Chapter 6
Direct Manipulation and Virtual Environment
Sections 6.1, 6.2 and 6.3

Direct Manipulation = Visual Representations of Actions and Objects

Examples of Direct-Manipulation Systems
Command line vs. display editors and word processors
- The advances of WYSIWYG word processors:
  - Display a full page of text
  - Display of the document in the form that it will appear when the final printing is done
  - Show cursor action
  - Control cursor motion through physically obvious and intuitively natural means
  - Use of labeled icon for actions
  - Display of the results of an action immediately
  - Provide rapid response and display
  - Offer easily reversible actions
Examples of Direct-Manipulation Systems (cont.)

Technologies that derive from the word processor:
- Desktop publication software
- Slide-presentation software
- Graphics editors
- Hypermedia environments
- Improved macro facilities
- Spell checker and thesaurus
- Grammar checkers
- *Note*: Integration of applications

Examples of Direct-Manipulation Systems (cont.)

The VisiCalc spreadsheet and its descendants
- VisiCalc users delighted in watching the program propagate changes across the screen.
- The "killer app" for direct manipulation!
- In some cases, spatial representations provide a better model of reality
- Successful spatial data-management systems depend on choosing appropriate:
  - Icons
  - Graphical representations
  - Natural and comprehensible data layouts

Examples of Direct-Manipulation Systems (cont.)
Examples of Direct-Manipulation Systems (cont.)

Video games
- From PONG to Nintendo GameCube, Sony PlayStation 2, and Microsoft Xbox
- Field of action is visual and compelling
- Commands are physical actions whose results are immediately shown on the screen
- No syntax to remember
- Most games continuously display a score
- Direct manipulation in SimCity
- Myst well received
- DOOM and Quake controversial

Definition of Direct Manipulation

The OAI Model explanation of direct manipulation

1. Continuous representation of the objects and actions of interest
2. Physical actions or presses of labeled buttons instead of complex syntax
3. Rapid incremental reversible operations whose effect on the object of interest is immediately visible

Human Factors Issues: Usability Measures

- Learning time (Novices)
  - Training times with display editors are much less than line editors
  - Why? Recall vs. recognition of commands
  - Why? Visual metaphor creates familiar tasks

- Performance time (Experts)
  - Line editors are generally more flexible and powerful
  - Why? Typing takes less time than pointing (.2sec/char vs. 1.2sec/point)

- Fewer errors
  - Display editors cause fewer errors
  - Why? Recognition vs. recall; See incremental results immediately

- How can you combine the best of both?
Human Factors Issues: Usability Measures (cont.)

- Satisfaction
  - Positive feelings associated with good user interfaces:
    - Mastery of the interface
    - Competence in performing tasks
    - Ease in learning the system originally and in assimilating advanced features
    - Confidence in the capacity to retain mastery over time
    - Enjoyment in using the system
    - Eagerness to show the system off to novices
    - Desire to explore more powerful aspects of the system

Why does Direct Manipulation work?

- An excursion into human memory

A Test of your Memory!
More on Human Memory

- Human memory is not perfect!
- How can we survive?
  - Information in the world
    - reminding
    - Great precision not required for most decisions, just need to select between alternatives
  - recall vs. recognition
  - Natural constraints are present
  - Cultural constraints are present

From Task to UI

Model of Human Action
(after Hutchins, Holland & Norman)
Designing Icons

• An icon is an image, picture, or symbol representing a concept

• Five levels of icon design:
  – Lexical qualities. Machine-generated marks—pixel shape, color, brightness, blinking
  – Syntactics. Appearance and movement—lines, patterns, modular parts, size, shape
  – Semantics. Objects represented—concrete versus abstract, part versus whole
  – Pragmatics. Overall legibility, utility, identifiability, memorability, pleasingness
  – Dynamics. Receptivity to clicks—highlighting, dragging, combining

Icons as a Language

What would be good icons for the following text editing functions? Design a pulldown menu.

Cut
Clear
Copy
Paste
Undo

Designing Icons (cont.)

• Icon-specific guidelines
  – Represent the object or action in a familiar manner
  – Limit the number of different icons
  – Make icons stand out from the background
  – Consider three-dimensional icons
  – Ensure a selected icon is visible from unselected icons
  – Design the movement animation
  – Add detailed information
  – Explore combinations of icons to create new objects or actions
Summary of Direct Manipulation

Benefits:
- Novices learn quickly
- Experts work rapidly
- Intermittent users can retain concepts
- Error messages are rarely needed
- Users see if their actions are furthering their goals
- Users experience less anxiety
- Users gain confidence and mastery

Summary of Direct Manipulation

Problems:
- Spatial or visual representations can be too spread out
- High-level flowcharts and database-schema can become confusing
- Designs may force valuable information off of the screen
- Users must learn the graphical representations
  - Icons can be difficult to recognize
- The visual representation may be misleading
- Typing commands with the keyboard may be faster