Direct Manipulation & Interface Principles

Modern User Interfaces

Windows 1.0
Mac OS 1.0
Windows 3.0
Mac OS 7

1987
1981
1985
1992
1998
Anatomy of a WIMP interface

Windows, Icons, Menus, Pointers
Graphical User Interface

WIMP interface emulates existing work practices
Direct manipulation
Desktop metaphor

UI Elements

• Windows
• Icons
• Menus
• Buttons
• Sliders
• Input fields
• Links
• Sounds

All modern UI’s have these, though the implementation, look & feel, and behavior differs
Windows

• Modal vs. Modeless
  – Dialogue Windows
  – Toolbars
  – Status indicators

• Elements
  – Title
  – Window controls
  – Menu
  – Content
  – Frame

• Operations
  – Move
  – Resize
  – Stack
  – Close

More Window Properties

• Opacity/Transparency
• Stay-on-top
• Positional and size memory
• ???
Menus

• **Pull-down and toolbar menus**
  – Pull-down menus
    • Always available, standardized
  – Key board shortcuts
    – E.g., Ctrl-C important to support efficiency
  – Toolbars, iconic menus, and palletes
    – Offers actions on a displayed object
  – Pop-up menus
    – Appear on a display in response to a check or tap with a pointing device.

Menus (cont.)
Menus (cont.)

- **Menus for long lists**
  - Scrolling menus, dynamic menus, and fisheye menus
    - Scrolling menus display the first portion of the menu and an additional menu item, typically an arrow that leads to the next set of items in the menu sequence.
    - Adaptive menus
    - Fisheye menus display all of the menu items on the screen at once, but show only items near the cursor at full size.
Adaptive menus in Microsoft Office.

A font-selection menu lists the recently used fonts near the top of the menu (as well as in the full list), making it easier to quickly select the popular fonts.

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Content Organization (cont.)

Menus (cont.)

• Two-dimensional menus
  – “Fast and vast” two-dimensional menus give users a good overview of the choices, reduce the number of required actions, and allow rapid selection.
Data Entry with Menus: Form Fill-in, Dialog Boxes, and Alternatives

- Novel design combining menus and direct manipulation
  - Pie menus
  - Marking menus
  - Flow menus
  - Toolglass/Magic Lense

Principles of Direct Manipulation

- Pointer as your virtual hand
- Mouse as your control into said world
- 2-dimensional (for the most part)
- Intuitive, natural

- Direct manipulation ≠ perfect analogue
Strengths of Direct Manipulation

- Natural analogue to how we interact with the real world
  - 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
  - Desire to explore more powerful aspects of the system

Interface-Building

Visual Thinking and Icons
- To use direct manipulation, we need an icon (an image, picture, or symbol representing a concept, operation or file)

- Most Operating systems and programming environments
  - Provide default icons for common elements/tasks
  - Have strict guidelines about the design and use of graphical elements
  - Sometimes designing icons for abstract operations may be challenging
  - Some graphical elements may be heavily culturally dependent, or may not age well
Examples of Direct-Manipulation Systems:

WYSIWYG word processing

Examples of Direct-Manipulation Systems (cont.):

spreadsheet
Examples of Direct-Manipulation Systems (cont.)

The VisiCalc spreadsheet and its descendants
• VisiCalc users delighted in watching the program propagate changes across the screen.

• Some concepts can be difficult to convey here

• Some operations not as easy to accomplish graphically

Examples of Direct-Manipulation Systems (cont.)

Video games
• Nintendo Wii, Sony PlayStation, 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
Examples of Direct-Manipulation Systems (cont.)

Discussion of Direct Manipulation

Problems with direct manipulation
• Spatial or visual representations can be too spread out
• Designs may force valuable information off of the screen
• Users must learn the graphical representations
• The visual representation may be misleading
• Typing commands with the keyboard may be faster
3D Interfaces

• “Pure” 3D interfaces have strong utility in some contexts, e.g., medical, product design. In other situations, more constrained interaction may actually be preferable to simplify interactions.

• “Enhanced” interfaces, better than reality, can help reduce the limitations of the real-world, e.g., providing simultaneous views.

• Avatars in multiplayer 3-D worlds

• First person games

3D Interfaces (cont.)

Challenges to effective 3D displays/interfaces

– Use occlusion, shadows, perspective, and other 3D techniques carefully.
– Minimize the number of navigation steps for users to accomplish their tasks.
– Keep text readable.
– Avoid unnecessary visual clutter, distraction, contrast shifts, and reflections.
– Simplify user movement.
– Prevent errors.
– Simplify object movement
– Organize groups of items in aligned structures to allow rapid visual search.
– Enable users to construct visual groups to support spatial recall.
Virtual and Augmented Reality

• Virtual reality breaks the physical limitations of space and allow users to act as though they were somewhere else
• Augmented reality shows the real world with an overlay of additional overlay
• Situational awareness shows information about the real world that surrounds you by tracking your movements in a computer model
• Augmented reality is an important variant
  – Enables users to see the real world with an overlay of additional interaction.

Virtual and Augmented Reality (cont.)

• Successful virtual environments depend on the smooth integration of:
  – Visual Display
  – Head position sensing
  – Hand-position sensing
  – Force feedback
  – Sound input and output
  – Other sensations
  – Cooperative and competitive virtual reality