Direct Manipulation Interfaces

Direct Manipulation = Visual Representations of Actions and Objects

Definition for DM: Visibility of the objects and actions of interest; rapid, reversible, incremental actions; and replacement of typed commands by a pointing action on the object of interest.

Classic Example: driving a car – steering – based upon what you see, braking, etc. – no menu’s

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

How well does it work for ‘visually impaired users’?
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!
- What about the 'ribbon' in Office
- In some cases, spatial representations provide a better model of reality
- Successful spatial data-management systems depend on choosing appropriate: << GOOGLE EARTH >>
  - Icons
  - Graphical representations << ZOOMING IN/OUT>>
  - Natural and comprehensible data layouts
  << OPTIONS >>

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 360, Guitar Hero
- 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

Obviously the game player is much different from our application users – where 'surprise' or random events is NOT fun! (ie, Jackpot Party)

Examples of Direct-Manipulation Systems (cont.)
- Gaming – gambling devices (based off a discussion with Mark Bansemer of IGT)
  - Patent - Gaming device having perceived skill
  - Random events and outcomes to determine an entertaining presentation are critical in the gaming world. Using randomness to create GUI’s kind of sounds like my Junior project and definitely doesn’t cause an entertaining display for the end user.
  - Intuitive GUI’s are a must in the world we live in today. There is so much competition in software applications and using non-intuitive GUIs are a surefire way to sink an application’s potential
  - Unplanned and indiscriminate events
  - Psychologist (none) – do rely on heavy user testing – including interviews, observations, etc.
  - Customizable – server/network based products – where the game can be changed for a specific group or individual – in a sense a somewhat customizable array of games and UI’s – finally said glad to see us exploring this area

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 – important part of what we are after!
  – 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!

Some experts suggest - we construct memories rather than record them. We store bits and pieces of information, and when it comes time to retrieve we take bits and pieces of our experience from different times and we integrate it.
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

Model of Human Action

(after Hutchins, Holland & Norman)

Goals

(Form) Intention to Act Evaluation

(Specify) Sequence of Actions Interpretation

(Do it) Physical Execution Perception(of world)

The WORLD

So how does the model help us

• Just another design aid

• Broken down into 4 main principles of good design:
  – Visibility - By looking, the user can tell the state of the device and the alternatives for action
  – Good Conceptual Model - Designer provides a good conceptual model for the user, with consistency in the presentation of operations and results and a coherent, consistent Image
  – Good mappings - possible to determine the relationships between actions and results, between the controls and their effects, and between the system state and what is visible.
  – Feedback - The user receives full and continuous feedback about the results of the actions.)
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
- What about people with vision problems