User Interfaces for Interactive Graphics

- User interface is at least as important as the "algorithm"
- One of the most important yet least understood aspects of interactive graphics
- Can make a significant different on:
  - effectiveness
  - acceptance

- Review of Basic Interaction Handling
  - Human Factors
    - simple consistent
    - don't overload user
    - show available options
    - provide feedback
    - provide graceful recovery

Basic Ergonomic Issues

- ## Fitts' Law
  - Movement time = $a+\log_2(2D/W)$
    - D=distance W=target

- ## Hick-Hymann Law
  - Reaction time = $a+bH_T$
    - H_T is the amount of information transmitted

- ## Task and Techniques
  - Task: basic entry of unit information by user
    - select, quantify, text, position
  - Technique: how the task is done
    - many techniques for a given task

Input Hardware - 2D

- Three levels of consideration
  - device - hardware characteristics
    - (mouse shape, fatigue using light pen, footprint)
  - task - appropriateness for a given task
    - (mouse better than joystick for picking)
  - dialogue - sequences of tasks
    - (shifting from mouse to keyboard)

- Locator Devices
  - absolute / relative
    - report position within a frame of reference or report only changes in position
  - direct / indirect
    - interact directly with the screen or not
  - discrete / continuous
    - smooth hand movements create smooth cursor movements

Locator Devices

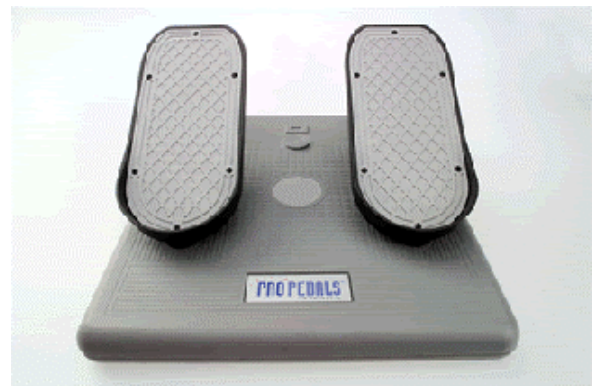**Absolute/Relative   Indirect/Direct   Discrete/Continuous**

Input Device for Computer Game?

Absolute/Relative Indirect/Direct Discrete/Continuous

	Mouse Keyboard Joystick Touch Screen ??
Device Level	
Task Level	
Dialogue Level	

Alternative Input Devices

Absolute/Relative   Indirect/Direct   Discrete/Continuous

Keyboard

- ## QWERTY keyboard
  - traditional keyboard

- ## Dvoøák
  - vowels and high frequency characters on home positions

- ## Alphabetic
  - keys in alphabetical order
- ## Chorded

Basic Interaction Tasks

- Position, Select, Quantity, Text

- Position - specifying (x,y) or (x,y,z)
  - coordinate system: if locator moves R, in which cs do we move object?
  - feedback: spatial vs. numeric (linguistic)
  - learning time (hand-eye coordination, sketching with mouse vs. tablet)
  - resolution & grids

- Selection (choose one from a set)
  - Large/varying set
    - naming (typing, wildcard, autocompletion, speech)
    - pointing (multi-level hierarchy)
      - char/word/sent/par hierarchy

Basic Interaction Tasks

- **Selection (choose one from a set)**
  - Small/fixed set - menus
    - order (alphabetical, logically grouped, most frequently used)
    - one level vs. hierarchical
      - slot machine
      - cascading hierarchy
      - panel hierarchy
    - menu placement
      - on/off screen
      - static & permanent vs. dynamic on request
    - visual representation
      - text names, icons, etc.
    - current selection
      - highlight item
    - size and shape
      - Fitts' Law
      - popup pie menus
    - function keys

Basic Interaction Tasks

- Text Interaction - entering characters which DO NOT have a special meaning
  - keyboard
  - character recognition
  - menu selection

- Quantity - specifying numeric values between a minimum and a maximum
  - linguistic (type a value) vs. spatial (slider)
  - setting dial, up/down counter

Input Hardware - 3D

- Three levels of consideration
  - device - hardware characteristics
    - (mouse shape, fatigue using light pen, footprint)
  - task - appropriateness for a given task
    - (mouse better than joystick for picking)
  - dialogue - sequences of tasks
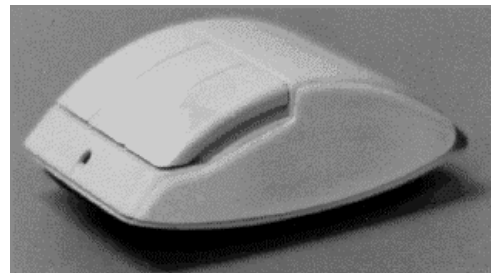   - (shifting from mouse to keyboard)

Input Hardware - 3D

- ## Joysticks & Trackballs
  - no direct mapping between movement of device and movement in 3D space

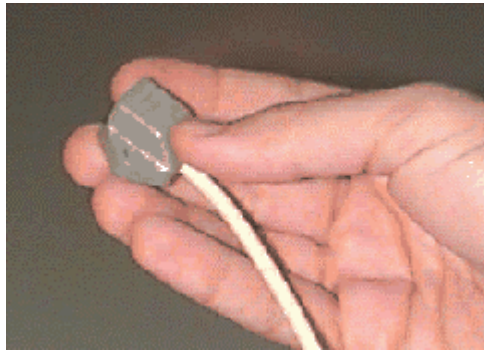- ## Spacemouse
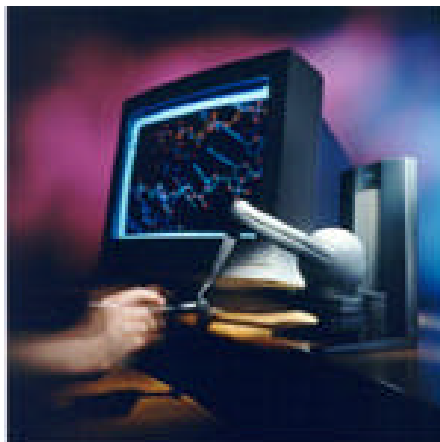
- ## 3D Rockin' Mouse

- ## Dataglove

Input Hardware - 3D

- Polhemus
  - Electromagnetic position and orientation trackers

- Phantom
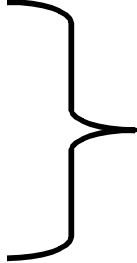 - 3D Input with force feedback

3D Interaction Tasks

- Position, Selection, Rotation
  - complex because of difficulty in perceiving 3D depth relationships on a screen
  - 3D cursors are inherently difficult (most locators/pickers are only 2D)
- Some methods to assist with 3D
  - use orthographic views
  - use button to specify an axis

Composite Interaction Tasks

- A combination of basic interaction techniques integrated into a unit
  - dialogue boxes
  - construction
  - manipulation

- dialogue boxes
  - to specify multiple units of information
  - remains visible until dismissed by user
- construction techniques
  - used to create objects requiring two or more positions
  - rubberband line drawing
- dynamic manipulation
  - modify existing geometric objects
  - move, resize, rotate

User Interface Styles

- WYSIWYG
- Direct Manipulation
- Iconic
- Menu Selection
- Command Entry
- Natural Language
- Question & Answer

These three are unique to computer graphics

- A good UI is often a blend of some or all of these

WYSIWYG & Direct Manipulation

What you see is what you get

- Characterized by no translation of indirection between what's on screen and the ultimate appearance
  - can be very advantageous ... "direct" coupling
  - BUT, difficult to show many things this way (e.g. Hierarchial relationships)
  - WYSIAYT (... is ALL you get)

Direct Manipulation

- commands invoked by a "graphic" action
- act directly on the screen representation
  - easy to learn but can be slow (must find file even if you know it's name)

Iconic & Other Dialogue Forms

- **Iconic**
  - use of a pictorial representation or graphic symbols to represent objects, operations, properties
    - recognition (of meaning of icon)
    - recall (ease of remembering meaning once learned)
    - discrimination (of one from another)
  - easy to recognize … IF well design
  - often takes less space than corresponding text
- **Other Dialogue Forms**
  - menu: often used (recognition rather than recall)
  - commands: traditional but relies on recall
  - natural language: nice but wordy and ambiguous
  - Q&A: simple
- **Comparison Chart**

CMPT 363 - User Interface Design

- January 2001
  - User-Centered Design
  - Participatory Design
  - Contextual Inquiry
  - Prototyping
  - Graphic Design
  - Usability Inspection
  - Cognitive Modeling
  - Usability Evaluation
  - Input/Output Techniques
  - Interaction Styles
  - Ubiquitous Computing
  - Research Issues in HCI