Object-Oriented Analysis and Design
with the Unified Process

chapter 11
DESIGNING THE USER-INTERFACE LAYER
Objectives

- Understand the differences between user interfaces and system interfaces
- Explain why the user interface *is* the system to the users
- Discuss the importance of the three principles of user-centered design
- Describe the historical development of the field of human-computer interaction (HCI)
Objectives (continued)

- Describe the three metaphors of human-computer interaction
- Discuss how visibility and affordance affect usability
- Apply the eight golden rules of dialog design when designing the user interface
- List the key principles used in Web design
- Define the overall system structure as a menu hierarchy
Objectives (continued)

- Write user-computer interaction scenarios as dialogs
- Create storyboards to show the sequence of forms used in a dialog
- Use UML class diagrams and sequence diagrams to document dialog designs
- Design window forms and browser forms that are used to implement a dialog
Overview

- User interfaces handle inputs and outputs that involve the system user directly
  - Design inputs and outputs involved for each use case
- Interactions with the user and computer (HCI) can be modeled with dialog designs
  - Use metaphors, standard guidelines, and UML diagrams to design user interfaces
- User-interface design occurs in each iteration
  - Address only a few use cases at a time
Identifying and Classifying Inputs and Outputs

- Inputs and outputs are defined early in order to:
  - Document key inputs/outputs in business cases
  - Identify actors
  - Define triggers and responses in an event table
  - Identify the system boundary in use case diagrams
  - Design use case descriptions and system sequence diagrams
  - Design the user-interface layer
  - Define messages in a use case realization
User Versus System Interfaces

System interface
- Involves inputs and outputs that require minimal human intervention

User interface
- Require user interaction to produce inputs and outputs

Most analysts separate design of system interfaces from user interfaces
- Requires different expertise and technologies
Understanding the User Interface

- To the end user, the user interface is the system itself
  - Physical devices, parts, or documents
  - Perceptual aspects including seeing, hearing, and touching
  - Conceptual details about how to use the system
    - Called the user’s model

- HCI (human-computer interaction) studies end users and their interactions with computers
Figure 11-1

Physical, perceptual, and conceptual aspects of the user interface
User-Centered Design

- Technique that places user at center of the development process
  - Focus early on users and their work
    - Understand user styles and preferences
  - Evaluate designs to ensure usability
    - Ease of learning and use dependent on type of user
  - Use iterative development
    - Continually return to user requirements and evaluating the system
Human-Computer Interaction as a Field of Study

- Evolved from human factor engineering (ergonomics)
- Important contributions by Xerox
  - Work on the usability of machines
  - Research at Xerox PARC led to first OO language (Smalltalk)
  - First personal computer with GUI (Xerox Star)
- Dependent on several disciplines
Figure 11-2
The fields contributing to the study of HCI
Metaphors for Human-Computer Interaction

- **Desktop**
  - Interaction with a display screen that includes objects commonly found on a desk

- **Document**
  - Involves browsing and entering data on electronic documents using hypertext and hypermedia

- **Dialog**
  - Carrying on a conversation with the computer by sending and receiving messages
Figure 11-3
The desktop metaphor based on direct manipulation, shown on a display screen

Object-Oriented Analysis and Design with the Unified Process
Figure 11-4
The document metaphor shown as hypermedia in a Web browser
The dialog metaphor expresses the concept that the user and computer interact by sending messages.
**Figure 11-6**

The user’s language and the computer’s language used to implement an e-mail application based on the natural dialog between manager and assistant.

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>USER’S LANGUAGE</th>
<th>COMPUTER’S LANGUAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manager</td>
<td>Did I get any messages while I was out?</td>
<td>Click the read messages menu item on the main menu.</td>
</tr>
<tr>
<td>Assistant</td>
<td>Yes, you have three messages— from Bob, Mary, and Lim.</td>
<td></td>
</tr>
<tr>
<td>Manager</td>
<td>What did Lim have to say?</td>
<td>Double-click the message from Lim in the list box.</td>
</tr>
<tr>
<td>Assistant</td>
<td>Lim left a message at 8:15 P.M. last night regarding the meeting next Monday about the inventory management system. The message is, “Can we change the time for the meeting to 10:30? I’ll be delayed by the testing session.”</td>
<td></td>
</tr>
<tr>
<td>Manager</td>
<td>I better respond. Say that the change is not a problem.</td>
<td>Click the Reply button on the message detail form. Type in the message, “Okay, that is not a problem.” Click the Send button.</td>
</tr>
<tr>
<td>Assistant</td>
<td>Okay, I’ll leave him that message. Do you want the next message?</td>
<td></td>
</tr>
<tr>
<td>Manager</td>
<td>What did Mary have to say?</td>
<td>Double-click the message from Mary in the list box.</td>
</tr>
<tr>
<td>Assistant</td>
<td>She left a message at 8:15 this morning regarding lunch. She said, “Lunch is still on, but Joe will not be able to join us.”</td>
<td></td>
</tr>
<tr>
<td>Manager</td>
<td>Okay, no response. And that’s all for now. Thanks.</td>
<td>Click the close message button.</td>
</tr>
<tr>
<td>Assistant</td>
<td>Okay, you still have one message from Bob. I’ll remind you later.</td>
<td>Click the close new message form button.</td>
</tr>
</tbody>
</table>
Guidelines for Designing User Interfaces

- Interface design guidelines must be followed for the interface of any system
- Two key principles (from HCI researcher Donald Norman)
  - Visibility
    - All controls should be visible and provide immediate feedback to the user
  - Affordance
    - Appearance of any control should suggest its functionality
Figure 11-7
The eight golden rules for designing interactive interfaces

1 Strive for Consistency
2 Enable Frequent Users to Use Shortcuts
3 Offer Informative Feedback
4 Design Dialogs to Yield Closure
5 Offer Simple Error Handling
6 Permit Easy Reversal of Actions
7 Support Internal Locus of Control
8 Reduce Short-Term Memory Load
Documenting Dialog Designs

- Inputs and outputs are obtained from use cases and scenarios.
- Menus reflect the overall system structure from the standpoint of the user.
  - Each subsystem might be represented as a menu, with each menu option representing a use case.
  - Menus might have several versions based on user type.
  - Menus should also include options that are not based on use cases (i.e., system controls, user help).
Figure 11-8
One overall menu hierarchy design for the RMO customer support system (not all users will have all of these options available)
Dialogs and Storyboards

- Several options for documenting dialogs (no de facto standards exist)
  - List the key steps for each dialog with descriptions of what the user and computer do at each step
  - Write out a human and computer conversation
    - Used for complicated or uncertain requests
  - Use storyboarding to show a sequence of sketches of a display screen during a dialog
    - Initial design can be a general framework
Figure 11-9
Storyboard for the DownTown Videos *rent videos* dialog
Dialog Documentation with UML Diagrams

- Use case descriptions show a list of steps followed as a user and computer interact.
- Activity diagrams document a user-computer dialog for each use case.
- SSDs describe sequential actor-computer messages.
- Class diagrams add user-interface classes for forms.
- Detailed sequence diagram show users interacting with specific objects in forms.
Figure 11-10
A sequence diagram for the RMO *Look up item availability* dialog with the ProductQueryForm added
Figure 11-11
A class diagram showing interface classes making up the ProductQueryForm
A sequence diagram showing specific interface objects making up the ProductQueryForm for the *Look up item availability* dialog (not all problem domain objects are shown)
Guidelines for Designing Windows and Browser Forms

- Principles the same for Microsoft Windows, X-Windows (UNIX), and Macintosh environments
- Two types of forms
  - Windows forms are programmed in a full-featured programming language
  - Browser forms are programmed using HTML, script languages, and server-side processing
    - Companies can use the same browser form for both intranet and Internet purposes
Form Layout and Formatting

- Prototype various alternatives and allow users to test them to ensure good layout and ease of use
- Design considerations
  - Consistency of all forms in look and feel
  - Clear headings, labels, and logos
  - Distribution and order of data-entry fields and buttons according to traditions
  - Judicious use of font sizes, highlighting, and colors
Figure 11-13
The RMO Product Detail form used to look up information about a product, select size and color, and then add the product to an order.
Data Keying and Data Entry

- Objective: require as little data entry as possible
- Text boxes accept keyboard data entry
- List boxes contain a list of acceptable entries
  - Spin boxes display entries in a text box
  - Combo boxes permit users to enter a new value
- Radio buttons enable the user to select one option from a group
- Check boxes enable the user to select multiple options from a group
Figure 11-14
Examples of data-entry controls on an input form
Navigation and Support Controls

- Standard window interface contain controls for navigation and window manipulation
  - Maximize, Minimize, and Close buttons
  - Scroll bars
  - Record selection and record navigation arrows
- Designers should add controls to move screens, close open windows, and to find and search
- Browser forms also provide navigation and support controls that applications should support
Help Support

- Tutorials
  - Assists in training new users

- Indexed list of help topics
  - Invoked through a keyword search or a help wizard

- Context-sensitive help
  - Automatically displays the appropriate help topic based on the location of the cursor
Ten Good Deeds in Web Design

- Place organization’s name and logo on every page and make the logo a link to the home page
- Provide a search function if the site is more than 100 pages
- Write straightforward headlines and page titles
- Structure the page to facilitate reader scanning
- Use hypertext to structure the content space
Ten Good Deeds in Web Design (continued)

- Use product photos with thumbnails on the primary page
- Use relevance-enhanced image reduction
- Use link titles to provide users with a link preview
- Ensure accessibility for users with disabilities
- Do (Design) the same as everyone else
Web Site Design Principles

- Web site design include many facets

- A Web-design book by Joel Sklar suggests that designers should focus on three aspects of Web design
  - Designing for the computer medium
  - Designing the whole site
  - Designing for the user
Designing for the Computer Medium

- Craft the look and feel of the pages to take advantage of the medium
- Make the design portable
- Design for low bandwidth
- Plan for clear presentation and easy access to information
- Reformat information from other sources for online presentation
Designing the Whole Site

- Craft the look and feel of the pages to match the impression desired by the organization
- Create smooth transitions between Web pages
- Lay out each page using a grid pattern to provide visual structure
- Leave a reasonable amount of blank space on each space between groups of information
Designing for the User

- Design for dynamic interaction
- Guide the user’s eye to important information
- Keep a flat hierarchy
- Use hypertext to facilitate navigation
- Do not clutter the pages
- Design for accessibility for a diverse group of users
Designing Dialogs for Rocky Mountain Outfitters

- Focus on one specific dialog
  - Phone-order sales for customers
  - Scenario: Phone order representative creates new order
  - Target environment: Representative’s Windows PC
- Refer to requirement models
  - Use case description
  - Activity diagram
  - System sequence diagram
Dialog Design for the RMO Phone-Order Representatives

- Coordinate user-interface design with the processing design from the use case realization
- Write a basic dialog between the computer and user
- Refine the list of forms that will be required
- Define a design concept for the flow of information from form to form
- Modify designs through iterations to achieve more flexibility and meet user needs
Figure 11-15
A design concept for the sequential concept to the *Create new order* dialog

- Main menu form
- Customer form
- Item search form
- Product detail form
- Order summary form
- Shipping and payment options form
- Order confirmation form
Figure 11-16
A design concept for an order-centered approach to the Create new order dialog
Figure 11-17
Prototype forms for an order-centered approach to the dialog
Dialog Design for the RMO Web Site

- The Web site version provides more information, flexibility, and ease of use
  - Browsing capabilities, pictures, organized display of information, user preferences
- Follow guidelines for visibility and affordance
- Use a well thought-out visual theme
- Favor speed over too much animation or fancy graphics
- Emphasize direct customer interaction
Figure 11-18
Rocky Mountain Outfitters’ home page
Figure 11-20
The shopping cart page from the Rocky Mountain Outfitter Web site
Summary

- To the user, the user interface *is* the system
- Design the interaction between the user and the computer (HCI)
- Define an overall user-interface concept for the system early in the project
  - Focus on users and their work
  - Ensure usability
  - Apply iterative development
Summary (continued)

- Metaphors to describe the user interface
  - Dialog
    - Emphasizes the interaction between the user and computer
  - Document
  - Desktop
- Interface design guidelines and standards
  - Norman’s visibility and affordance guidelines
  - Shneiderman’s eight golden rules
Summary (continued)

Dialog design
- Identify dialogs based on use cases
- Add dialogs and designs for integrity controls, user preferences, and menu hierarchies
- Tools include dialog sequence, storyboards, and sequence, collaboration, and class diagrams

Form design (window and browser)
- Use guidelines for layout, controls, and navigation
- Web forms require additional guidelines