Human Computer Interaction (HCI)

Input-Output Channels

Input-output channels

- Human input
  - Using senses
  - Sight, hearing, touch, taste and smell
  - Sight, hearing & touch have important role in HCI
- Human output
  - Motor control of effectors
  - Limbs (arms, legs), fingers, eyes, head and vocal system

2

Input-output channels

- Human input / output (Example)
  - User interacting with a PC using mouse and keyboard
  - Manipulating objects (icons, windows, etc.)
  - Receive information through vision mostly
  - Receive information through ears too (e.g. beep)
  - Provide output to PC through effectors (fingers, hands, etc.)

3

Vision

- Primary source of information
- Two stages in vision
  - Physical reception of stimulus (event)
  - Processing and interpretation of stimulus

4

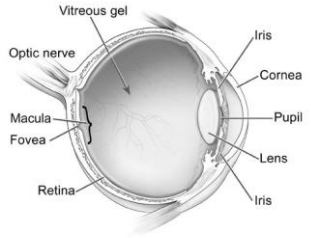
The Eye - physical reception

- Mechanism for receiving light and transforming it into electrical energy
- Light reflects from objects

5

The Eye - physical reception

- Two receptors in retina
- Rods
  - For peripheral vision
  - For low (dim) light vision
  - More densely packed at the outer parts (Edges) of our visual field
  - Detect changes in movement
- Cones
  - In normal lighting
  - Three types of cones for different wavelengths
  - This helps in colour vision
  - Densely packed towards the center of our visual field
  - Help in reading and distinguishing



6

Visual Perception

- How we (eyes) perceive:
  - Size
  - Depth
  - Brightness
  - Colour
- Important for the design of effective visual interfaces!

7

Interpreting the visual signal

- Size, depth and relative distances?
- Visual angle:
  - Depends on the size of the object and its distance from the eye
    - Two objects: different size, same distance
    - Two objects: same size, different distances

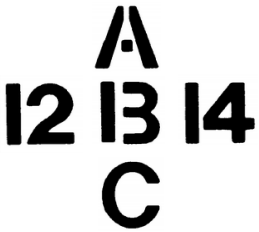
8

Vision

9

Interpreting the visual signal

- Our expectations affect the way an image is perceived
  - Known object ←→ distance
- Context is used to resolve ambiguity

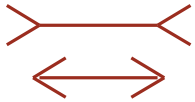


10

Optical Illusions

- The way things are and the way we perceive them
- Take care of distances, color schemes and the contextual objects

Our perception of size is not completely reliable



The Ponzo illusion
(distance)

The Muller Lyer illusion
(edges)

11

Reading

12

Reading

- Several stages:
  - Visual pattern of the word is perceived
  - Decoded using internal representation of language
  - Interpreted using knowledge of syntax and semantics

13

Reading

- Reading involves “saccades” and “fixations”
- **Saccades:**
  - The fast movements of eyes in the same direction
  - Meaning: A rapid intermittent eye movement, as that which occurs when the eyes focus on one point after another in the visual field
- **Fixations:**
  - Stable movement of the eye (maintaining the visual gaze at single location)
  - Perception occurs during fixations

14

Reading

Example:
Read aloud and quickly !

The quick brown
fox jumps over the
the lazy dog

15

Reading

- Words can be recognized as quickly as characters
- Word shape is important to recognition
  - Familiar words are recognized using word shape

16

Reading

- What if we remove the word shape clues (e.g. capitalizing words)
  - " NEGATIVE CONTRAST IMPROVES READING FROM COMPUTER SCREEN "
  - " Negative contrast improves reading from computer screen "
  - Reading is **slower** in which case?

17

Reading

Reading Test

aocdcrnig to rseecrah at Cmabrigde Uinervtisy, it dseno't mttaer in waht oderr the lterets in a wrod are, the olny irpoamtnt tihng is taht the frsit and lsat ltteer be in the rhgit pclae. The rset can be a taotl mses and you can sitll raed it whoutit a pboerlm. Tihs is bucseae the huamn mnid deos not raed ervey ltteer by istlef, but the wrod as a wlohe.

Can you read without difficulty?

18

Hearing

19

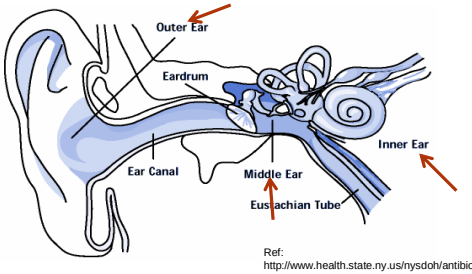
Hearing

- Provides information about environment:
  - Objects
    - cars, birds, machinery, neighbour, …
  - Distances
  - Directions etc.

20

Hearing

- Physical apparatus:
  - Outer ear – protects middle ear and amplifies sound
  - Middle ear – transmits sound waves as vibrations to inner ear
  - Inner ear – cells release chemical transmitters and cause impulses in auditory nerve



Ref: http://www.health.state.ny.us/nysdoh/antibiotic/ear.gif

21

Hearing

- Sound
  - Changes or vibrations in air pressure
- Sound characteristics:
  - Pitch
    sound frequency
    low freq – low pitch , high freq – high pitch
  - Loudness
    amplitude of the sound (greater amplitude = greater volume)

22

Hearing

- Sound's location
  - Factors involve in determining the location of sound:
    1. Two ears receive slightly different sounds
    2. Sound waves reflecting from the head have reduced intensity
- Humans can hear frequencies from 20Hz to 20kHz
  - Less accurate distinguishing high frequencies than low
- Auditory system filters sounds
  - Can attend to sounds over background noise

23

Hearing

- In interface design:
  - Warning sounds / Notifications
  - To convey information about the system state
  - User attention to a critical situation
    - Virus found / software updates (in Avast)…
  - Status information
    - Continuous state of a system (e.g. In hospitals)
  - Confirmation of an operation
    - Deleting a file
  - Supporting navigations with different sound effects

24

Touch

25

Touch / Haptic perception

- Provides important feedback about environment
  - Hot coffee
  - Cold water
  - Pressing a button to turn on fan …

    … as warning

26

Touch / Haptic perception

- What if we cant “feel” …
  - The shape of the glass while picking it?
  - Feet on the ground ?
  - “ Speed and accuracy of action is reduced! ”
- Key sense for **visually impaired**

27

Touch / Haptic perception

- Stimulus received via receptors in the skin:
  - Thermoreceptors – heat and cold
  - Nociceptors – pain
  - Mechanoreceptors – pressure
- Some areas more sensitive than others

  Fingers and thumbs have the highest sensitivity

28

Touch / Haptic perception

- Kinesthesis - awareness of body position and limbs
  - Affects comfort and performance e.g. touch typist
  - Awareness of relative position of fingers on keyboard
  - Tactile feedback from keyboard

29

Touch / Haptic perception

- In Virtual Reality (VR)
  - Games
- In Touch screens
  - Touch tables …
- In Tangible User Interfaces (TUIs)
- E-commerce
  - The experience of shopping online !
  - Buying clothes / food etc...
  - Users need to feel surfaces and shapes

30

Reaction Time (Input Channels)

- Audio / Visual / Touch stimulus (event) occurs
- Time taken to respond to stimulus:
  - Reaction time + Movement time
- Movement time dependent on age, fitness etc.

31

Fitts' Law

- The time taken to hit (**select**) a screen target:

$$\mathbf{Mt = a + b \log_2(D/S + 1)}$$

Where: **Mt** is time taken to move a **pointing device** to a target

a and **b** are constants

D is Distance from starting point to the center of the target

S is Size of target (width of the target)

32

Fitts' Law

- This affects **the type of the target** we design
- Targets as large as possible
- Distances as small as possible

33