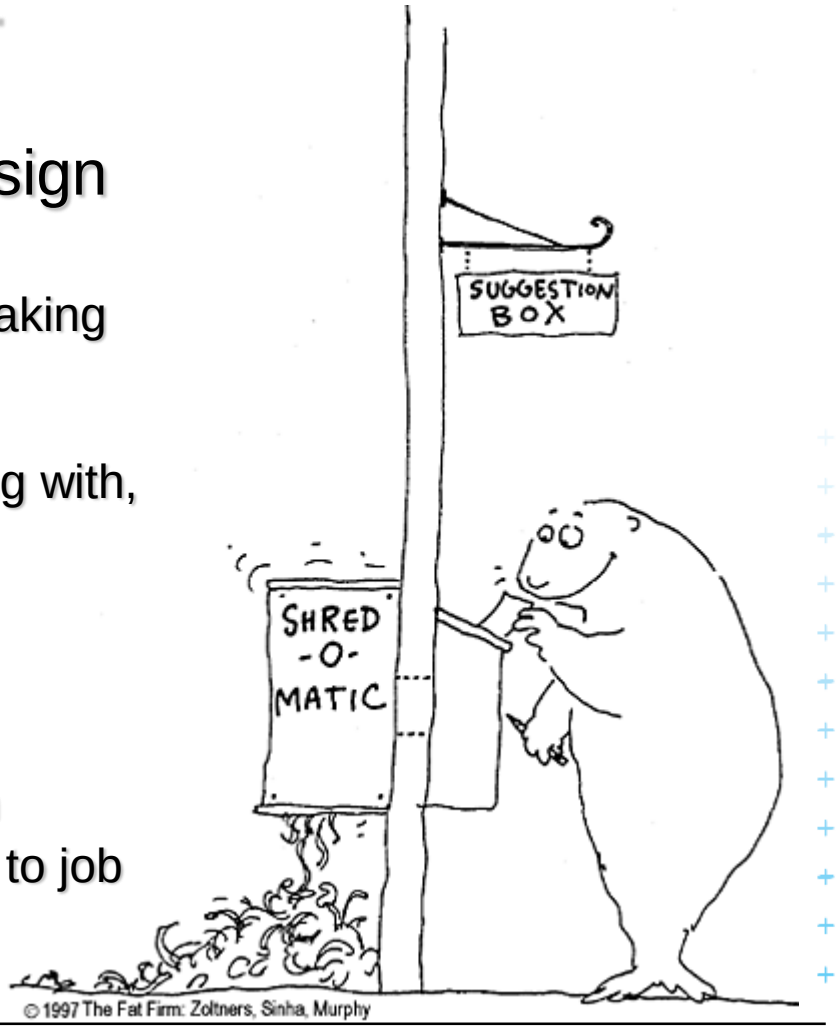
- UCD is a *dialog* between the customer and the designer
- Rules of thumb:
  - Get to know and understand the users.
  - Build an application, applying usability principles.
  - Test designs by observing users in a real work setting (environment and work load).

Usability Design Process



What is UCD?

- User-Centred Design is:
  - A process
  - Users engaged in the design process
    - Users having real decision making powers
    - Users having appropriate mechanism for communicating with, and negotiation with, the development team
  - A socio-technical design process
    - Containing *iterative* approach
    - Where consideration is given to job satisfaction



What is UCD?

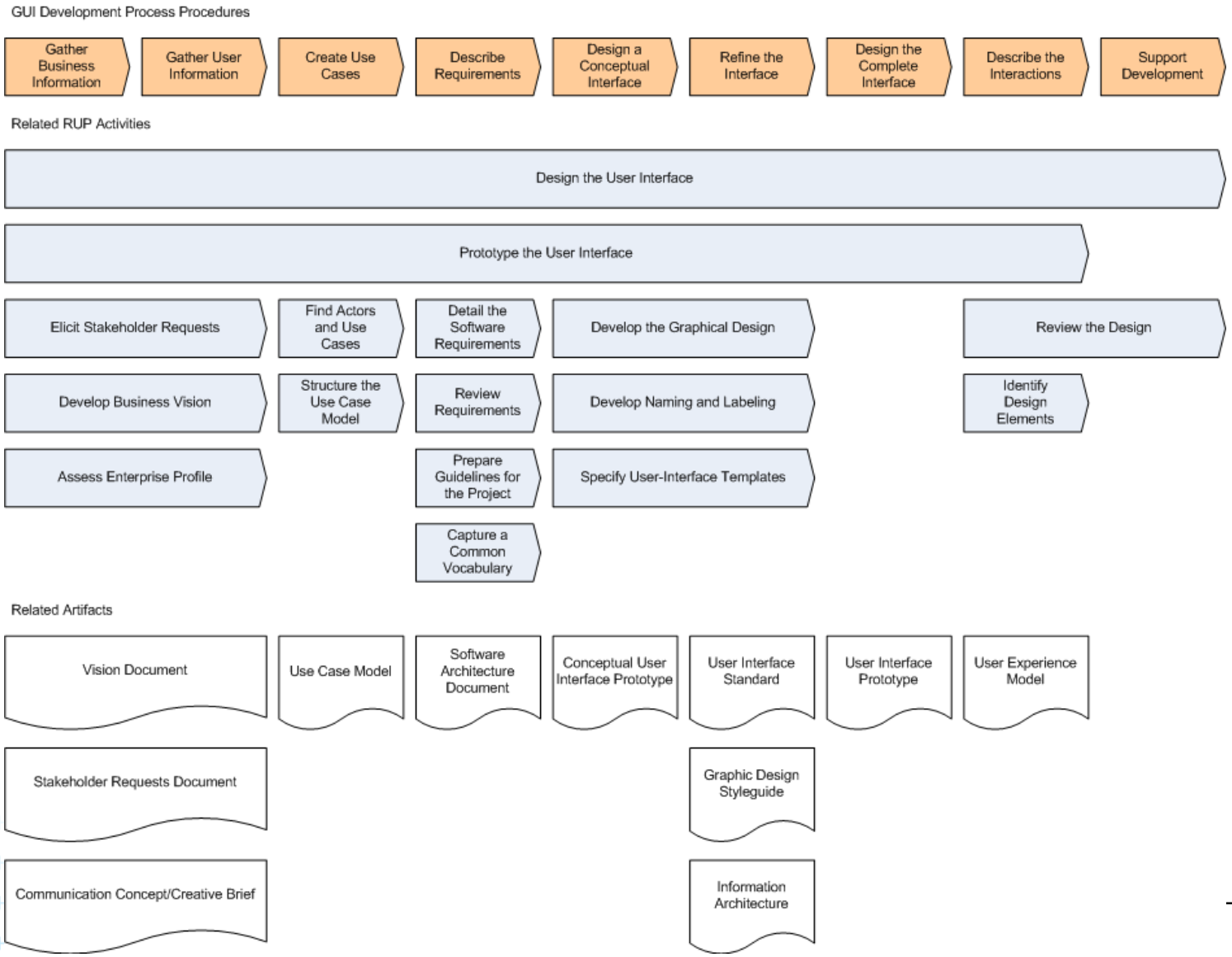
- Includes:
  - User needs assessment & requirements
  - **Development of style guide**
    - **Graphic, layout, information architecture, navigation model, interaction behaviour**
  - **Prototyping and user testing (iterative)**
  - Assisting development & implementation
  - Usability Testing

Developer watching videotape of usability test.

Benefits

- Reduced development time
  - Reduces later changes, reducing cost of future design
- Increased efficiency, effectiveness, and satisfaction of usage
  - Reduces task time
  - Fewer user errors
  - Less training and support documentation
  - Reduced staff turnover
- Happier project team ☺

Lifecycle


GUI Development Process Procedures
Gather Business Information
Gather User Information
Create Use Cases
Describe Requirements
Design a Conceptual Interface
Refine the Interface
Design the Complete Interface
Describe the Interactions
Support Development
Related RUP Activities
Design the User Interface
Prototype the User Interface
Elicit Stakeholder Requests
Find Actors and Use Cases
Detail the Software Requirements
Develop the Graphical Design
Review the Design
Develop Business Vision
Structure the Use Case Model
Review Requirements
Develop Naming and Labeling
Identify Design Elements
Assess Enterprise Profile
Prepare Guidelines for the Project
Specify User-Interface Templates
Capture a Common Vocabulary
Related Artifacts
Vision Document
Use Case Model
Software Architecture Document
Conceptual User Interface Prototype
User Interface Standard
User Interface Prototype
User Experience Model
Stakeholder Requests Document
Graphic Design Styleguide
Communication Concept/Creative Brief
Information Architecture

User Profile

- A general description of a user group for a specific interface.
- Includes:
  - Demographic characteristics
  - Education
  - Language
  - Computer Expertise
  - Domain Experience
  - Motivation
  - Expectations

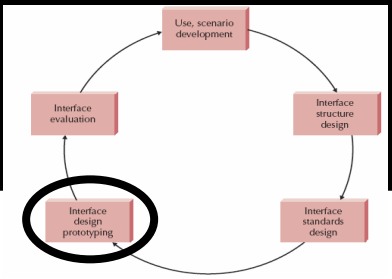
Personas

- Personas – A concrete characterization of a single user group through a synthesis of user, task, and environment profiles of that group.
  - Detailed example of the potential end-user that represents a specific target audience.

Kivio Users

	The researcher	The Sysadmin	The OSS developer	The CS student
				
Name	Alexander Weiß	Donald M. Berry	Kristian Larsson	Eric Neville
Age	30	30	26	24
Location	Germany	US	Sweden	France
Social Life	Alexander lives with his girl-friend in a flat in Hamburg.	Donald lives with his wife and 1-year old daughter in a house in Portland.	Kristian shares an apartment with two friends in Stockholm. His girl-friend lives in Uppsala. They see each other every weekend.	Eric lives with his parents in a small city close to Lyon. He visits the university there. Often, he stays at his friend's apartment for playing PC games and programming.
Work Life	He works at centre for environmental systems research and designs plans for replacable energies in a EU-funded project.	He is a lead system administrator in a huge network solutions company in Portland.	A software developer with a dayjob in a medium-sized software company. Works on KDE in his spare time.	He is a student of computer science. Besides university, he performs small programming jobs for people in his neighbourhood.

DCGI Creating a UI Prototype



- Low-fidelity prototypes are good!

  e.g.

  - Paper prototype
  - Visio/HTML/PPT/… prototype

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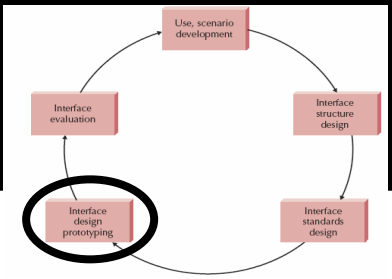
Example



Exercise – Part 1

- Design the web-site for your customer.
- Consider: What is the purpose of the web-site? Who are the users? What features and tools are needed in such a web-site?
  - Are these already documented as *requirements*?
  - Have you documented any *usability* requirements?
- Choose the look-and-feel and layout.
- Create a site map.

- You should have done this already. Right?

Accessible Design

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Accessible design - the design of entities that satisfy specific legal mandates, guidelines, or code requirements with the intent of providing accessibility to the entities for individuals with disabilities.

This definition focuses on the legal implications of the term.

Accessible design derives its legal meaning from:

- **Americans with Disabilities Act (ADA)**
- **Section 255 of the Telecommunication's Act of 1996**
- **Section 508 amendments to the Workforce Investment Act of 1998**

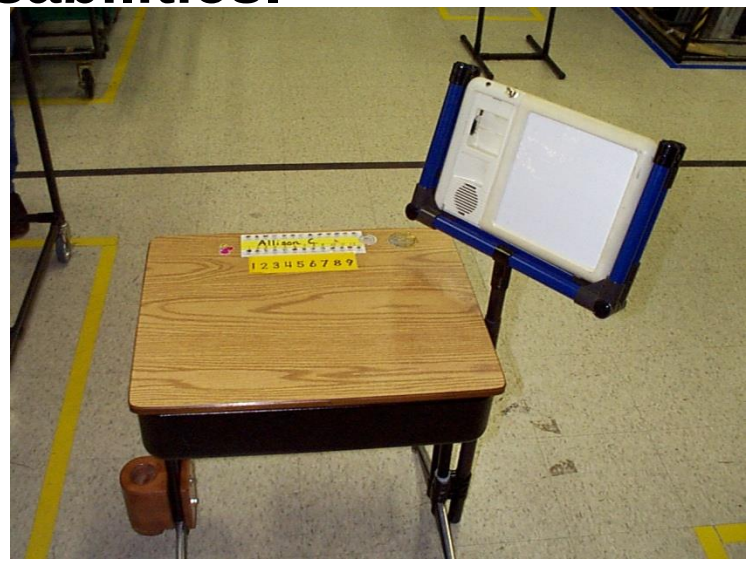
These laws also state that either

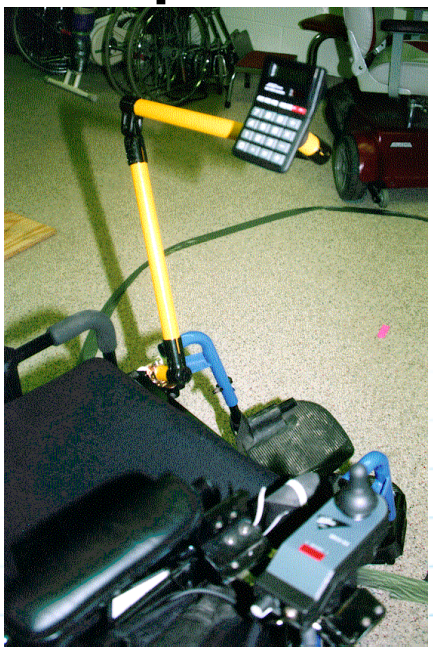
•products need to be compatible with assistive technology devices used by people with disabilities

or

•products are able to be modified so as to be rendered accessible

Note: systems may be designed so that they are not accessible, but with specific modifications be made accessible to individuals with specific disabilities.





Such modifications are termed *accommodations* and characterize the process of adaptable design.

More talk of potential conflict

Peter-Paul Koch

“The delicate balance between accessibility and usability needs more thought. At the moment I don't see any answers, only a few questions, one possible rule, and a potential danger. The rule is "Accessibility should not restrict usability”.

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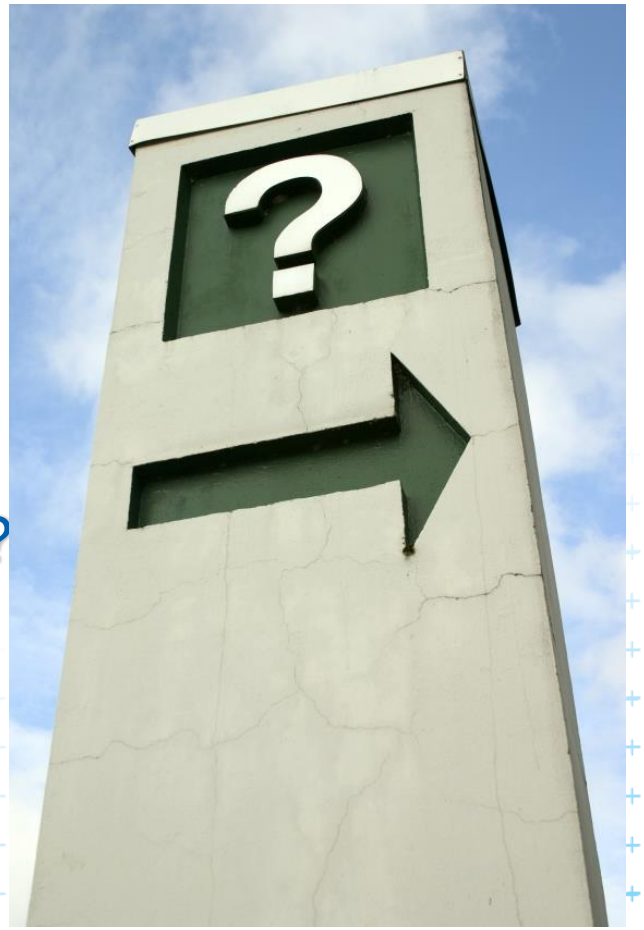
Common questions

- Are usability and accessibility compatible design approaches?
- Does accessibility improve usability for other users?
- Does usability improve accessibility?
- How does the relationship between accessibility and usability affect practitioners?



Some starting points for our discussion

- What is it?
  - What is accessibility?
  - What is usability?
  - How are they defined?
- How is it done?
  - What do practitioners in each field do?
  - What methods/techniques do they use?
- Common expressions of the relationship
- Return to our original questions

Definition of usability – from the guru

Usability is the measure of the quality of the user experience when interacting with something - whether a website, a traditional software application, or any other device the user can operate in some way or another.

Jakob Nielsen

Definition of usability – practitioner's view

The 5 Es of usability

- Effective
- Efficient
- Engaging
- Error tolerant
- Easy to learn

Whitney Quesenbery

Formal definition of usability

Usability is a measure of the effectiveness, efficiency and satisfaction with which *specified users* can achieve *specified goals* in a *particular environment*.

ISO 9421

Definition of accessibility – from the guru

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

Tim Berners-Lee
Founder of the web

Two key differences

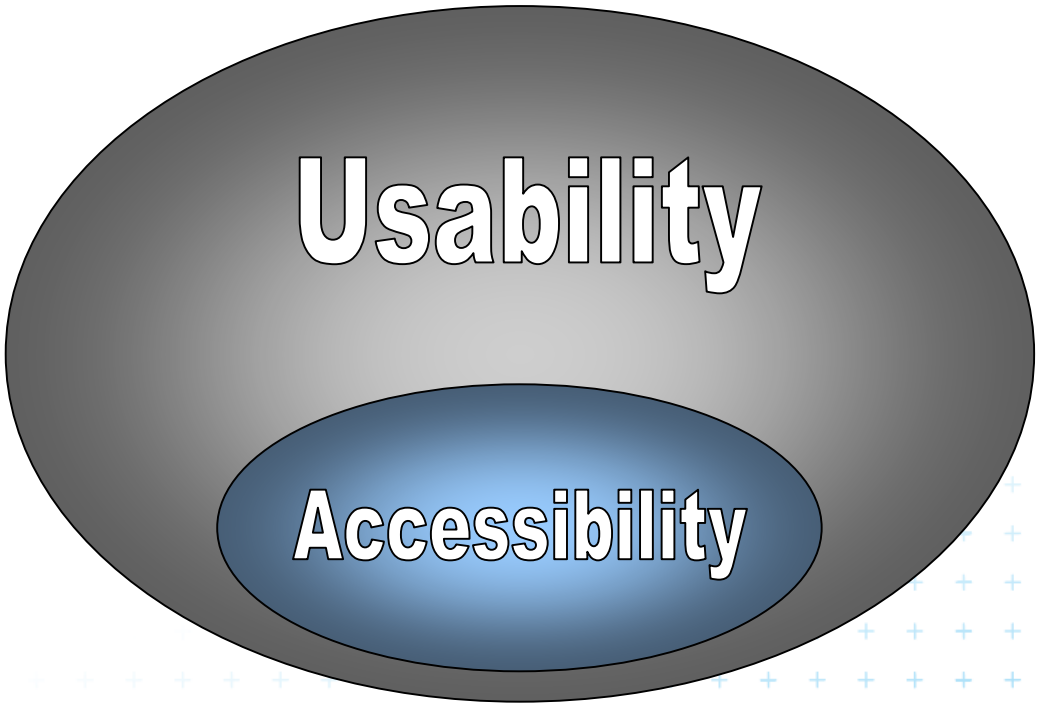
	Users	Design goals
Usability	**Varies each time**	**Improve user experience, ease of**
Accessibility	**Always the same**	**Remove barriers to access, equitable use**

Comparison based on methods

- Number of methods differ
- Methods are roughly equivalent
  - Conformance evaluation and standards inspection
  - User testing differences
- But all usability methods could be used in designing for people with disabilities

Common expressions of the relationship (1)

- One is a subset of the other



Does accessibility improve usability?

- In many cases, yes
- Examples:
  - Providing site maps
  - Clearly identifying the target of a link

Does usability improve accessibility?

- In many cases, yes
- Examples:
  - Writing concisely and in plain English
  - Clear and simple navigation

- VIDEA

Adaptable Design

Adaptable design - features are modifications made to the standard design for the purpose of making the design usable for an individual, as needed.

This definition focuses on modifications made to existing entities which make the entity accessible to people with disabilities.

- **Van conversion provides wheelchair accessibility for occupants.**

- **Vans are a standard, non- wheelchair accessible, design. After modifications, vans are wheelchair accessible.**

- **Van accommodation is not required or mandated by any law, code or guidelines; hence, it is not considered accessible design, but adaptable design.**

How adaptable design differs from accessible design:

- adaptable design is not mandated by laws
- adaptable design focuses on modifying an existing standard design

How adaptable design differs from universal design:

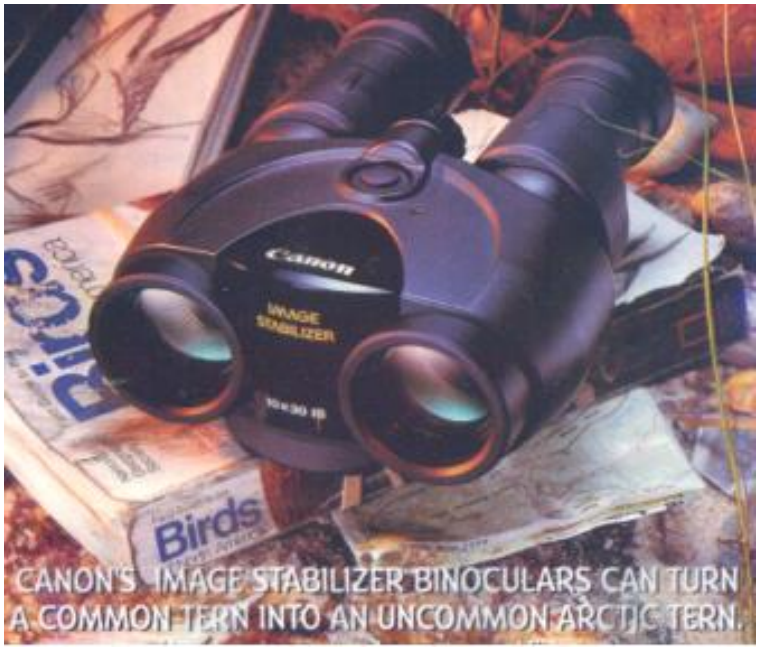
- universal design creates products and services that are accessible and usable without adaptations

- adaptable design focuses on modifying an existing standard design

- universal design occurs at the beginning of the design process

- adaptable design occurs after the design process is complete and the product has been produced

Image Stabilizing Binoculars provide the same means of use for all users.



Microcomputer technology stabilizes the image for :

- **people who are tired**
- **people with arthritis**
- **people with neuro-muscular disabilities**

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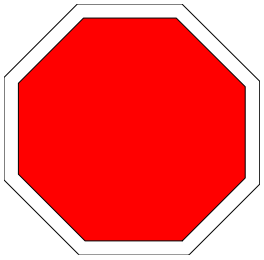
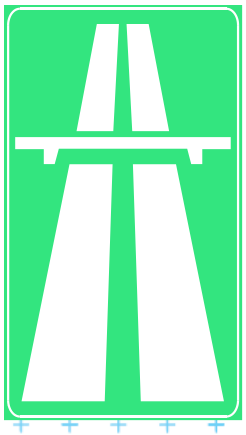
Cognitively Sound

International icons allow people of differing nationalities, people who cannot read, and people who are cognitively impaired to negotiate complex environments.





The automotive industry has led the way in terms of flexible design. Vehicles provide :

- adjustable seats
- adjustable steering wheels
- adjustable floor pedal positioning
- adjustable mirror positions
- adjustable temperature
- adjustable lights for different areas of the vehicle
- adjustable distribution and intensity of music

Error Managed (Error Proofed): Entities must be designed so that they support doing the right thing. It is important to create a design wherein errors can be managed. This applies to consumers, workers, and students.

Error Proofing Strategies:

1. Do not allow the user to make an error.

   Examples: a) Microwave oven stops when the door is opened.
   b) Car will not start unless gear in park/neutral.

2. Provide a warning that an error has or will occur.

   Examples: a) A buzzer sounds if car key is left in ignition when car door is opened.
   b) Warning display for car high engine temperature.

3. Provide easy way to correct errors if they occur.

   Examples: a) Microsoft Windows use of the <ctrl>z key stroke.
   b) Undo option in word processor edit features.

Error Managed (Error Proofed)

- Designers strive to eliminate errors when consumers use their products and when workers manufacture and assemble products in a production system.

EXAMPLE:
Diesel fuel nozzle too large for unleaded gas tank opening.

Note Color Coding

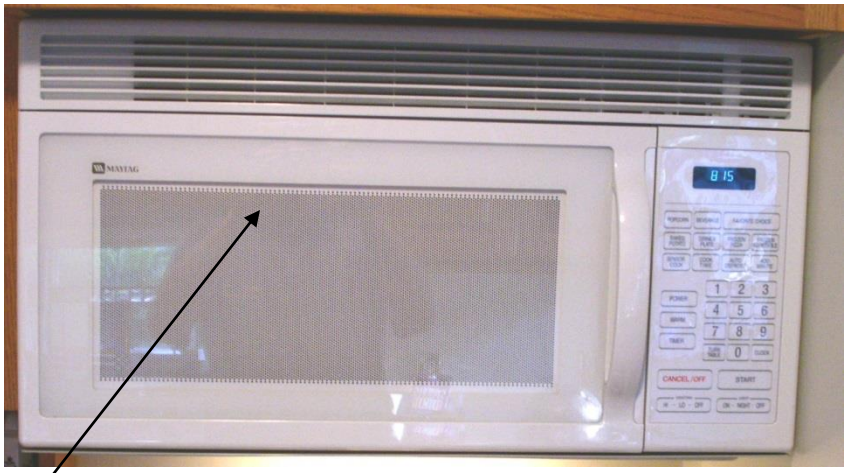
Steering Wheel

Ignition Keys

Door Locks

Warning Lights
- Electrical
- Temperature
- Gas
- Door Open
- Seat Belts

Today's cars exhibit a host of error proofing features.



When doors open:

- The microwave oven turns off
- The washer stops
- The dryer stops

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TASK: Read the dials and verify correct operation based on meter readings.

VISUAL CONTROL SYSTEM
READING METERS

LEVEL 1

- STANDARDS ARE ESTABLISHED AND METERS READ PERIODICALLY. A CHECK SHEET INDICATES CONFORMANCE TO STANDARDS.

Read & Interpret

Very error prone.

VISUAL CONTROL SYSTEM
READING METERS

LEVEL 3

- STANDARD POSTED ON METERS ENABLES IMMEDIATE CHECK TO CONFORMANCE AND AVOIDS MISREADINGS.

The acceptable level is marked.

Much less error prone.

VISUAL CONTROL SYSTEM
READING METERS

LEVEL 4

- STANDARDS ALL AT 12 O' CLOCK BY ADJUSTING METERS - ALL THREE METERS CAN BE CHECKED CONCURRENTLY.

Least cognitively Demanding.

Rotate meter dial – vertical alignment means acceptable. Also use markers.

Some solutions for accessible UI

Multi-modal Interaction

- **Provides access to information through more than one mode of interaction**
- **Sight is predominant and most interactive systems use visual channel as primary presentation**
  - graphics
  - text,
  - video
  - animation

Multi-modal interaction

- **Sound important**
  - keeps us aware of surroundings
  - provides clues and cues to switch our attention
  - music - also auditory
    - convey and alter moods
    - conjure up visual images
    - evoke atmospheres
- **Touch**
  - tactile feedback to operate tools
  - hold and move tools, instruments, pens

Multi-modal interaction

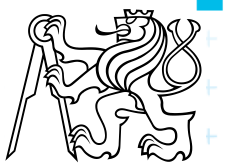
- Taste and smell
  - less appreciated
  - check food if bad, detect early signs of fire, …

Multi-modal interaction

- Human-human everyday interaction multi-modal
- Each sense provides different information to make whole
- Want Human-computer interaction to be multi-modal
  - visual channel can get overloaded
  - provide richer interaction
  - provide redundancy for an equivalent experience to all

Sound in the interface

- Contributes to usability
- Audio confirmation
  - changes in key clicks
  - error occurrences
- Provide information when visual attention elsewhere
- …or environment has visual limitations
- Dual presentation through sound and vision supports universal design
  - enables access to visual and hearing impaired
- Two kinds: speech and nonspeech



Sound in the interface: Speech

- Language complex
  - structure
    - pronunciation
      - phonemes - atomic elements of speech (40 in English)
      - prosody - alteration in tone and quality
      - co-articulation - phonemes sound different next to others
      - allophones - differences in sound in phonemes
      - morphemes - smallest unit of language that has meaning
    - grammar

Sound in the interface: Speech

- Speech recognition
  - Useful when hands are occupied
  - **Alternative means of input** for users with visual, physical and cognitive impairment
  - single-user systems; require training
  - **barriers**

    background noise

    redundant and meaningless noise (‘uh’)

    variations between individuals and regional accents
  - **Examples**

    speech-based word processors

    telephone -based systems

    interactive systems that give feedback

Sound in the interface: Speech

- Speech Synthesis
  - **Complementary to speech recognition**
  - **Problems**
    - monotonic - doesn’t sound natural
    - canned messages - not too bad, prosody can be hand coded
    - spoken output cannot be reviewed or browsed easily
    - intrusive (more noise or equipment)
  - **Application areas**
    - blind or partially sighted
      accessible output medium (screen readers)
    - assist those with disabilities affecting their speech
      predefined messages can be stored

Sound in the interface: Speech

- Un-interpreted speech
  - **Speech does not have to recognized by computer to be useful**
  - **Examples**:
    - Fixed pre-recorded messages
      - human prosody and pronunciation
      - quality is low
      - example: announcements in airport
    - Voice mail
    - Audio annotations
  - Can be **digitally sped up** without changing pitch

Sound in the interface: Non-speech sound

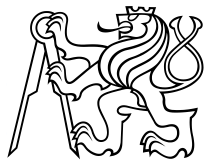
- Assimilated quickly
- Learned regardless of language
- Require less attention
- Uses:
  - indications of changes or errors in interactive system
  - provide status changes
  - sound representation of actions and objects
  - provide confirmation
  - give redundant information
- Two Kinds - auditory icons and earcons

Sound in the interface: Non-speech sound

- **Auditory icons**
  - Use **natural sounds to represent** types of objects and actions
  - **Example: Mac's SonicFinder**
    - crumpling paper when putting file in wastebasket
  - **Problem**: Some objects or actions don't have a natural sound

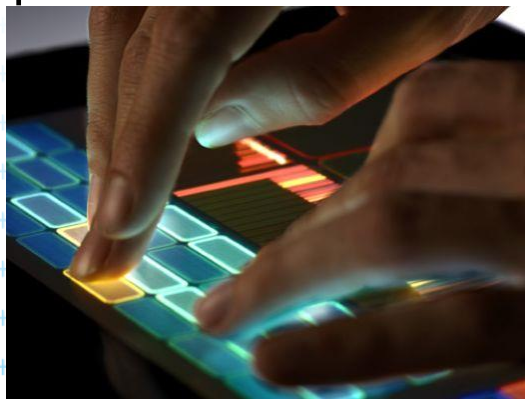
Sound in the interface: Non-speech sound

- Earcons
  - **use structure**- combinations of notes (motives) to represent actions and objects
  - **vary** according to rhythm, pitch, timbre, scale and volume
  - **hierarchically structured**
    - compound earcons - combine motives
      'create' and 'file'
    - family earcons - 'error' family
    - makes learning easier
  - even lack of musical ability has little effect on ability to remember earcons



Touch in the interface

- Touch both sends and receives information
- Touch in the interface is haptic interaction
- Two areas:
  - cutaneous - tactile sensations through skin
    - vibrations against skin; temperature, texture
  - kinesthetics - perception of movement and position
    - resistance or force feedback
- Entertainment or training
- Tactile devices
  - electronic braille display
  - force feedback devices in VR equipment



Handwriting Recognition

- Handwriting provides textural and graphical input
- Technology for recognition
  - digitizing tablet
    - sampling problems
  - electronic paper - thin screen on top

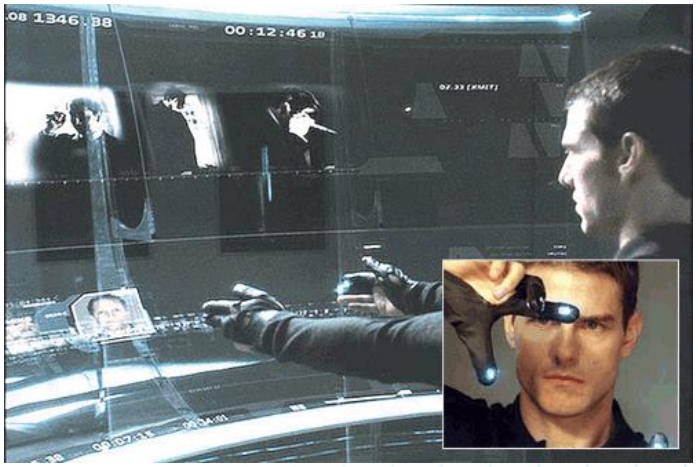
- Recognizing handwriting
  - variation among individuals (even day-to-day)
  - co-articulation - letters are different next to others
  - cursive more difficult

Gesture recognition

- Subject in multi-modal systems recently
- Involves controlling computer with movements
  - Put that there
- Good situations
  - no possibility for typing (VR)
  - supports people with hearing loss (sign language
- Technology expensive
  - computer vision
  - data glove (intrusive)

Gesture recognition

- Problems
  - Gestures user dependent
    - variation
    - co-articulation
  - segmenting gestures difficult



Web accessibility

- Web accessibility encompasses all disabilities that affect access to the Web, including visual, auditory, physical, speech, cognitive, and neurological disabilities.

Web accessibility

- Web accessibility also benefits people without disabilities.
  - Includes designing Web sites and software that are flexible to meet different user needs, preferences, and situations.
  - Benefits people such as those using a slow Internet connection, people with “temporary disabilities” such as a broken arm, and people with changing abilities due to aging.

Why is it important?

- The Web is an increasingly important resource in many aspects of life: education, employment, government, commerce, health care, recreation, and more.
- Accessibility provides equal access and equal opportunity to people with disabilities.
- An accessible Web can also help people with disabilities more actively participate in society.
- Web accessibility is often required by law.

Thanks for your attention!

Material from
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