User Interface Design

Lecture 4
May 30, 2006
Housework

- Midterm
- Presentations for project will come closer to the end of the semester -- will have more info later
Choosing an Alternate Design

• Two categories of decisions:
  – External
    • E.g. outward appearance, wait time, etc
  – Internal
    • E.g. things that affect the outward behaviour

• How do we decide between competing designs?
How do you generate alternative designs?

• Common tendency:
  – Stick with what you know
• How do we get creative?
  – Some are naturally
  – Most aren’t
• Most ideas aren’t new
  – Just need to find inspiration!
  – Case-based reasoning
• Existing constraints
• “An expert is someone who gets reminded of just the right prior experience to help him in processing his current experiences” Schank

• Were there any truly innovative elements in your calendar design?
Quality

• Which version is of higher quality?
• “Quality” is a relative term
  – Think of loading a web page before you give up
  – Can be different for each stakeholder!
Conceptual Models

• “The most important thing to design is the user’s conceptual model. Everything else should be subordinated to making that model clear, obvious, and substantial. That is almost exactly the opposite of how most software is designed” -- David Liddle
Conceptual Models

• A description of the proposed system in terms of a set of integrated ideas and concepts about:
  – What it **should** do
  – How it should **behave**
  – What it should **look like**

  …that is understandable by the users *in the manner intended*
Interaction Mode

• Ask:
  – What are the users doing when carrying out their tasks?
  – E.g. searching for info? Creating docs? Communicating with others?

• What interaction mode best supports this?
  – E.g. browsing versus direct queries
Interaction Style

• What kind of interaction style?
  – Consider the interaction mode

• Types
  – Command language
  – Menu selection
  – Direct manipulation
  – Form fill-in
  – Natural language
Command Language

• Advantages
  – Flexibility
  – Supports user initiative
  – Appeals to power users
  – Potentially rapid for complex tasks
  – Supports scripting

• Disadvantages
  – Requires substantial training and memorization
  – Difficult to retain
  – Poor error handling
Menu Selection

• Depth versus breadth
• Meaningful groupings
• Meaningful presentation
• Phrasing
• Graphic layout and design
• E.g.
  – Pie menus
  – Adaptable menus
Pie Menus as seen in The Sims from Maxis.
Menu Selection

– Advantages
  • Reduces keystrokes
  • Recognition vs. recall
  • Accurate
  • Structures decision making

– Disadvantages
  • Requires screen space
  • Complexity of several menu levels
  • Slows expert users
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Direct Manipulation

- Coined by Ben Shneiderman
- 3 fundamental properties
  - Continuous representation of objects and actions of interest
  - Rapid reversible incremental actions with immediate feedback
  - Physical actions and button pressing instead of commands with complex syntax
Benefits of DM

- Helps beginners learn fast
- Experts can work quickly on wide range of tasks
- Infrequent users can remember
- Rare need for error messages
- Immediate feedback
- Less user anxiety
- Users gain confidence; feel in control
Direct Manipulation

• Apple was one of the first with the Macintosh (inspired by Xerox Star):
  – Used visual and auditory clues to mimic real world and exploit user knowledge
  – Physical actions should have physical results
    • Throwing something in the trash can
    • Noises from expanding/minimizing windows

• Other examples
  – Virtual reality; video games; data visualization tools; CAD
Direct Manipulation

• Drawbacks
  – Can take model too literally
    • Ejecting a disk from a Mac
  – Not all tasks can be described by objects
  – Not all tasks can be done directly
    • Imagine E-mail as icons that had to be dragged and dropped!
  – Hard to track history/write macros
  – More programming required
  – Requires GUI
XEROX
6085 Workstation
User-Interface Design

To make it easy to compose text and graphics, to do electronic filing, printing, and mailing all at the same workstation, requires a revolutionary new interface design.

Bit-map display - Each of the pixels on the 19" screen is mapped to a bit in memory, thus, arbitrarily complex images can be displayed. The 6085 displays all fonts and graphics as they will be printed. In addition, familiar office objects such as documents, folders, file drawers and in-trays are portrayed as recognizable images.

The mouse - A unique pointing device that allows the user to quickly select any text, graphic or office object on the display.

See and Point
All functions are visible to the user on the keyboard or on the screen. The user needn't bother with paper. All printout is confirmed on the display and backup is recorded in the memory of the file.

Shorter Production Times:
Experience at Xerox with prototype workstations has shown shorter production times and less errors, as a function of the percentage of use of the workstations. The following equations can be used to express their

18-point text.
24-point text.
36-point text.
Icons

- Provide imagery that allows for immediate recognition
- Help improve recall
- Reduces the need for interpreting text
- Speed search for actions
- Language independent interfaces
- Save space
Good Icon Design

• Difficult!
  – Cultural and context sensitive

• Some tips
  – Always draw on existing traditions or standards
  – Concrete objects or things are easier to represent than actions
  – Consider clip art
Form Fill-In

• E.g. lists, radio buttons, text fields

• Advantages
  – Simplifies data entry
  – Fast for specific types of data
  – All information is visible

• Disadvantages
  – Consumes screen space
  – Requires typing skills
  – Modest training required
Form Fill-in

– Design guidelines
  • Meaningful title
  • Comprehensible instructions
  • Logical grouping and sequencing of fields
  • Visually appealing layout
  • Familiar field labels
  • Consistent terminology and abbreviations
  • Space and boundaries for data-entry fields
  • Convenient cursor and “tab” movement
  • Error correction for characters and entire fields
  • Error prevention – meaningful constraints
  • Error messages for unacceptable values – explain what is acceptable
  • Optional fields clearly marked
  • Explanatory messages for fields
Natural Language

• Advantages
  – Don’t need to learn syntax

• Disadvantages
  – May require more keystrokes
  – Requires clarification dialogue
  – Unpredictable
  – May not show context
Interaction Styles

• What interaction style(s) would you use for the following?
  – A software DVD player?
  – A personal organizer (calendar and address book)?
  – A 3D CAD package?
Compare

• Interaction *mode*:
  – higher level of abstraction
  – Nature of activities to support

• Interaction *style*:
  – lower level of abstraction
  – Selection of specific kinds of interface
Next: fleshing out

• After establishing interaction mode/style
  – Concretize
  – How will the interface behave?
  – Look & feel?
  – Specific interaction styles?
    • Where and when?
  – Best to explore many options here
Interaction Types

• WIMP: Windows Icons Menus Pointers
• Input devices
  – Keyboards
  – Pointing devices
    • Direct control pointing devices, e.g. light pen, touch screen
    • Indirect control pointing devices, e.g. mouse, trackball, joystick, tablet
Interaction Types

- Output devices
  - Visual
    - Screens
  - Audio
  - Olfactory
    - iSmell -- digiscent!
  - Touch
    - Haptic interfaces recreate a sense of touch in a VR way
    - Force feedback
  - Taste
    - Nothing yet.. (Thankfully?)
Fleshing Out

• Can be done iteratively
  – Storyboarding
  – Describing possible scenarios
  – Protoyping
Activity

• Put to practice:
  – A company is building a wireless information system to help tourists navigate an unfamiliar city.
  – What do they need to find out in order to develop a conceptual model?
Conceptual Model Types

- Activity-Based
- Object-Based
Most Common Activity-Based CMs

- Instructing
- Conversing/communicating
- Manipulating/navigating
- Exploring/browsing
Instructing

• Letting user issue instructions to system
  • Command-based
    – E.g. giving instructions to a system to perform options
      • Tell time; print file; remind user of appointments
    – Essentially one-way communication with system
  • Supports quick and efficient interaction
  • Well-suited to repetitive kinds of actions performed on multiple objects
    – E.g. saving, deleting
Instructing

• Examples
  – VCRs, alarm clocks, computers
  – Unix, DOS, GUIs
  – Word processing, E-mail
Instructing

• A wide range of functions are provided which users choose to apply to what they are working on
  – E.g. format a document, count words, check spelling

• Commands can be carried out in a variety of ways
  – Buttons, control keys, mouse, etc.
Instruction: Optimizing

• Much research into
  – Form of commands
    • E.g. abbreviations, icons
  – Syntax
    • How best to combine diff commands
  – Organization
    • How to structure options in different menus
Conversing/Communicating

• Converse with system like another person
  – System == dialogue partner
  – Two-way communication
  – E.g. advisory systems, help facilities, search engines
Kinds of Conversation

• Voice-recognition menu-driven
  – Phone banking, ticket booking
  – Single-word phrases

• More complex natural language systems
  – Search engines, help systems
  – Type in specific query (in some cases speak)
Conversing

• Pros
  – Natural interface
    • Esp. useful for beginners
    • E.g. “Ask Jeeves for Kids”

• Cons
  – Misunderstandings when query is not understood
  – Tasks can become cumbersome
    • Think phone trees!
Animated agents

- Range from “real” people to cartoons
- Psychological factors
  - Seeing an approximation of a human tells people it is limited
  - When hidden from view, many think it is more intelligent than it is
    - Eliza
    - Can lead to frustration
  - But can be annoying!
Repliee Q1
Examples in real life

• Frustrat-o-meters
  – Actually in place!

• Facial expression recognition
Animated agents

• What do you think?
Manipulating/Navigating

- Navigate environment of virtual objects
- Assumption of shared properties between real and virtual worlds
  - Exploit user knowledge
  - E.g. zooming, moving, closing, choosing virtual objects
  - Can extend beyond to tasks impossible in real world
Exploring/Browsing

• Structured information
• User: no specific questions
• Exploits user knowledge of existing media
  – E.g. books, magazines, TV, radio, libraries
• Structure of information is important
  – Must support effective navigation
Some Examples

• Windows XP?
• Flight sim?
• Web browser?

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<td>(Dialogue)</td>
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<td>Direct Manipulation</td>
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Object-Based Conceptual Models

- Object such as tool, book or vehicle
- Specific
- Analogy-based
- E.g. spreadsheet -- ledger sheet
- Can be easier to see user needs
  - Kinds of activities
  - Problems with existing tools
Hybrid models

- Mix and match activity- and object-based interfaces
- E.g. Online shopping
- Can lead to unwanted complexity and ambiguity
- Can offer user more choice
  - Higher learning curve
  - More user control ultimately
Interface Metaphors

• A conceptual model developed to be similar to a physical entity/ies
  – But, has its own behaviours & properties
• Can be activity, object, or hybrid-based
• Combine familiar knowledge with new concepts
  – When people learn, they try to fit in the new material with what they already know
Role of the Metaphor

• Facilitate
  – Learning
  – Orientation
  – Concept formation and maintenance
    • I.e. the conceptual model
A Metaphor Methodology

• Step 1. Looking for possible metaphors
  - Identify metaphors
  - Consider could form a consistent system and which exclude each other.
  - Take into account their emotional value, and also how they match the characteristics of potential users
  - Determine interaction styles that support the metaphor(s).
A Metaphor Methodology

• Step 2. Working out the details
  – Use typical user scenarios to detail the use of each metaphor
  – Imagine how people would use the system while achieving specific goals, and how they could rely on your metaphor during the course of their activity
  – Scenarios, use cases, storyboarding
A Metaphor Methodology

• Step 3. Finding mismatches
  – No such thing as the perfect metaphor
  – Determine implications of mismatches
    • The discrepancies must be manageable.
  – E.g. in most systems using the desktop metaphor, we do not write into a document by picking up a pen but we use the keyboard instead
  – If the mismatch is too strong, disturbing, not easily manageable, then the metaphor should be abandoned.
A Metaphor Methodology

• Step 4. Handling mismatches
  - User should be free to explore the system without risk.
  - Make mismatches clear to user
  - Use help functions, error and informative messages, tool for training, documentation, escape & undo function etc.
A Metaphor Methodology

- These four steps may occur multiple times over the course of multiple iterations
  - Metaphor problems are found through tests during interface development.
- The metaphor “system” should be consistent
  - E.g. the user should be able to "pick up" things on the whole desktop in the same way
- Avoid functionally irrelevant details of a metaphor
- Interface metaphors are rarely verbalized, but visualized
  - Thus they are faster
Examples

- Desktop
- Scrollbar
- Toolbar
- Trashcan
- “Information Superhighway”
- Others?
Benefits

• Orienting
• Easy to learn/understand
• Easier to talk about
Issues

- Mismatches
- Too constraining
- Conflicts with design principles
- Limiting
  - Users
  - Designers
- Can be too tenuous
- Metaphor is itself a poorly designed object/program
Interaction Paradigms

• A particular philosophy or way of thinking about interaction design
  – E.g. Desktop paradigm: CPU, monitor, keyboard and mouse; GUI

• More general than metaphors

• Alternative interaction paradigms:
  – Ubiquitous computing
  – Pervasive computing
  – Wearable computing
  – Tangible Bits/augmented reality
  – Attentive Environments
  – Workaday World
Realism versus Abstraction

• The illusion of behaving and looking like real-world counterparts
  versus

• Appearing simply as abstractions of the objects being represented
Transparency

• Design principle
  – Make systems transparent so people can understand them better and know what to do
  – NOT to be understood as literal

• Transparency means:
  – Useful feedback
  – Easy to understand
  – Intuitive
  – Clear & easy to follow instructions
  – Appropriate online help
  – Context sensitive guidance of how to proceed when stuck
Conceptual Models to Physical Design

- Interface design is \textit{iterative}
- Cycle:
  - Think through a design problem
  - Understand user needs/requirements
  - Generate possible conceptual models
  - Prototype Models
  - Evaluate wrt usability and user experience goals
  - Make changes
  - Re-evaluate prototype/re-evaluate original data
Our Goals

• Describe protoyping
• Enable you to produce a simple prototype
• Enable you to produce a conceptual model for a system and justify your choices
• Enable you to attempt some aspects of physical design
• Explain the uses of task descriptions and prototypes in conceptual design
• Discuss standards, guidelines, and rules
• “It is often said that users can’t tell you want they want, but when they see something and get to use it, they soon know what they don’t want”
What is a prototype?

• Not just a “mini-version” or pre-alpha software
• Can be
  – Paper-based outline of screen or storyboard
  – Video simulation
  – 3-d paper mockup of a workstation
  – Stack of hyperlinked screenshots
  – PowerPoint presentation
• Allows stakeholder opportunity to *interact* with product
  – E.g. PalmPilot wood carving
Why Prototypes…

• Answer questions and support designers
  – In choosing between designs
  – Clarifying vague requirements
  – In iterative design
  – Test feasibility
  – User testing and evaluation
  – Compatibility

• Encourages reflection
What do you prototype?

• Technical Issues
• Work flow, task design
• Screen layouts and information display
• Difficult, controversial, critical areas
Low-fidelity prototyping

- Does not look much like final product
- Simple, cheap and quick
- Never intended to be kept
LFP: Storyboarding

• A series of sketches showing how a user might progress through a task using the device being developed
  – Stick figures and boxes okay!
  – Can use index cards, Post-Its e.g.
• Often used in conjunction with scenarios
• Offers stakeholders chance to role-play with prototype
Library System

Book Name

Call No.

Description

Save  Exit  Help
Activity

• Draw a storyboard that illustrates how to fill a car with gas.
LFP: Wizard of Oz

- User interacts as if with product
- Computer connected to another machine where a human emulates response
High-fidelity Prototyping

• Uses materials you would expect in final product
• Looks close to final product
• Common prototyping software
  – Macromedia Director
  – Visual Basic
  – Smalltalk
HFP: Problems

- Take too long to build
- Users tend to comment on superficial aspects during testing
- Developers are reluctant to change
- Can set expectations too high
- One bug can bring testing to a halt
Low-Fidelity

- Paper-based sketches
- Paper-based storyboard / PICTIVE
- Computer-aided sketches / storyboard
- Wizard of Oz / Slide shows / Video prototyping
- Computer-based scenario simulation
- Computer-based Horizontal simulation
- Computer-based Vertical simulation
- Computer-based full functionality simulation

High-Fidelity
Early Design

- Brainstorm different representations
  - Choose a representation
  - Rough out interface style
- Task centered walkthrough and redesign
- Fine tune interface, screen design
- Heuristic evaluation and redesign
- Usability testing and redesign
  - Limited field testing
  - Alpha/Beta tests

Late Design

- Low fidelity paper prototypes
- Medium fidelity prototypes
- High fidelity prototypes / restricted systems
- Working systems
Considerations

• Cost and schedule constraints
• Proof-of-concept
• Navigation and flow
• Look-and-feel the product
• Usability testing
• Facilitation skill/programming skill
• Current development stage