Outline

- Hypertext interfaces
- Hypermedia interfaces
- Virtual environments
- Evaluation methods

Hypertext

- Hypertext user-interfaces
- Hypertext issues
- Potential problems from hypertext

Hypertext user-interfaces

- What is the ‘user interface’
  - Hardware (mouse, screen, keyboard etc.)
    - can often be improved by the user
  - Icons, scroll-bars, font
    - Can sometimes be changed by user
  - Functionality
    - Can sometimes be improved (e.g. by Macros)

Hypertext issues

- Advantages
  - Non-linear representation via links in text
  - easy browsing (through links)
  - searching
  - easier updating (advertising is cheaper)
- Disadvantages
  - Often difficult to represent dynamic information
  - It is easy to get lost, loss of context
  - Author task more complicated (more explicit)
  - Versioning problems

Potential problems from hypertext

- Problem: Reading from screens
  - People read slower from typical screens
  - Accuracy of reading usually better with paper
  - Eye fatigue by reading from screens
  - Comprehension
  - User ratings (preferences)

Potential problems (continued)

- Solution
  - Better screens improve reading speed and accuracy
  - Higher refresh rates decrease eye fatigue (use VESA standards)
  - Comprehension difficult to measure, but it *seems* comprehension is better with paper but this may stem from differences in manipulation times (maybe not an expert user)
  - User preferences change with the possibilities from hypertext
- Conclusion
  - Nothing inherent in the enabling technology to the failure of hypertext

Potential problems (continued)

- Problem: Reader behaviour
  - People generally like to underline, mark, highlight etc.
  - Can you create personal links, annotations etc.
  - Difficult to support diff. user reading behaviour at the same time (browsing, searching etc.)
- Solution
  - We need research and improvements in the hypertext software in order to support different user reading behaviours
  - Hypertext may not be the solution to all texts (I.e. novels)

Potential problems (continued)

- Problem: Interface issues
  - Display size
  - Manipulation facilities (I.e. scroll bars)
  - Input devices
  - (Mis)use of icons, colors etc. (use of media ‘language’)
- Solution
  - Within limits, larger is better (require less manipulation for user)
  - More investigation needed here
  - Depends largely on task & more investigation needed
  - Users should learn about the media (like desk-top publishing)

Potential problems (continued)

- Problem: Navigation
  - Getting lost
  - Transition of users from ‘old’ systems
- Solution
  - Graphical browsers (hierarchical view of nodes with links between them)
  - Use of metaphors from the ‘old’ systems can greatly help new users convert to new systems

Hypermedia interfaces

- Characteristics
- Potential benefits
- Potential problems

Characteristics of hypermedia

- Nonlinear representation including various media
- Related terms
  - Multimedia
  - Multimodal
- Hypercafé: an example application
  - Includes text, sound and video

Potential benefits

- Richer communication
- Enables new modes of expression
- Enables new types of applications
- More fun!
- Better explanations
- User in control/freedom

Potential problems from hypermedia

- Navigation: Links and searching
- Media allocation/construction
- Media combination/integration
- Authoring hypermedia

Links in hypermedia

- Representations of links
  - In static media
  - In dynamic media
  - Source/destination
- Dead ends
- Getting lost

Searching in hypermedia

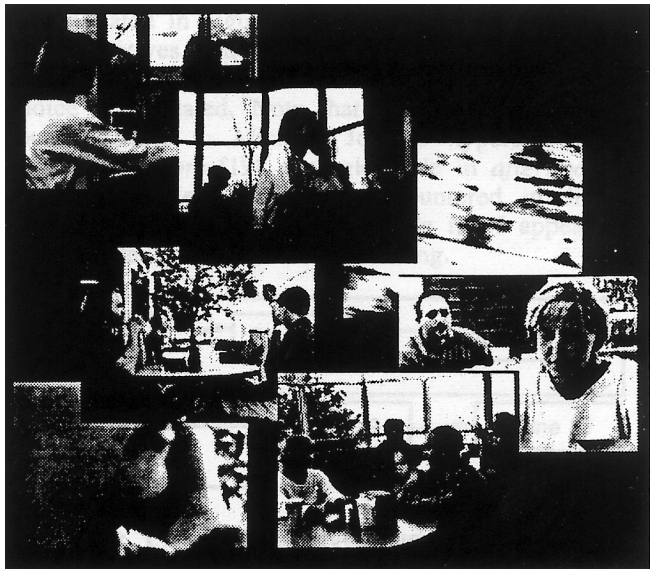
- Searching in non-textual information

Media allocation/construction

- Technology driven
- Common sense driven
- Based on understanding of "media language"
  - Media biases

Media integration

- Lack of conventions
- Info overload



Authoring hypermedia

- “getting lost”
  - Maps
- Embedded guidelines/rules
- Interface of authoring system
- Use of different media types in different stages of the design process
- Who should be hypermedia designer?

Virtual Environments

VE, VR, AR, VW, Cyperspace

Timeline

- Flight simulators (late 50's)
- 1965: "The ultimate display:"
  - *"The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal."* [Sutherland 65].
  - Sutherland builds HMD system with:
    - see-through stereo head-mounted display
    - head tracking
    - hand tracking

Timeline (continued)

- 1980’s
  - Better LCD screens
  - Performance and cost improvements in image generating systems

Problems of VE

- High-resolution and wide-angle images
- Image generation (>15fps)
- Tracking of head and hand accurately

Fooling the senses

Visual		Screen, optics, image-generation system
Auditory		Headphones, speakers
Olfactory		Odor transport system
Gustatory		(Taste transport system)
Haptic	Tactile	Touch, temperature, texture, pressure sensed by skin
	Kinesthetic	Force sensed by muscles, joints, tendons
	Proprioceptic	Sense of limb-torso positions and angles
Vestibular		Sense of balance (motion platform)

What does what??

Head movement	Head tracker
Body or limb movement	tracker, force-feedback device, Spaceball, Bodysuit
Finger movement	glove, gamepad, joystick, keyboard
Eye movement	eye tracker
Speech	speech-recognition system
Force exerted	Force-feedback device with force detection, Bodysuit

Matching Display to Senses

- Visual
  - Field of view (208 deg.)
  - Illumination [1 to 10^{10}]
  - 3 primitives
  - Refresh rate (When is a flashing light perceived as a steady light)
  - Depth perception ability decreases with range

Matching Display to Senses

- Auditory
  - Mixing of sounds
  - Location/direction
  - Elevation accuracy lower than azimuthal accuracy
- Haptic
  - Not localized sense
  - Humans are sensitive to many diff. types of input
    - Texture
    - Temperature
    - Pressure

Matching Display to Senses

- Vestibular
  - Realbody motion
  - Matching problem
- Smell
  - Re”fresh” problem
- Gustatory (Taste sense)
  - Primitives: Sweet, sour, salty, bitter
  - What can be swallowed
  - Re”fresh” problem

Displays

- General
  - Display location should be close to sensory organ
  - Display should match sensory stimulus range
  - Replace or augment outside environment
  - Display should be wearable
- Visual
  - Screens
  - Head mounted display
  - Arm mounted display

Displays(Continued)

- Auditory
  - Earphones
  - Speakers mounted in envronment
- Haptic
  - Force-feedback joysticks
  - Force-feedback arms
  - Force-feedback exoskeletal devices for hand, arm,….

Visual Displays

- Desired Display Spec.
  - Stereo
  - 4,000x4,000 resolution.
  - “Alpha” channel
  - Full color
  - 100 Hz update rate
  - Lightweight
  - No cables

Auditory Systems

- Mixing (Dep. on processing power)
- Sampled vs. comp. gen. sound
- Modeling: World may/must affect sound

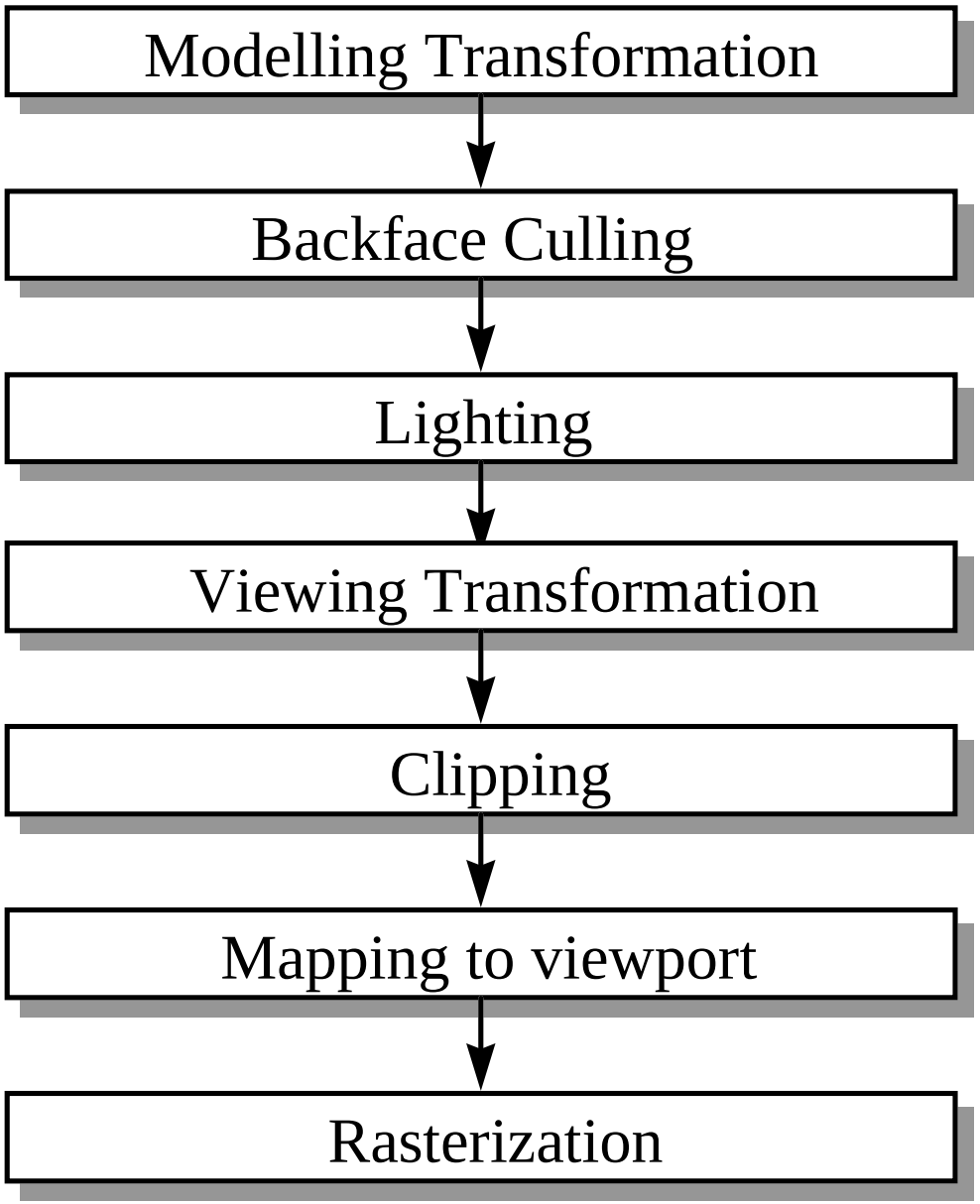
Haptic Displays

- Sensors scattered throughout human body
- Modeling of physical characteristics
  - Hardness
  - Texture
  - temperature
  - weight
- Collision detection
- SAFETY

Image Generation

- VE demands high framrates (> 15 fps)
- VE demands high resolution
- VE demands complex models
  - 1,000 polygons: A room with some detail
  - 5,000 polygons: A detailed room
  - 50,000 polygons: A house with some detail
- To become mainstream VE render machines must be cheap or relatively cheap (< 10,000$)

The graphics pipeline



Improving the model

- Antialiasing
- Illumination
  - Common
    - Ambient lighting
    - Diffuse lighting
    - Specular
  - Radiosity illumination
    - Computationally expensive to be calculated realtime
    - Illumination is view independent

Improving the model(continued)

- Shading
  - Flat fastest (almost no shading)
  - Gouraud (relatively fast)
  - Phong (Very accurate specular hightlights but computationally expensive)
- Texture mapping
  - Increases polygon detail
- Shadows

Tracking the user

- Magnetic detectors
- Optical detectors
- Mechanical detectors
- Acoustic
- Inertial

Users problems

- Possibly restrictive to user motions
- Potentially physical danger
  - Physical sickness (simulator sickness)
- Increasing chance of “getting lost”
  - Getting “desorientated”
    - Lack of detail
    - Physical desorientation “claustrophobic”
  - Getting lost via links
    - System should feature “⇦”

Problems for the creator

- Complexity of creating a world
  - Needs to manage different techniques
    - Texture mapping
    - 3D object design
    - Lighting
    - Material knowledge (what is temp., texture, dampness,… of object)
    - Video input
    - Sound sampling/generating
    -
    -

VR from the Neurosurgical perspective

- Advantages of VR
  - Neurosurgeons will have the feel of the brain
  - No need to learn to use a computer
    (provided the VR system is automatically updating world to match the ward)
- Disadvantages
  - Cumbersome to wear VR-gear
  - Potential technology fear of Neurosurgeons
    - Hands are the surgeons “bread and butter”

Evaluation methods

- Hypertext
  - Number of users
  - Number of links
- Hypermedia
  - Few specific hypermedia/multimedia
  - evaluation methods exist
- Virtual environments
  - Sense of presence