Chapter 6

Direct Manipulation and Virtual Environment

Introduction

- Positive feelings associated with good user interfaces: (convey an image of the pleased user)
  - ☐ Mastery of the interface
  - ☐ Competence in performing tasks
  - ☐ Ease in learning the system and its advanced features
  - ☐ Confidence 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

Direct-Manipulation Interfaces

- Central ideas in these satisfying interfaces (*direct-manipulation* interfaces) are:
  - Visibility of the objects and actions of interest;
  - Rapid, reversible and incremental actions; and
  - Replacement of typed commands by a pointing action on the object of interest.
- Newer concepts that extend direct-manipulation:
  - Virtual reality
  - Augmented reality
  - Tangible user interfaces

Examples of Direct-Manipulation Systems

Command line vs. display editors and word processors

- Training times with display editors are much less than line editors

- The advantages 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 natural means
  - Use of labeled icons for frequent actions
  - Display of the results of an action immediately
  - Provide rapid response and display
  - Offer easily reversible actions

► Examples of Direct-Manipulation Systems

Technologies that derive from the word processor:

- Integration
  - ☐ graphics, spreadsheets, photographs, …
- Desktop publishing software
  - ☐ Newsletters, reports, broachers, books, newspapers
  - ☐ Examples: Adobe PageMaker, QuarkXPress
- Slide-presentation software
- Hypermedia environments and the Web (hyperlinks, bookmarks, etc)
- Improved macro facilities, style sheets and templates
- Spell checker and thesaurus
- Grammar checkers
- Document assemblers (contracts, wills)

► Examples of Direct-Manipulation Systems

The VisiCalc (1979) spreadsheet and its descendants

- The first electronic spreadsheet

- VisiCalc users delighted in watching the program propagate changes across the screen.

- Lotus 1-2-3 dominated the market in 1980s

- MS Excel is the current leader

- Features of modern spreadsheets? …

► Examples of Direct-Manipulation Systems

Spatial data management

- In some cases, spatial representations (electronic maps) provide a better model of reality. Examples:
  - ☐ ArcView (by ESRI, Inc.)
  - ☐ Xerox PARC Information Visualizer
- Successful spatial data-management systems depend on choosing appropriate:
  - ☐ Icons
  - ☐ Graphical representations
  - ☐ Natural and comprehensible data layouts

ArcView
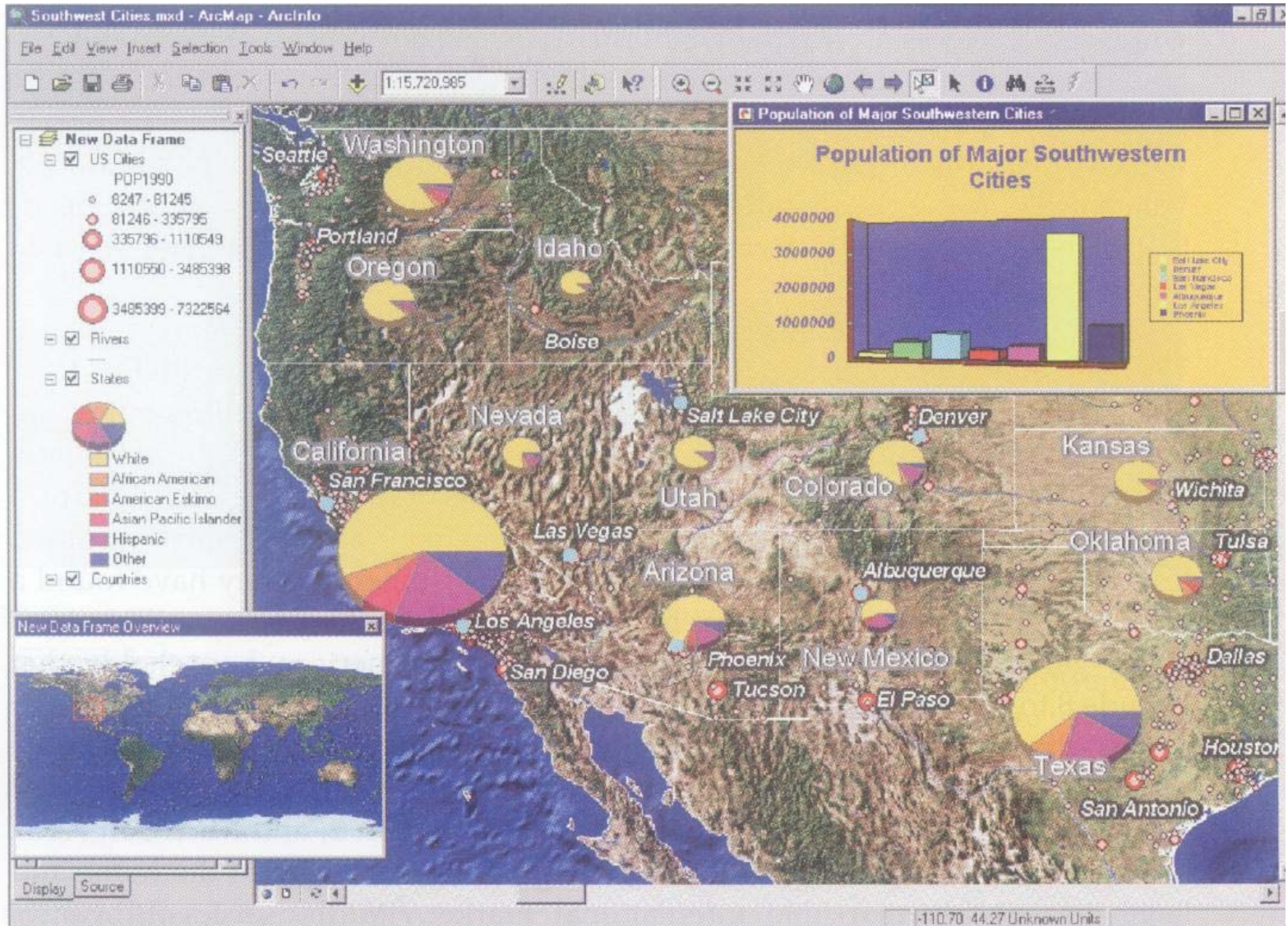
► Examples of Direct-Manipulation Systems

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
- Almost no need of error messages

- Good lessons, but there are limits to the applicability
  - □ Games have a competitive environment
  - □ Random events make it more challenging and enjoyable
  - □ Non-game environments need to be predictable

► Examples of Direct-Manipulation Systems

Computer-aided design (CAD)

- For automobiles, electronic circuits, aircrafts, buildings,…

- Manipulate the object of interest directly

- Generate alternatives easily

- Computer-aided manufacturing (CAM) and process control is a related area

Office automation

- Rapid and continuous graphical interaction

- Xerox Star (1982) was a pioneer with sophisticated formatting

- Apple Lisa System

- Macintosh used experiences of Star and Lisa

- Microsoft Windows is a descendant and currently dominates the market

  - Compare to MS-DOS …

Problems with Direct Manipulation

- Not good for vision-impaired users
- Spatial or visual representations can be too spread out forcing valuable information off-screen causing scrolling or multiple actions
  - Table vs. plot; table vs. icons; program text vs. flowchart
- Users must learn the graphical representations
  - Do you understand the meaning of various icons around you?
- The visual representation may be misleading
  - Drawing incorrect conclusion
- Typing commands with the keyboard my be faster
  - Keyboard maybe more direct device in some cases.
- Choosing the right objects and actions for DM maybe difficult
- Some DM principles can be surprisingly difficult to realize in software
  - Rapid, incremental, reversible actions;
- Web-based implementers face further challenges because of the limitations of HTML

The OAI Model Explanation of Direct Manipulation

- Many of the previous examples demonstrate the advantages of direct manipulation, which can be summarized by three principles:

  - Continuous representation of the objects and actions of interest

  - Physical actions or presses of labeled buttons instead of complex syntax

 - Rapid, incremental, reversible operations whose effect on the object of interest is immediately visible

■ Beneficial attributes:

☐ Novices learn quickly, usually through demos.

☐ Experts can work rapidly to carry out a wide range of tasks

☐ Intermittent users can retain operational concepts

☐ Error messages are rarely needed

☐ Users see if their actions are furthering their goals, and if not, they can change the direction of their activity

☐ Users experience less anxiety because the interface is comprehensible and actions are reversible

☐ Users gain confidence and mastery because they are the initiators of actions, they feel in control, and they can predict interface's responses

► The OAI Model Explanation of Direct Manipulation

- The success of DM is understandable in the context of OAI model. Objects of interest are visible and actions correspond to actions in the task domain
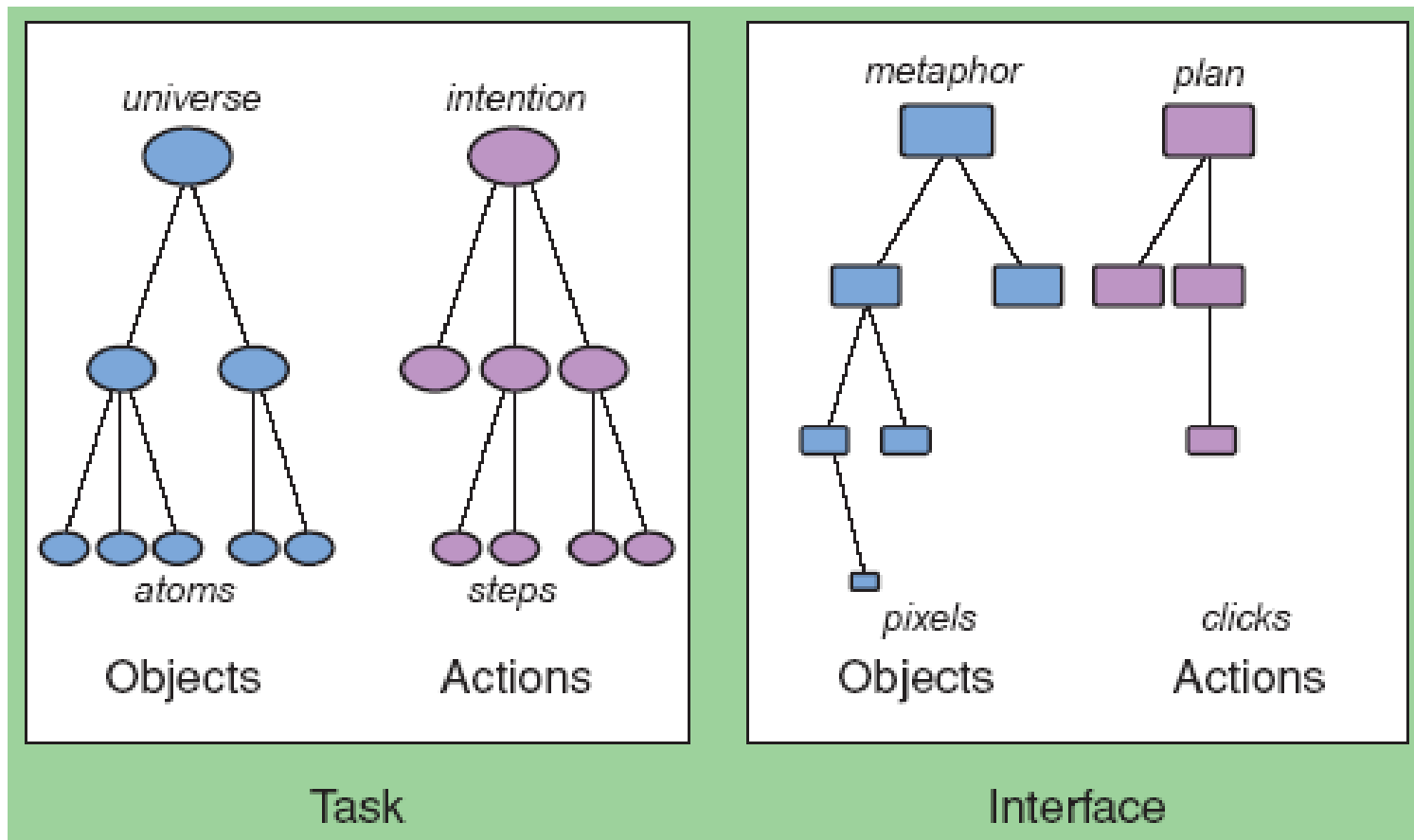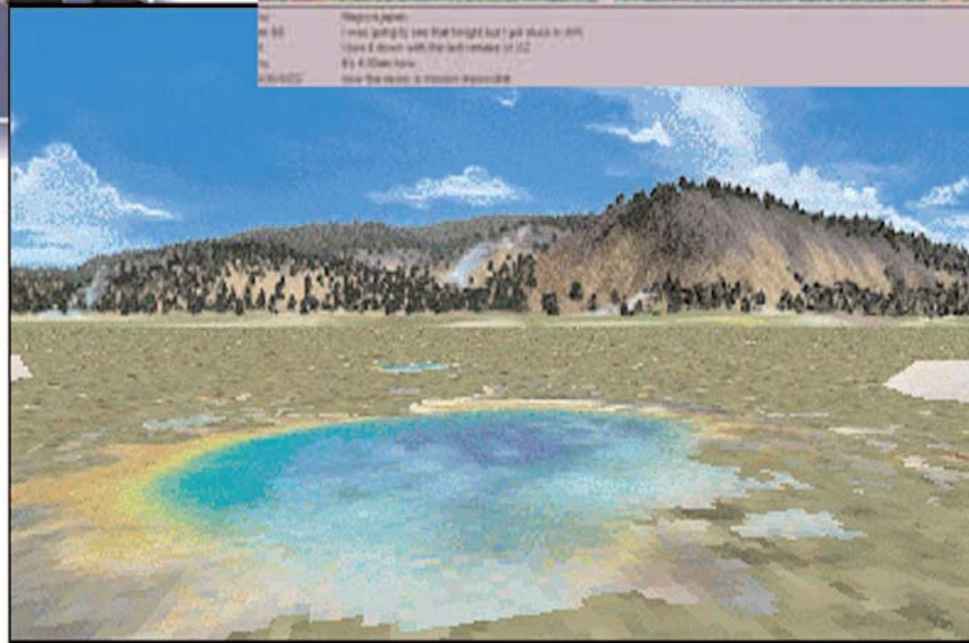
3D Interfaces

- Visualize things in three-dimension space (real world)
- Some 3D prototypes only add clutter and limit navigation. e.g., digital libraries and file directories
- More constrained interaction may actually be preferable to simplify interactions.
- "Enhanced" interfaces, better than 3D reality, can help reduce the limitations of the real-world, e.g., providing simultaneous views, or flying through objects.
- "Pure" 3D interfaces have strong utility in some contexts, e.g., medical, architectural, product design, scientific visualization.
- Successful applications of 3D representations are game environments
  - First person games
  - Users choose avatars to represent themselves in multiplayer 3-D worlds. e.g., ActiveWorlds

► 3D Interfaces
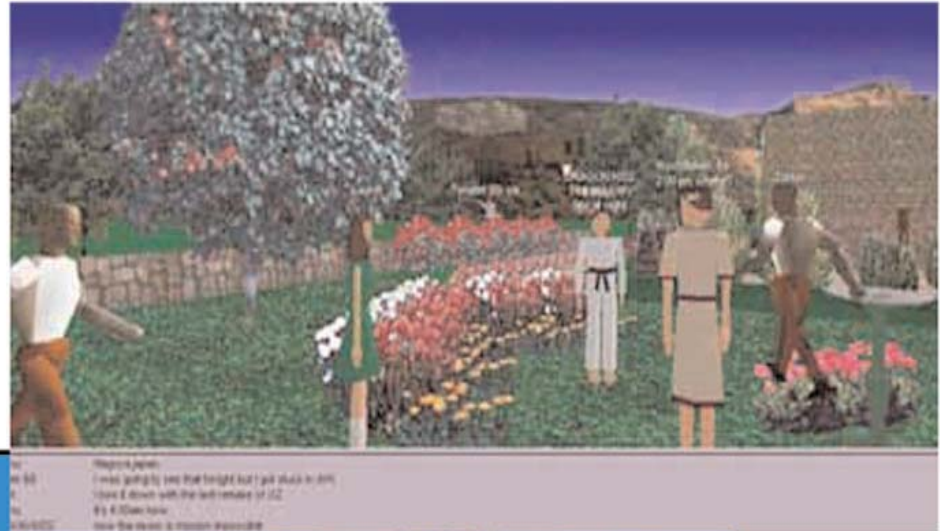
ActiveWorlds

A web-based
environment

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► 3D Interfaces

Features for effective 3D

- ☐ Use 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 and distraction.

- ☐ Simplify user and object movement.

► 3D Interfaces

Guidelines for inclusion of *enhanced* 3D features:

- ☐ Provide overviews so users can see the big picture

- ☐ Allow teleportation (rapid context shifts)

- ☐ Offer X-ray vision so users can see into or beyond objects.

- ☐ Provide history keeping (recording, undoing, replaying)

- ☐ Permit rich user actions on objects (save, copy, annotate, share, send)

- ☐ Give users control over explanatory text and let users select for details on demand.

- ☐ Offer tools to select, and mark.

► 3D Interfaces

► Guidelines for inclusion of enhanced 3D features:

- ☐ Implement dynamic queries to rapidly filter out unneeded items.
- ☐ Support zooming and movement
- ☐ Enable landmarks to show themselves even at a distance
- ☐ Allow multiple coordinated views
- ☐ Develop novel 3D icons to represent concepts that are more recognizable and memorable.

■ Development Tools for the web: X3D, Xj3D

Virtual and Augmented Reality

- *Virtual reality* puts users in an immersive environment in which the normal surroundings are blocked out by a head-mounted display.

- It breaks the physical limitations of space and allow users to act as though they were somewhere else.

- Imagine a 3D design view of a building on a display; and then using a head-mounted display, virtually walking through the doors
    - It takes the user from "looking at" to "being in"
    - In some situations, "looking at" maybe more effective

- Successful Examples:
    - Flight-simulators
    - Medical: treatment of phobia, fear of height

► Virtual and Augmented Reality

- *Augmented reality* is an important variant of virtual reality
    - Enables users to see the real world with an overlay of additional information.
- Effectively used in:
    - Medical
    - Tourist guides
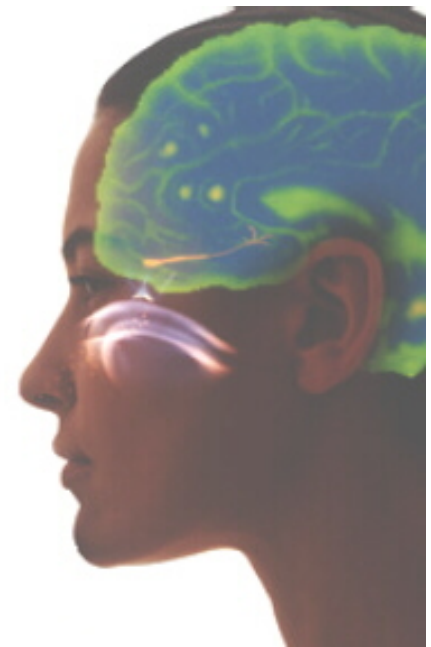
► Virtual and Augmented Reality

- Successful virtual environments depend on the smooth integration of:
    - Visual Display
        - faster and wider ranged are desirable
    - Head position sensing
        - in head-mounted display or by video recognition
    - Hand-position sensing (glove devices)
    - Handheld manipulatives
    - Force feedback
    - Sound input and output
    - Other sensations (tilting, vibrating, hot/cold sensing, etc.)
    - Collaborative and competitive virtual environments

Skipped Sections

The following sections have been skipped:

- ☐ 6.2.7 The continuing evolution of direct manipulation

- ☐ 6.3.3 Visual thinking and icons
- ☐ 6.3.4 Direct manipulation programming

- ■ 6.5 Teleoperation