



1

ISE 164- HCI



Haptic and Gesture Interfaces

Abbas Moallem, Ph.D.

Session 11

© A. Moallem

2

2

Touch is the earliest sense to develop

ISE 164- HCI



- Apprehension
- Coordination



© A.Moallem

3

Touch and Movements

ISE 164- HCI



© A.Moallem

4

4

Touch

ISE 164- HCI

- Provides important feedback about environment.
- May be key sense for someone who is visually impaired.
- Stimulus received via receptors in the skin:
 - thermoreceptors – heat and cold
 - nociceptors – pain
 - mechanoreceptors – pressure
(some instant, some continuous)
- Some areas more sensitive than others e.g. fingers.
- Kinesthesia - awareness of body position
 - affects comfort and performance.



© A.Moallem

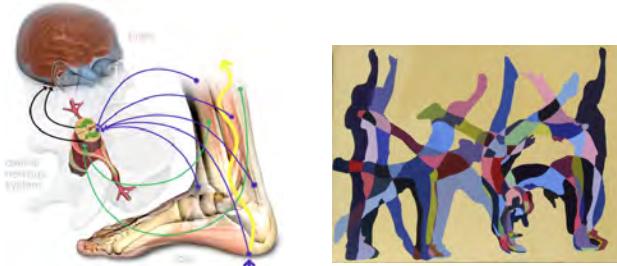
5

5

Movement

ISE 164- HCI

- Kinesthesia - awareness of body position
 - affects comfort and performance.
- Proprioception:
 - The ability to sense stimuli arising within the body regarding position, motion, and equilibrium.



© A.Moallem

6

6

Tactile Perception

ISE 164- HCI

- Thermo receptors
- Nociceptors
- Mechanoreceptors
 - Rapidly Adapting Mechanoreceptors
 - Slowly Adapting Mechanoreceptors



© A.Moallem

7

7

What is Haptic?

ISE 164- HCI

Ability to touch and manipulate objects

- “Haptics” often also refers sensing and manipulation of virtual objects in computer – generated environment/when performing sensory-motor tasks.



© A.Moallem

8

8

Haptic Applications

ISE 164- HCI

- **Simulation**

- Surgical simulation
- Museum display
- Military
- Art: painting sculpting and CAD
- Assistive Technology



© A.Moallem



9

9

Haptics

ISE 164- HCI

- **Haptics refers to the modality of touch and associated sensory feedback.**
- **Sensing includes**
 - **Passive Haptic Sensing:** contact between the stationary hand (i.e. passive) and an object. The object may not necessarily be stationary.
 - **Active Haptic Sensing:** contact of the voluntarily moving hand over an object and dominated for identifying an object.
 - **Prehension:** which involves basic tasks to grasp an object and
 - **Non-prehensile skilled movements** which are related to the gestures of the hand.

Jones, L.A., Lederman, S.J.: Human Hand Function.
Oxford University Press, London (2006)

© A.Moallem

10

10

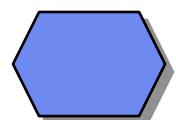
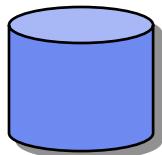
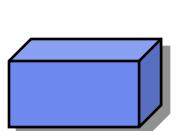
Object Identification

ISE 164- HCI

Tangible object properties can be categorized into two:

- Material properties (texture, roughness, hardness, thermal and weight)
- Structural or geometrical cues (shape, size, orientation, curvature, patterns).

- Objects can be recognized by geometrical cues.



Klatzky and Lederman

© A.Moallem

11

Hand and Fingers Function

ISE 164- HCI

Studies can be categorized into two fields:

- **Neurophysiology:** study of the relation between physical stimuli (physical events) and responses of single afferent units (neural events).
- **Psychophysics.** There are three general methods in psychophysics that are used to determine human thresholds of perception: detection, discrimination, and identification.

Jones and Lederman



© A.Moallem

12

12

Hand and Fingers Function

ISE 164- HCI

- Detection and discrimination involve the measurement of sensory thresholds of perception of a stimulus.
- Identification, on the other hand, involves human ability to categorize stimuli without providing explicit references.



Jones and Lederman

© A.Moallem

13

13

ISE 164- HCI

SENSORY MOTOR CONTROL

© A.Moallem

14

14

Maximum Force Exertion

ISE 164- HCI

- A maximum grasping force of 400 N for males and 228 N for females was measured in a study by An and coworkers (An et al., 1986).
- In a study on maximum
 - it was found that the maximum force exerted by the pointer and index fingers was about 50 N, whereas the ring finger exerted a maximum force of 40 N (Sutter et al., 1989).
- In order to ensure user safety, a haptic interface should never apply forces that the user cannot successfully counter.

© A.Moallem

15

Sustain Force Exertion

ISE 164- HCI

- Prolonged exertion of maximum force leads to fatigue.
- Fatigue is an important consideration when designing feedback for applications like data visualization where force feedback may be present for extended periods of time.

© A.Moallem

16

16

Force Tracking Resolution

ISE 164- HCI

- Force tracking resolution represents the human ability to control contact forces in following a target force profile.
 - (Srinivasan and Chen (1993) studied fingertip force)
- It was found that when no visual feedback was available, the absolute error rate increased with target magnitude.
- When visual feedback was present, the error rate did not depend on target magnitude.

© A.Moallem

17

17

Compliance Resolution

ISE 164- HCI

- Compliance, or softness, resolution is critical in certain applications.
- If a haptic interface is to be used for exploratory tasks that require discrimination among objects based on their compliance, then designers should ensure that the simulated virtual objects appear sufficiently different to the human operator.

© A.Moallem

18

18

Mechanical Impedance

ISE 164- HCI

- The impedance of the human operator's arm or finger plays an important role in determining how well the interface performs in replicating the desired contact force at the human-machine contact point.
- It was noted that the damping and stiffness increased linearly with force. In similar work.

© A.Moallem

19

19

Sensing and Control Bandwidth

ISE 164- HCI

- Sensing bandwidth refers to the frequency with which tactile and/or kinesthetic stimuli are sensed, and control bandwidth refers to the frequencies at which the human can respond and voluntarily initiate motion of their limbs.
- In humans, the input (sensory) bandwidth is much larger than the output bandwidth. As noted earlier, it is critical to ensure that the level of haptic feedback is sufficient for task completion while being comfortable for the user.

© A.Moallem

20

20

Sensing and Control Bandwidth

ISE 164- HCI

- It is critical to ensure that the level of haptic feedback is sufficient for task completion while being comfortable for the user.
- The hands and fingers have a force exertion bandwidth of 5 to 10 Hz, compared to a kinesthetic sensing bandwidth of 20 to 30 Hz
- Design an application that requires repetitive force exertion by the user, to guarantee user comfort the required rate should not be more than 5 to 10 times a second. Similarly, any kinesthetic feedback to the user should be limited to 20 to 30 Hz.

© A.Moallem

21

21

When to Select A Haptic Interface

ISE 164- HCI

There are two basic functions of haptic interfaces. First, the device is used to measure the motion (position, velocity, and possibly acceleration) and the contact forces of the user's entire body, or arm, foot, or hand.

Second, the device is used to display contact forces and motion along with spatial and temporal distributions to the user (Tan et al., 1994)

© A.Moallem

22

22

Design Guidelines

ISE 164- HCI

Ensure that the characteristics of the system, such as workspace size, position bandwidth, force magnitude, force bandwidth, velocity, acceleration, effective mass, accuracy, and other factors, are well matched to 2 Haptic Interfaces

© A.Moallem

23

23

Human Sensitivity to Tactile Stimuli

ISE 164- HCI

- the location of application of the stimuli or even the gender of the user can affect detection thresholds (Sherrick & Cholewiak, 1986).
- Stimuli must be at least 5.5 msec apart, and pressure must be greater than 0.06 to 0.2 N/cm² (Hale & Stanney, 2004).
- Additionally, vibrations must exceed 28 dB relative to a 1-microsecond peak for 0.4 to 3 Hz frequencies for humans to be able to perceive their presence (Biggs & Srinivasan, 2002).

© A.Moallem

24

24

Use Active Rather than Passive Movement

ISE 164- HCI

- To ensure more accurate limb positioning, use active movement rather than passive
- movement of the human operator. Additionally, avoid minute, precise joint
- rotations, particularly at the distal segments, and minimize fatigue by avoiding
- static positions at or near the end range of motion (Hale & Stanney, 2004).

© A.Moallem

25

25

Active Rather than Passive Movement

ISE 164- HCI

- Ensure Accuracy of Position Sensing in Distal Joints For Exoskeleton Devices, Minimize Contact Area at Attachment Points for Mechanical Ground
- Ensure Realistic Display of Environments with Tactile Devices
- Keep Tactile Features Fixed Relative to Object's Coordinate Frame
- Maximize Range of Achievable Impedances
- Limit Friction in Mechanisms
- Avoid Singularities in Workspace
- Maximize Pin Density of Tactile Displays

© A.Moallem

26

26

Active Haptic Devices

ISE 164- HCI

- Active haptic devices are interfaces to computers or networks that exchange power (e.g., forces, vibrations, heat) through contact with some part of the user's body, following a programmed interactive algorithm. For example, a force feedback device can physically render a computed virtual environment model within limits such as its workspace and actuator torque.
- Cell phone vibrators and force feedback game joysticks are also active haptic interfaces; whereas the vibrator is only a display, the joystick is both an input and an output device, and its control is considerably more complex.

© A.Moallem

27

27

Haptic Design

ISE 164- HCI

- Haptic design almost always is multi modal.
- Touch in conjunction with other sensory modality

© A.Moallem

28

28



ISE 164- HCI

Gesture-control

© A.Moallem

29

29



ISE 164- HCI

Gesture

- **Non-verbal communication**
 - human can interface with the machine without any mechanical devices.
- **Human movements are typically analyzed by segmenting them into shorter and understandable format.**

© A.Moallem

30

30

Gesture

ISE 164- HCI

- The movements vary person to person. It can be used as a command to control different devices of daily activities, mobility etc.
- Natural or intuitive body movements or gestures can be used as command or interface to operate machines, communicate with intelligent environments to control home appliances, smart home, telecare systems etc.

© A.Moallem

31

31

Hand Gestures

ISE 164- HCI

- Hand Gestures : Direct control via hand posture is immediate, but limited in the number of Choices .
 - finger point movements
- Body Gestures:
- Head gesture
- Gesture with voice

© A.Moallem

32

32

Elderly Users

ISE 164- HCI

- Assistive living
- Entertainment
- Training & Education
- Simulation
- Artificial Intelligence

© A. Moallem

33

33

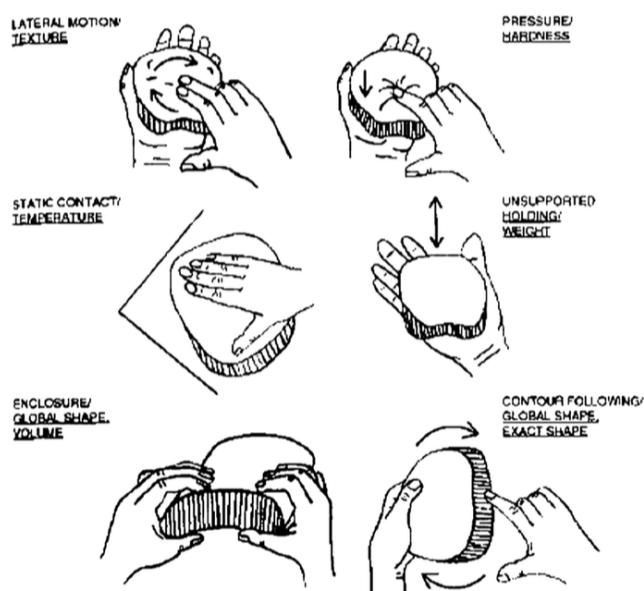
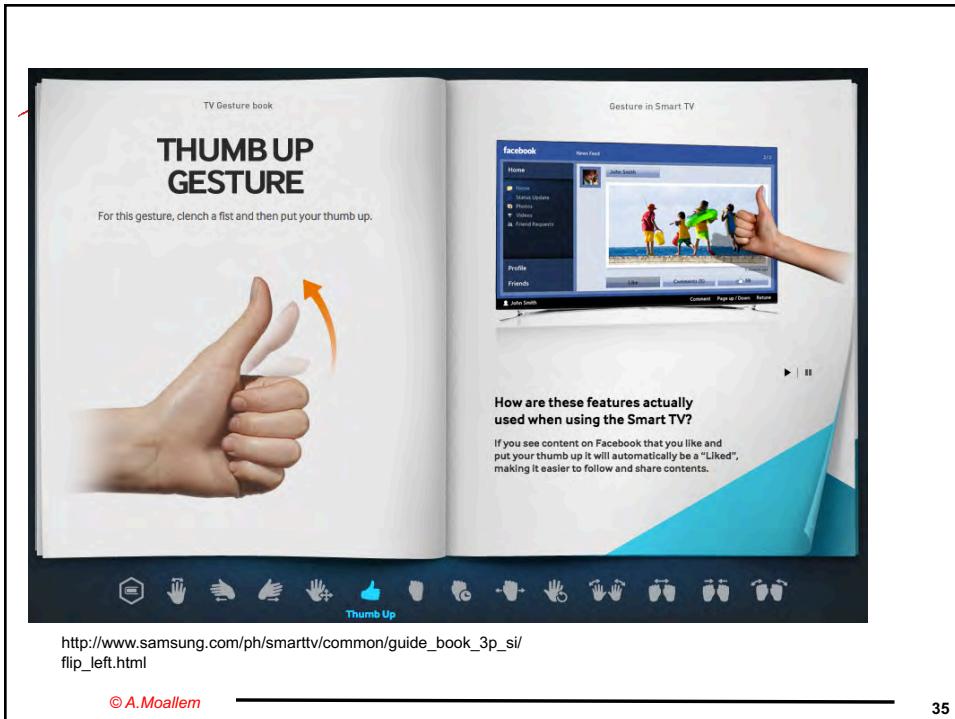


Figure 5.4. Exploratory procedures. The nature of desired physical information guides strategic touching ("action for perception"). Reproduced with permission from Lederman and Klatzky (1996).

34

34



35



36



ISE 164 - HCI



Universal Design

Abbas Moallem, Ph.D.

Session 13

A. Moallem ©

1



Overview

ISE 164 - HCI

- **Universal Design**
 - What are Disabilities?
 - Laws and Regulations
 - Categories of Disability
 - Different Types of Disabilities
- **Accessibility**
 - Physical disability
 - Hearing Loss, Low vision, Blindness, Colorblindness
- **Multi-modal Design**



A. Moallem ©

2

Historical Perspective

ISE 164 - HCI

- Before the Wars
- After World War II
- In USA
- International Year of Disabled Persons (1981)



A. Moallem ©

3

People with Disabilities

ISE 164 - HCI

- Approximately 40 million Americans have a disability of some kind.
- As the population ages, more and more of us will develop age-related disabilities (25% by age 55, jumping to 50% at age 65).
- 1.5 million people in California have vision disabilities



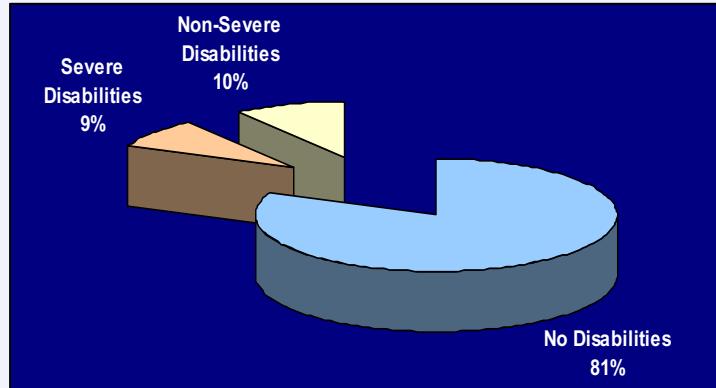
A. Moallem ©

4

People with Disabilities

ISE 164 - HCI

32.1 million working-age people (or 18.7% of the population age 15 to 64) have a disability.



A. Moallem ©

5



What Is a Disability?

ISE 164 - HCI

Under the Americans With Disabilities Act an individual with a disability is a person who:

- has a physical or mental impairment that substantially limits one or more major life activities;
- has a record of such an impairment; or
- is regarded as having such an impairment.



A. Moallem ©

6

Americans with Disabilities Act (ADA) (42 U.S.C. 12101 et seq. 1990)

ISE 164 - HCI

- The ADA is a federal anti-discrimination statute designed to remove barriers which prevent qualified individuals with disabilities from enjoying the same employment opportunities that are available to persons without disabilities. And requires that State and local governments give people with disabilities an equal opportunity to benefit from all of their programs, services, and activities
- The ADA was signed into law on July 26, 1990.
- Many other countries have similar laws.



A. Moallem ©

7

Compliance with the ADA

ISE 164 - HCI

It is a requirement in all current federal contracts to comply with the section 508 of the Federal Rehabilitation Act and the Americans with Disabilities Act (ADA).



A. Moallem ©

8

Physical Impairment Definition

ISE 164 - HCI

A physical impairment is defined by the ADA as:

"Any physiological disorder or condition, cosmetic disfigurement, or anatomical loss affecting one or more of the following body systems: neurological, musculoskeletal, special sense organs, respiratory (including speech organs), cardiovascular, reproductive, digestive, genitourinary, hemi and lymphatic, skin, and endocrine."



A. Moallem ©

9

Categories of Disabilities: Mental Impairment

ISE 164 - HCI

A mental impairment is defined by the ADA as:

"Any mental or psychological disorder, such as mental retardation, organic brain syndrome, emotional or mental illness, and specific learning disabilities."



A. Moallem ©

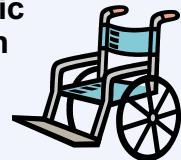
10

Impairment under ADA

ISE 164 - HCI

Does not include:

- Simple physical characteristics: eye or hair color.
- A physical condition that is not the result of a physiological disorder: pregnancy, or a predisposition to a certain disease.
- Personality traits: poor judgment, quick temper or irresponsible behavior.
- Environmental, cultural, or economic disadvantages: as lack of education or a prison record .



A. Moallem ©

11

Reasonable Accommodation

ISE 164 - HCI

- Reasonable accommodation is any modification or adjustment to a job or the work environment that will enable a qualified applicant or employee with a disability to perform essential job functions.
- Reasonable accommodation also includes adjustments to assure that a qualified individual with a disability has the same rights and privileges in employment as non-disabled employees.



A. Moallem ©

12

The Rehabilitation Act Amendment (Section 508)

ISE 164 - HCI

- Section 508 is a part of the Rehabilitation Act of 1973 that requires all electronic and information technology developed, procured, maintained, or used by the Federal government to be accessible to people with disabilities.
- On August 7 1998, President Clinton signed the Rehabilitation Act Amendments of 1998 into law .



A. Moallem ©

13

Different Types of Disabilities

ISE 164 - HCI

- Physical Disabilities
- Visual Disabilities
- Hearing Disabilities
- Language, Cognitive Disabilities
- Communication and other Disabilities



A. Moallem ©

14

Accessibility

ISE 164 - HCI

- Accessibility means removing barriers that can prevent people with disabilities from participating in substantial life activities, including the use of services, products, and information.
- Removing barriers often benefits to a wide range of people other not only those with disabilities.



A. Moallem ©

15

Accessibility Solutions for Physical Disabilities

ISE 164 - HCI



Keyboard



Alternate I/O technology



Accessible hardware devices



Speech control

A. Moallem ©

16

Assistive Technology

ISE 164 - HCI



A. Moallem ©

17

ISE 164 - HCI

Accessibility

SOLUTIONS FOR HEARING DISABILITIES

A. Moallem ©

18

Guidelines for Hearing Disabilities

ISE 164 - HCI

- Never assume a user will hear an audible notification.
- Where appropriate, allow users to choose between audible or visual cues.
- Do not overuse or rely exclusively on audible cues.
- Allow users to configure frequency and volume of audible cues.



A. Moallem ©

19

Accessibility

SOLUTIONS FOR VISUAL DISABILITIES

A. Moallem ©

20

Users with Disabilities

ISE 164 - HCI

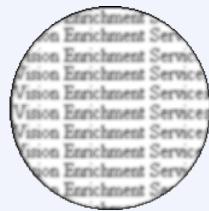
- **Visual Impairment**
 - screen readers, SonicFinder
- **Hearing Impairment**
 - text communication, gesture, captions
- **Physical Impairment**
 - speech I/O, eyegaze, gesture, predictive systems (e.g. Reactive keyboard)
- **Speech Impairment**
 - speech synthesis, text communication
- **Dyslexia**
 - speech input, output
- **Autism**
 - communication, education

A. Moallem ©

21

Guidelines for Visual Disabilities

ISE 164 - HCI



Low Vision



Blindness



**Color
Blindness**

A. Moallem ©

22

Visual Disabilities: Low Vision

ISE 164 - HCI

- A person with low vision to be someone who can only read print that is very large, magnified, or held very close.
- 9-10 million people with low vision (USA)
- The common issue for low vision users is to read what is on the screen.
- Users with low vision may have a limited field of view.



A. Moallem ©

23

Visual Disabilities: Low Vision

ISE 164 - HCI

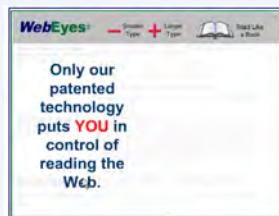
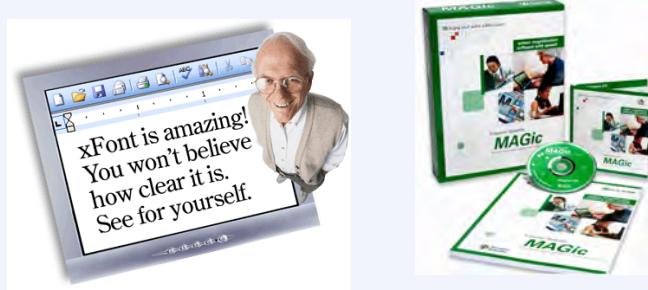


A. Moallem ©

24

Screen Magnifiers

ISE 164 - HCI



A. Moallem ©

25

Guidelines for People with Low Vision

ISE 164 - HCI

- All fonts, including those in text panes, menus, labels, and information messages, should be easily configurable by users.
- Even with magnification hardware or software to enlarge view, performance & image quality are improved if larger font sizes are available prior to magnification.
- Providing redundant audio cues (or the option of audio) can notify users about new information or state changes.



A. Moallem ©

26

Visual Disabilities: Blindness

ISE 164 - HCI

- A blind person is considered to be anybody who does not use a visual display.
- Screen reader software provides access to graphical user interfaces by providing navigation as well as a Braille display or speech synthesized reading of controls, text, and icons.
- The blind user typically uses tab and arrow controls to move through menus, buttons, icons, text areas, and other parts of the graphic interface.



A. Moallem ©

27

Assistive Technologies and Adaptive Strategies

ISE 164 - HCI

- Braille and Refreshable Braille
- Scanning Software
- Screen Magnifiers
- Screen Readers
- Speech Recognition
- Speech Synthesis
- Tabbing Through Structural Elements
- Text Browsers
- Visual Notification
- Voice Browsers

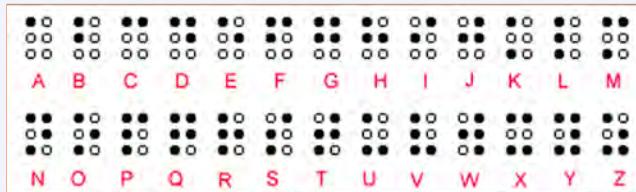
A. Moallem ©

28

Braille

ISE 164 - HCI

the human readable text
look like the printed text
numbers and symbols
letters are represented with
symbols and combinations
and spaces and punctuation
the symbols are a space
or a period



A. Moallem ©

29

Braille Displays

ISE 164 - HCI

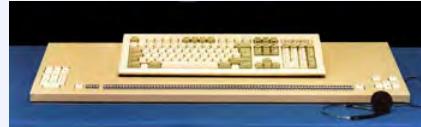


A. Moallem ©

30

Braille Displays

ISE 164 - HCI



A. Moallem ©

31

Screen Reading Software

ISE 164 - HCI



A. Moallem ©

32

Text To Speech

ISE 164 - HCI



A. Moallem ©

33

Accessibility Issues for People with Blindness

ISE 164 - HCI

- Screen reading software can read the text contents of buttons, menus, and other control areas.
- Screen readers cannot read the contents of an icon or image, only the descriptive label or accessible name associated with them.



A. Moallem ©

34

Accessibility Guidelines for People with Blindness

ISE 164 - HCI

- Meaningful names should be provided for user interface objects in their code to provide useful information to users with visual impairments.
- Rather than naming an image “Widget5”, for example, the code should call it “Eraser” or some other descriptive name, that users will understand if spoken by a screen reader.



A. Moallem ©

35

Visual Disabilities Color Blindness

ISE 164 - HCI

- Red-green color blindness is common — about 4-5% of the population.
- 8-10% of the male population is “red-green” colorblind.
- Many people with low vision are also unable to distinguish among some or any colors.
- A significant portion of any population is “color blind”.



A. Moallem ©

36

Color Vision

ISE 164 - HCI

- Cone cells are called "red, green, or blue" based on the photo pigment they contain.
- Photo pigments are sensitive to different wavelengths of light,
 - long-wavelength sensitive ("red"),
 - middle-wavelength sensitive ("green"),
 - and short-wavelength sensitive ("blue").
- L, M, and S are common abbreviations for "red", "green", and "blue" when referring to photo pigments.



A. Moallem ©

37

Colorblindness

ISE 164 - HCI

When someone is colorblind, there is something wrong with one of their groups of photo pigments, usually the red (L) or green (M), which is why they are called "red-green" colorblind.



A. Moallem ©

38

Type of Colorblindness

ISE 164 - HCI

- Trichromats (normal color vision) have their color vision based on 3 different types of photo pigment, one from each of the L, M, and S group.
- Dichromats (severely colorblind) are missing one whole group of photo pigment. Most mammals (including cats and dogs) have dichromatic color vision.



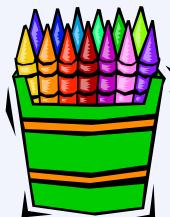
A. Moallem ©

39

Type of Colorblindness

ISE 164 - HCI

- Monochromats (very rare) cannot distinguish between any colors.
- Anomalous trichromats (mildly or moderately colorblind) have color vision based on 3 different photo pigments, but from only 2 of the photo pigment groups.



A. Moallem ©

40

Examples of Colorblindness

ISE 164 - HCI

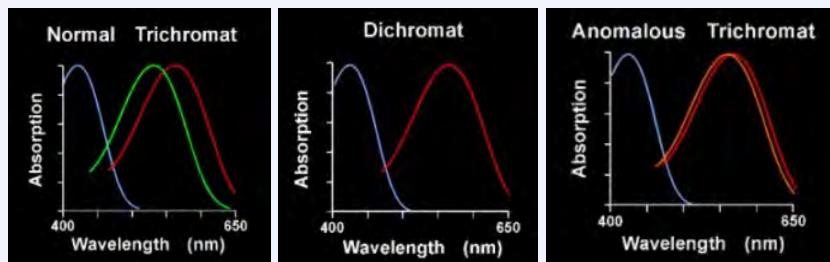


A. Moallem ©

41

Examples of Colorblindness

ISE 164 - HCI



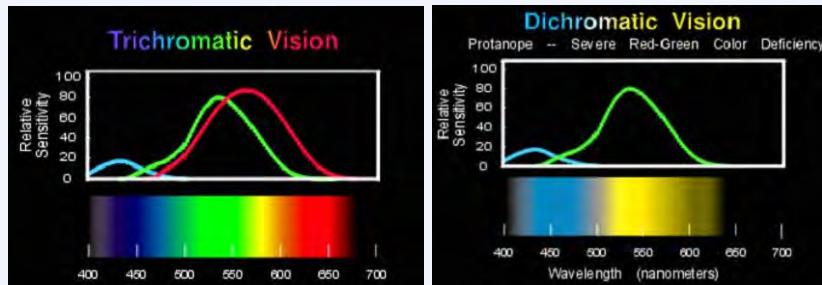
A. Moallem ©

42

Colorblindness

ISE 164 - HCI

The spectral sensitivities of the cone pigments and spectrum in color normal trichromats are compared with those of a color blind person:



A. Moallem ©

43

How the World Appears to a Person with Colorblindness

ISE 164 - HCI

Color vision defects cause problems in the real world. The following demonstration is an example of how the world appears to a person with a severe type of color blindness, deutanopia. See how you would do in a color blind world.



A. Moallem ©

44

Which Meat is the Most Thoroughly Cooked?

ISE 164 - HCI

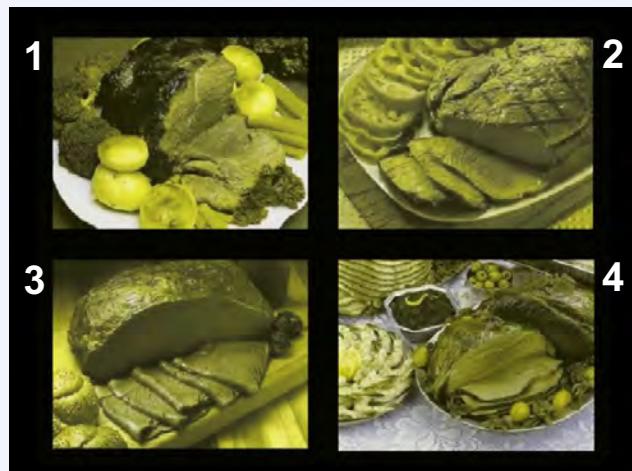


A. Moallem ©

45

Which Meat is the Most Thoroughly Cooked?

ISE 164 - HCI



A. Moallem ©

46

Guidelines for People with Colorblindness

ISE 164 - HCI

Use of Color

- Color should be used with care to ensure that color-blind people can view the information.
- Color should not be used as the only way to convey information.
- Pages that are printed on black and white printers can also become unintelligible if color is the only way information is being conveyed.



A. Moallem ©

49

Guidelines for People with Colorblindness

ISE 164 - HCI

Use of Color

- Do not use color only to change backgrounds or text color to red to indicate an error.
- Do not use an icon that changes color based on status but is otherwise the same. Make sure the icon changes shape as well.



A. Moallem ©

50

Guidelines for People with Colorblindness

ISE 164 - HCI

- Do not hard code application colors.
- Do not hard code graphic attributes such as line, border, and shadow thickness.
- Do not hard code font sizes and styles.
- Provide descriptive names for all widgets and any widget using graphics instead of text (e.g., palette items or icons).



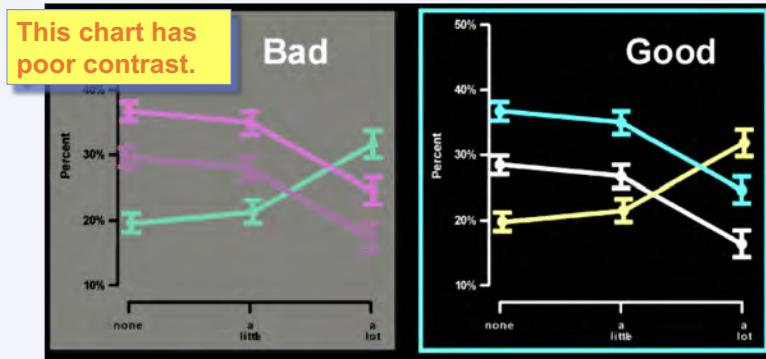
A. Moallem ©

51

Graphics

ISE 164 - HCI

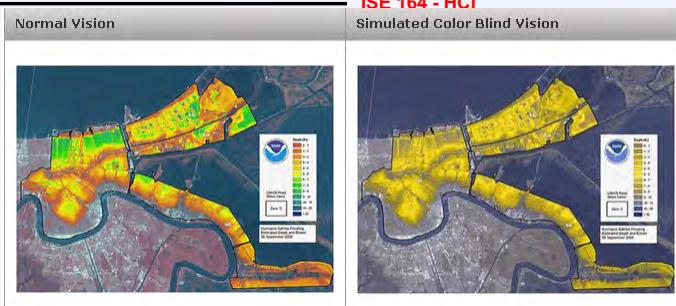
Clear graphics are very important because graphics are often the source of the most difficulty. Here are two examples showing the difference between good and bad use of color:



A. Moallem ©

52

Simulated Color Blind Vision



3

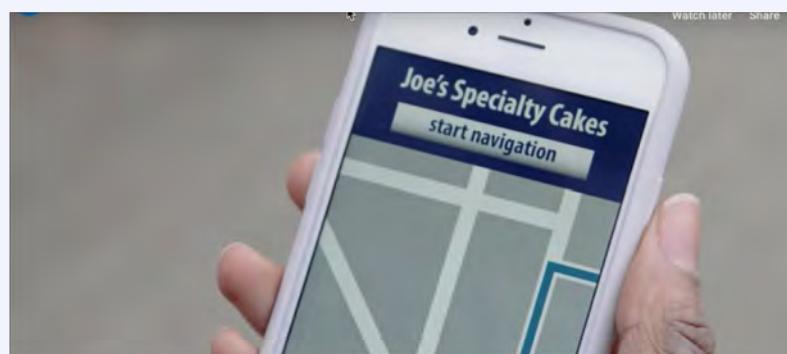
4

A. Moallem ©

53

Color Blindness

ISE 164 - HCI



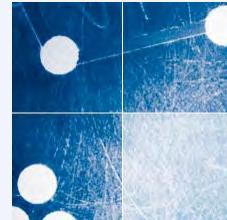
A. Moallem ©

54

Multi-Sensory Systems

ISE 164 - HCI

- 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



A. Moallem ©

55

Multi-modal vs. Multi-media

ISE 164 - HCI

- 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

A. Moallem ©

56

Speech Recognition

ISE 164 - HCI

- Single user or limited vocabulary systems
e.g. computer dictation
- Open use, limited vocabulary systems can work satisfactorily
e.g. some voice activated telephone systems
- general user, wide vocabulary systems ...
... still a problem
- Great potential, however
 - when users hands are already occupied
e.g. driving, manufacturing
 - for users with physical disabilities
 - lightweight, mobile devices



A. Moallem ©

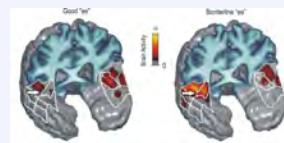
57

Non-Speech Sounds

ISE 164 - HCI

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



A. Moallem ©

58

Auditory Icons

ISE 164 - HCI

- 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



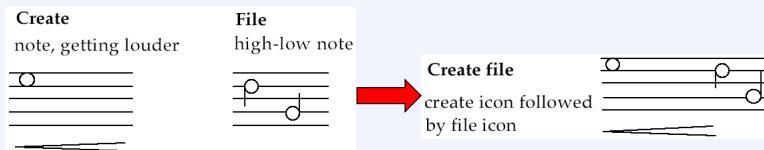
A. Moallem ©

59

Earcons

ISE 164 - HCI

- 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



A. Moallem ©

60

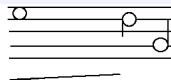
Earcons

ISE 164 - HCI

- **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**



Create file
create icon followed
by file icon



A. Moallem ©

61

Touch

ISE 164 - HCI

- **Haptic interaction**
 - cutaneous perception
 - tactile sensation; vibrations on the skin
 - kinesthetics
 - movement and position; force feedback
- **Information on shape, texture, resistance, temperature, comparative spatial factors**
- **Example technologies**
 - electronic braille displays
 - force feedback devices e.g. Phantom
 - resistance, texture



A. Moallem ©

62

Gesture

ISE 164 - HCI

- **Applications**

- gestural input - e.g. “put that there”
- sign language

- **Technology**

- data glove
- position sensing devices e.g MIT Media Room

- **Benefits**

- natural form of interaction - pointing
- enhance communication between signing and non-signing users

- **Problems**

- user dependent, variable and issues of co-articulation

A. Moallem ©

63

Universal Design Principles

ISE 164 - HCI

- **Equitable use**
- **Flexibility in use**
- **Simple and intuitive to use**
- **Perceptible information**
- **Tolerance for error**
- **low physical effort**
- **Size and space for approach and use**



A. Moallem ©

64

Accessibility Guidelines (Compliance with Section 508)

ISE 164 - HCI

- Guidelines include:

- Guidelines to comply with Section 508 accessibility standards.
- Solutions to critical usability issues for users with disabilities.



A. Moallem ©

65

General Guidelines

ISE 164 - HCI

- Guidelines include:

- Things that must be done to comply with Section 508 accessibility standards.
- Things that are critical for usability of application pages by users with disabilities.



A. Moallem ©

66

Basic Guidelines

ISE 164 - HCI

- Provide sufficient contrast between foreground and background
- Don't use color alone to convey information
- Ensure that interactive elements are easy to identify
- Provide clear and consistent navigation options
- Ensure that form elements include clearly associated labels
- Provide easily identifiable feedback
- Use headings and spacing to group related content
- Create designs for different viewport sizes
- Include image and media alternatives in your design
- Provide controls for content that starts automatically
- Learn more about accessibility

A. Moallem ©

67

Contrast

ISE 164 - HCI

Example: Contrast ratio

● Insufficient

Some people cannot read text if there is not sufficient contrast between the text and background. For others, bright colors (high luminance) are not readable; they need low luminance.

● Sufficient

Some people cannot read text if there is not sufficient contrast between the text and background. For others, bright colors (high luminance) are not readable; they need low luminance.

A. Moallem ©

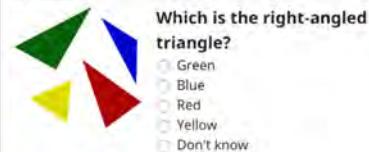
68

Don't use color alone to convey information

ISE 164 - HCI

Example: Refer to something using color alone

Color only



Color and number



W3C Web Accessibility Initiative (WAI)

A. Moallem ©

69

Unique styles for different link states

ISE 164 - HCI

Example: Unique styles for different link states

Style links to stand out from text

Some people can't use a mouse and use only a [keyboard to navigate](#) through web pages.

It is important that users can reach all interactive elements using the keyboard, and that it is clear which element has focus.

Visible keyboard focus could be a border or highlight that moves as you tab through the web page.

Mouse hover style

[Keyboard to navigate](#)

Keyboard focus style

[Keyboard to navigate](#)

Touch or click style

[Keyboard to navigate](#)

A. Moallem ©

70

Consistent Navigation

ISE 164 - HCI

- **A consistently located control**
 - A search field is the last item on every Web page in a site. users can quickly locate the search function.
- **An expanding navigation menu**
 - A navigation menu includes a list of seven items with links to the main sections of a site. When a user selects one of these items, a list of sub-navigation items is inserted into the top-level navigation menu.

A. Moallem ©

71

Consistent Navigation

ISE 164 - HCI

- **A Consistently positioned skip navigation controls**
 - A "skip navigation" (or "skip to main content") link is included as the first link on every page in a Web site. The link allows users to quickly bypass heading information and navigational content and begin interacting with the main content of a page.
- **Skip to navigation link**
 - Navigational content is consistently located at the end of each page in a set of Web pages. A "skip to navigation" link is consistently located at the beginning of each page so that keyboard users can easily locate it when needed

A. Moallem ©

72

All Fields Must have Label

ISE 164 - HCI

Example: Labels and input fields associated by proximity

Add a comment

Your E-mail

I am happy for you to contact me

Your Website

Comment

A. Moallem ©

73

Provide Easily Identifiable Feedback

ISE 164 - HCI

Example: Using error list, icon, and background color to make errors stand out

Please correct the following errors:

1. ⚠ Email address is invalid
2. ⚠ A Comment is required

Add a comment

Required fields are in red and marked with an *

Name Superbear

⚠ E-mail * superbear@hq.example.com

Website

⚠ Comment *

A. Moallem ©

74

Spacing to Group Related Content

ISE 164 - HCI

Little spacing and unclear relationship

Main heading



A. Moallem ©

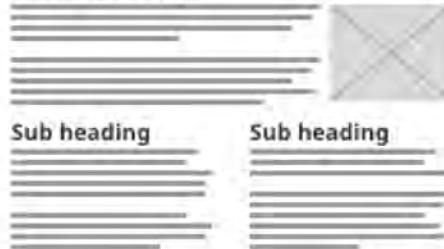
75

Spacing to Group Related Content

ISE 164 - HCI

More spacing and clearer relationship

Main heading



A. Moallem ©

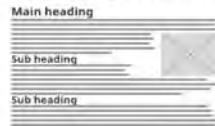
76

Use headings and spacing to group related content

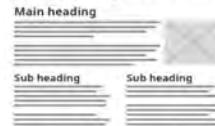
ISE 164 - HCI

Example: Spacing highlights relationship between content

Little spacing and unclear relationship



More spacing and clearer relationship

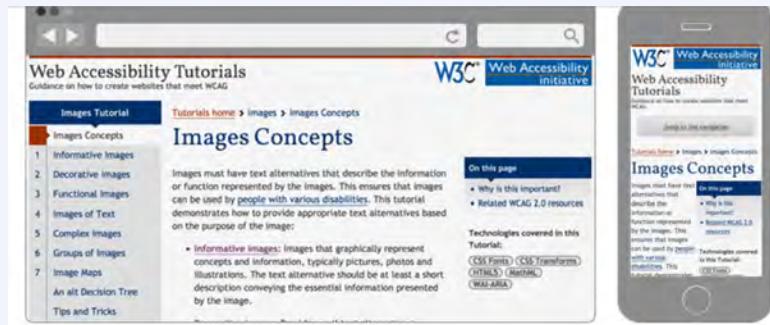


A. Moallem ©

77

Create Designs for Different Viewport Sizes

ISE 164 - HCI



Display in a wide window with small text uses multiple columns for primary content, visible navigation options, and visible secondary information.

Display in a narrow window, such as a mobile phone, or with large text uses single column for primary content, navigation options are revealed using an icon, and secondary information is also revealed via icon.

A. Moallem ©

78

Who was the remote control was built for?

ISE 164 - HCI



A. Moallem ©

79

Conclusion

ISE 164 - HCI

You should create an accessible product because:

- People with disabilities will benefit.
- A wide range of people without any disability will have a better user experience.
- It's the law!

A. Moallem ©

80

Reading Material

ISE 164 - HCI

- **Web Accessibility Initiative (WAI)**
 - <https://www.w3.org/WAI/>

A. Moallem ©

81

Conclusion

ISE 164 - HCI

You should create an accessible product because:

- People with disabilities will benefit.
- A wide range of people without any disability will have a better user experience.
- It's the law!

A. Moallem ©

82

Reading Material

ISE 164 - HCI

- **Web Accessibility Initiative (WAI)**
 - <https://www.w3.org/WAI/>

A. Moallem ©

83

Web Accessibility-Introduction

ISE 164 - HCI



Fortunately, computers can
convert text to speech.

A. Moallem ©

84

