System Analysis and Design

Eighth Edition

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Chapter 8

User Interface Design

Objectives

- Explain the concept of usability regarding the user interface.
- Describe several fundamental user interface design principles.
- Explain the process of user interface design.
- Explain ways to understand the perspectives of the users of the user interface.
- Describe ways to define the structure of the user interface.
- Explain the standards that should be established for the user interface.
- Describe various ways to prototype the user interface.
- Discuss ways to evaluate and test the user interface.
- Discuss special concerns associated with touch-screen-enabled user interfaces.
- Be able to design a highly usable user interface.

Introduction

- System Interface: “connections” with other systems, where systems exchange information with each other
  - Designed as a part of program design.
- User Interface: “connections” with users. Focus of this chapter.
  - The navigation mechanism provides the way for users to tell the system what to do
  - The input mechanism defines the way the system captures information
  - The output mechanism defines the way the system provides information to users or other systems
- Graphical user interface (GUI): most common type of interface in use today

The Usability Concept

- The system is easy to use and easy to learn
- Tasks are completed more efficiently and with more accuracy
- Mistakes with system are reduced
- User satisfaction with new system is increased
- Adoption of system is more likely

Principles for User Interface Design

- Layout
- Content awareness
- Aesthetics
- Usage level
- Consistency
- Minimize user effort

Principles of User Interface Design

Principle	Description
Layout	The interface should be a series of areas on the screen that are used consistently for different purposes—for example, a top area for commands and navigation, a middle area for information to be input or output, and a bottom area for status information.
Content awareness	Users should always be aware of where they are in the system and what information is being displayed.
Aesthetics	Interfaces should be functional and inviting to users through careful use of white space, colors, and fonts. There is often a trade-off between including enough white space to make the interface look pleasing and losing so much space that important information does not fit on the screen.
Usage level	Although ease of use and ease of learning often lead to similar design decisions, there is sometimes a trade-off between the two. Infrequent users of software will prefer ease of learning, whereas frequent users will prefer ease of use.
Consistency	Consistency in interface design enables users to predict what will happen before they perform a function. It is one of the most important elements in ease of learning, ease of use, and aesthetics.
Minimize user effort	The interface should be simple to use. Most designers plan on having no more than three mouse clicks from the starting menu until users perform work.

Layout

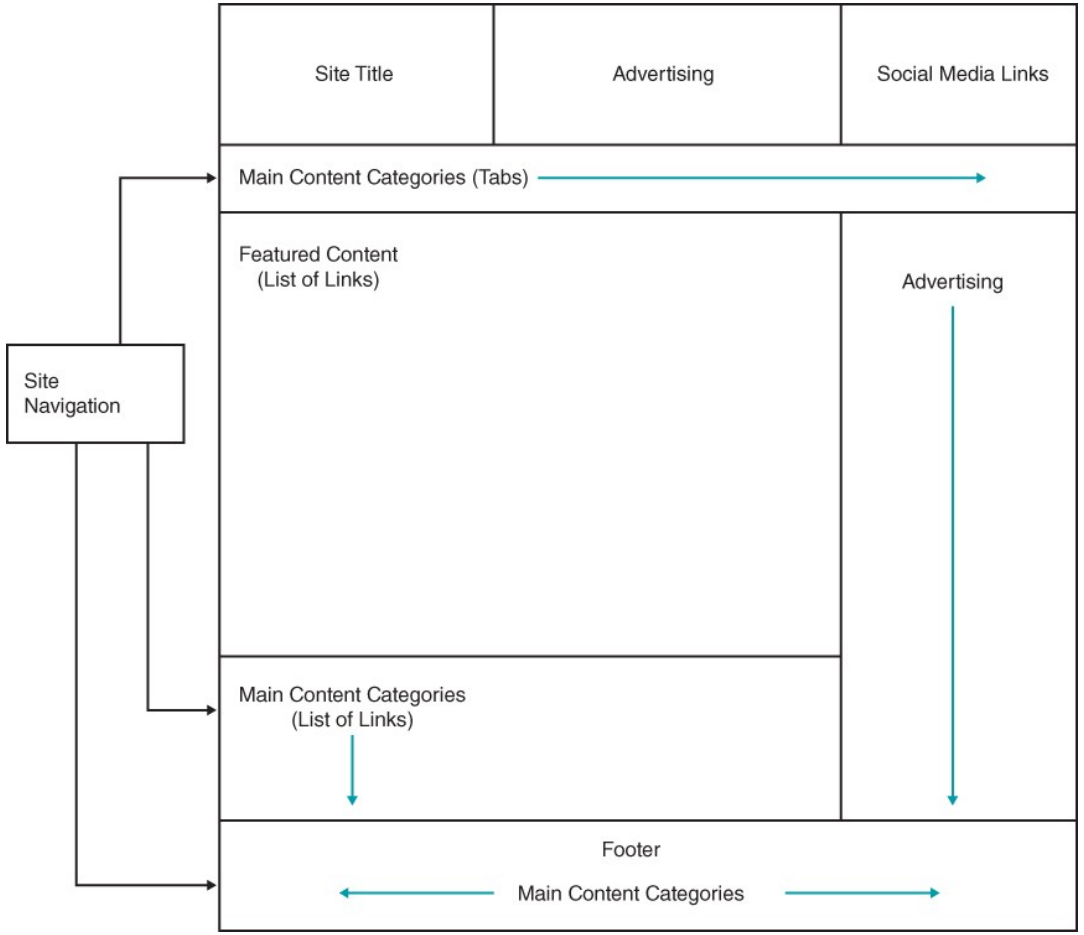
- The screen is often divided into three boxes
  1. Navigation area (top)
  2. Status area (bottom)
  3. Work area (middle)
- Information can be presented in multiple areas
- Like areas should be grouped together

More Layout Concepts

- Areas and information should minimize user movement from one to another
- Ideally, areas will remain consistent in
  - Size
  - Shape
  - Placement for entering data
  - Reports presenting retrieved data

Model Layout for Web Page

- Note use of multiple layout areas for site navigation
- As the user navigates to each part of the site, the overall page layout is the same
- This use of multiple layout areas also applies to inputs and outputs



Content Awareness

- All interfaces should have titles
- Menus should show
  - Where you are
  - Where you came from to get there
- It should be clear what information is within each area
- Fields and field labels should be selected carefully
- Use dates and version numbers to aid system users

Content Awareness Continued

- Note the use of highlighting to indicate menu selections
- Breadcrumbs provide additional clues on navigational path

Clients >> Flight Requests >> Edit Request

Aesthetics

- Interfaces need to be functional and inviting to use
- Avoid squeezing in too much, particularly for novice users
- Design text carefully
  - Be aware of font and size
  - Avoid using all capital letters
- Colors and patterns should be used carefully
- Use colors to separate or categorize items

Usage Level

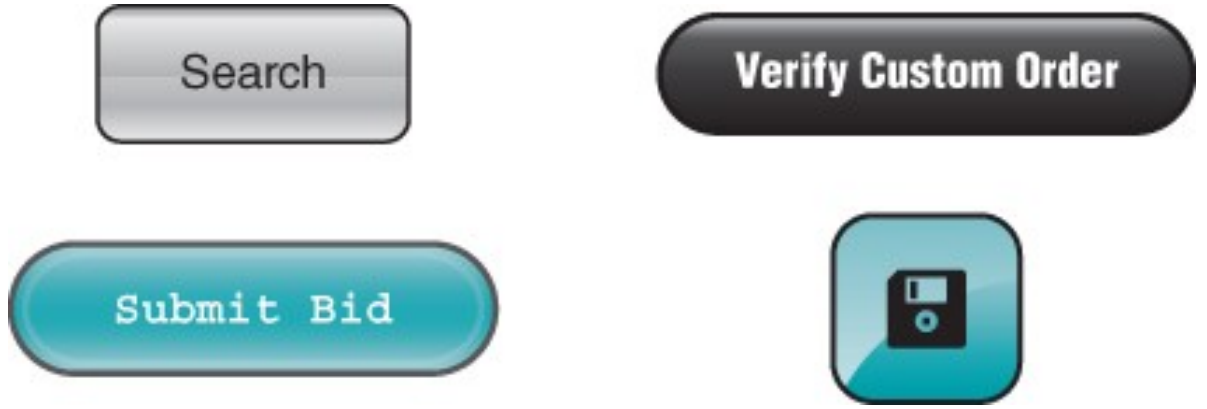
- Some people will be frequent, heavy users of the system
  - Frequent users desire ease of use – quick and easy completion of job tasks
  - For systems primarily used by frequent users, include ways to perform tasks directly (hot keys, short-cut keys, etc.)
- Other people may use the system infrequently
  - Infrequent users desire ease of learning – quick and easy ways to figure out what to do
  - For systems primarily used by infrequent users, include careful menu designs, tool tips, and extensive help systems
- User interface design should anticipate the types of users expected
- For systems with both user types, incorporate both user preferences in design as much as possible

Consistency

- Elements are the same throughout the application
- Enables users to predict what will happen
- Reduces learning curve
- Considers elements within an application and across applications
- Pertains to many different levels
  - Navigation controls
  - Terminology
  - Report and form design

Example of Inconsistent Elements

- These buttons all came from the same application
- Note the different button styles, colors, and font styles
- Inconsistency is likely to cause uncertainty and confusion



Minimize User Effort

- Interfaces should be designed to minimize the amount of effort needed to accomplish tasks
- Three clicks rule
  - Users should be able to go from the start or main menu of a system to the information or action they want in no more than three mouse clicks or three keystrokes

Special Issues of Touch Screen Design

- Ideal for information display but not data entry
- Place content at top and navigation controls at bottom so finger does not obscure content area
- Place labels on top of navigation controls
- Size objects correctly for “fat fingers”
- Include adequate spacing between objects
- Consider needs of left-handed and right-handed users
- Bright colors/backgrounds can help reduce glare and hide fingerprints
- Use each device’s standardized gesture interactions to enhance the user’s ease of learning and ease of use

Android Device Common Navigational Gestures

Gesture	Meaning/Function
Tap	Users can navigate to destinations by touching elements
Scroll and pan	Users can slide surfaces vertically, horizontally, or omnidirectionally to move continuously through content
Drag	Users can slide surfaces to bring them into and out of view
Swipe	Users can move surfaces horizontally to navigate between peers, like tabs
Pinch	Users can scale surfaces to navigate between screens

Android Device Common Transform Gestures

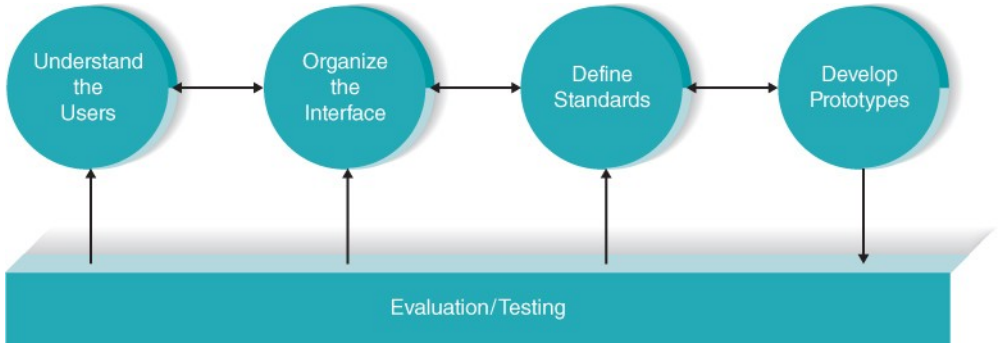
Gesture	Meaning/Function
Double tap or Pinch	Users can zoom into and out of content
Compound gestures	Users can fluidly transition between various gestures
Pick up and move	Users can reorder content with a long press and drag

Android Device Common Action Gestures

Gesture	Meaning/Function
Tap or Long press	Users can interact with elements and access additional functionality
Swipe	Users can slide elements to complete actions upon passing a threshold

User Interface Design Process

- Understand the users
- Organize the interface
- Define standards
- Develop prototypes
- Evaluation / testing



Understand the Users

- Users likely will have very different goals and intentions when using the system
- Use personas to develop characterizations of various user groups
  - Interests
  - Typical behaviors
  - Goals and objectives
  - Expectations
- Plan a user interface that will be satisfying for that particular user group
- Use scenarios outline the steps users perform to accomplish their work
- Presented in a simple narrative tied to the related DFD
- Document the most common paths through the use case so interface designs will be easy to use for those situations

Organize the Interface

- Define the basic components of the interface and how they work together to provide functionality to users.
- Use Interface Structure Diagram (ISD)
  - Shows how all screens, forms, and reports are related
  - Shows how user moves from one to another
- Like DFD in using boxes and lines
  - Boxes denote screens
  - Lines show movement from one to another
- Different from DFD in having no standard rules or format
- For Web sites, use site map
  - Show how all the information on the site fits together
  - Helps establish the hierarchy of information on the site

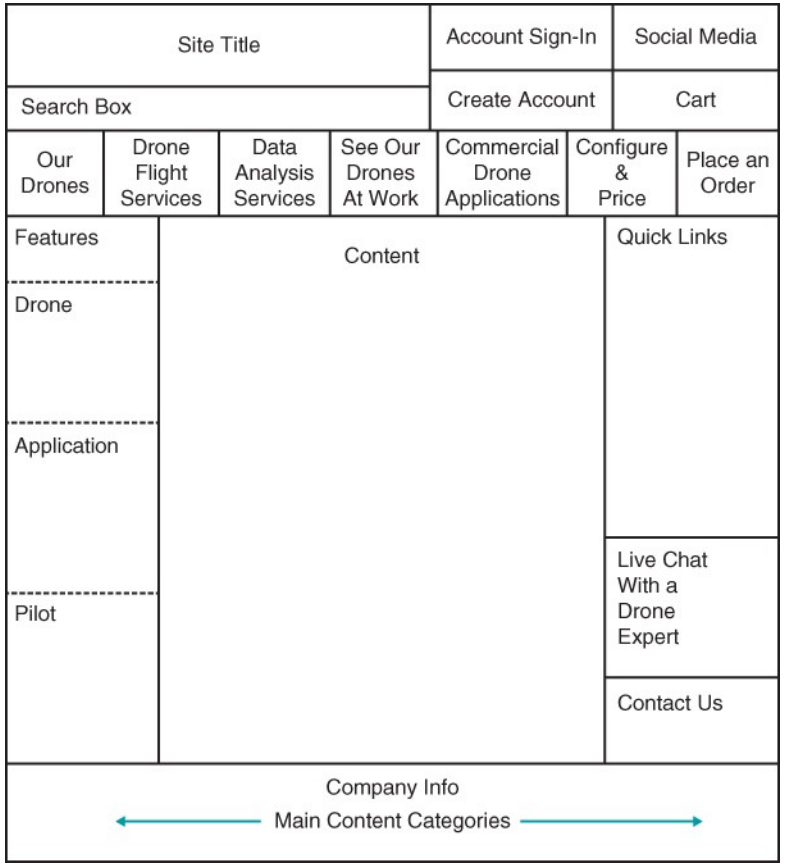
Define Standards

- Clarify decisions on all key interface elements to ensure consistency
- Basic common elements across individual screens, forms, and reports within the application
- Interface metaphor (e.g., calendar, checkbook, shopping cart)
- Interface objects (e.g., customer/client; employee/associate)
- Interface actions (e.g., buy/purchase/check out; exit/quit)
- Interface icons (pictures) representing status or actions (e.g., trashcan for delete; disk for save)
- Interface templates (layout guide for all screens)

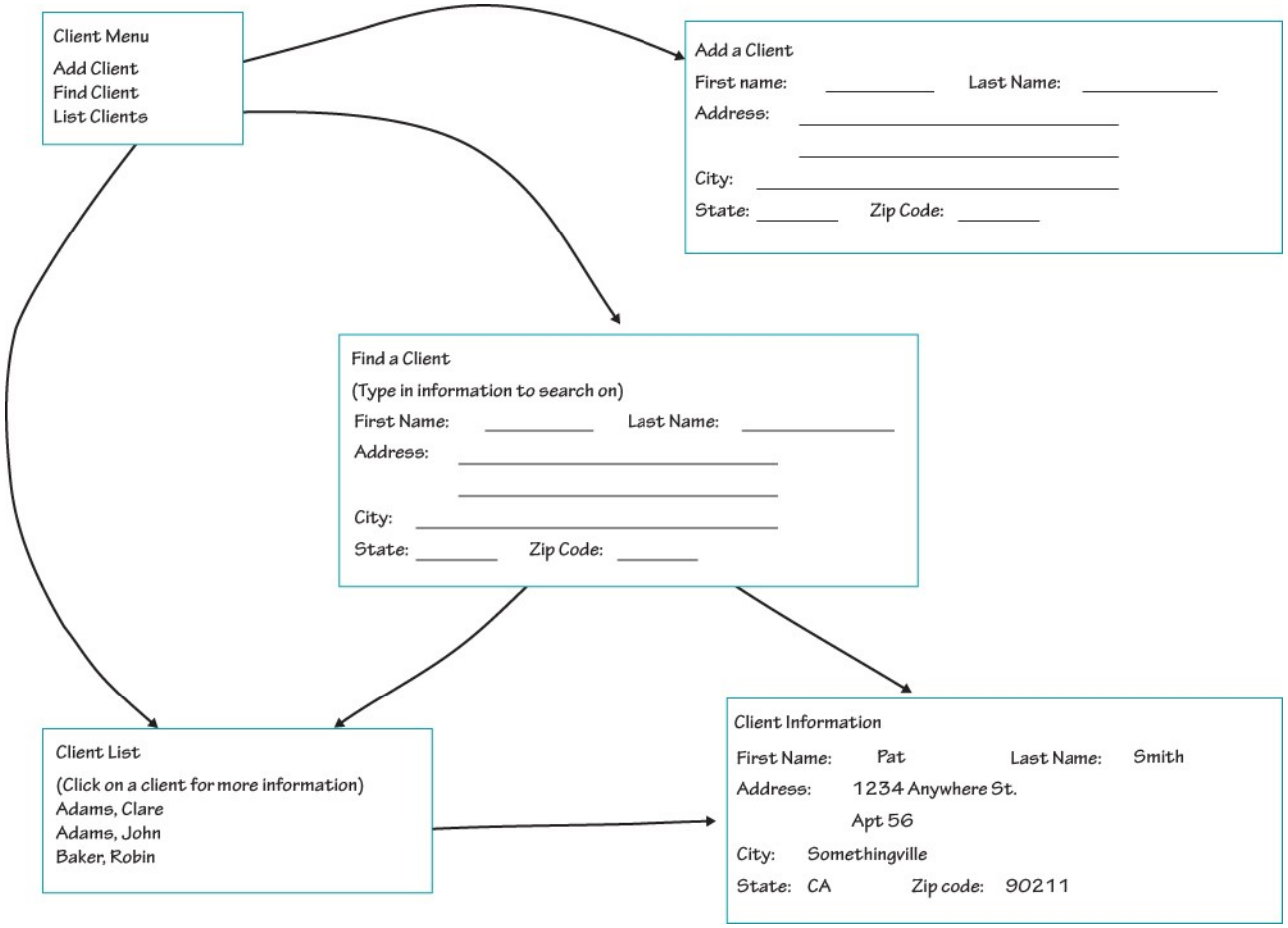
Interface Design Prototyping

- A mock-up or simulation of screens, forms, or reports
- Common methods include:
  - Paper sketches
  - Wireframe diagrams
  - Storyboarding
  - Wireflow diagrams
  - H T M L prototype
  - Language prototype

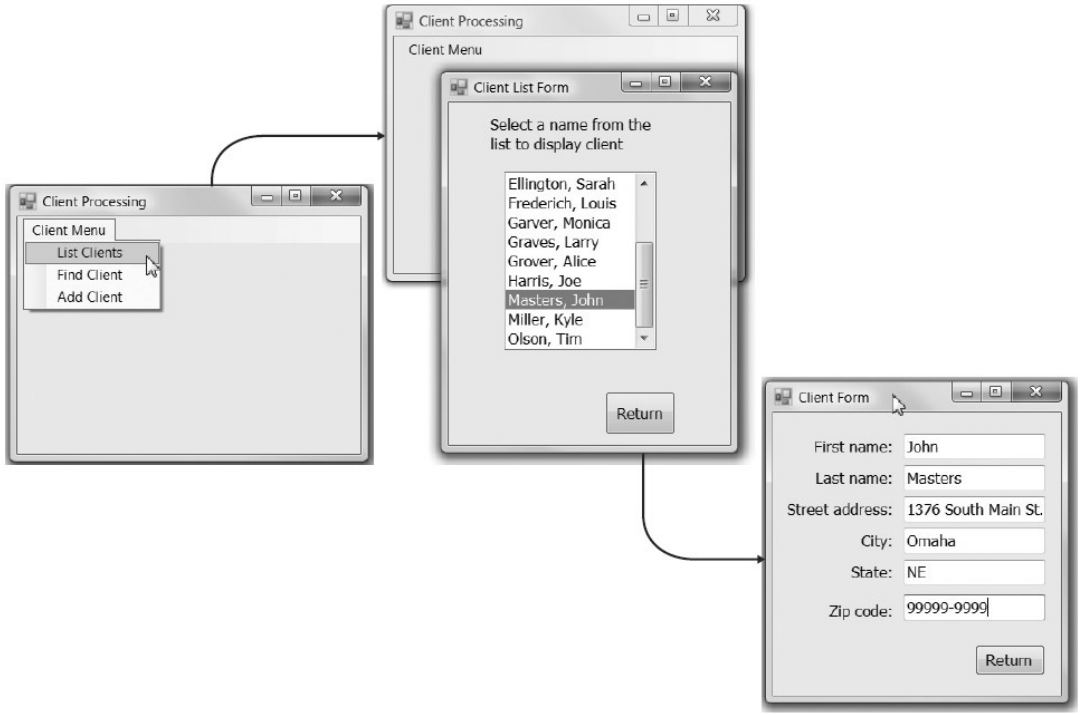
Wireframe Example

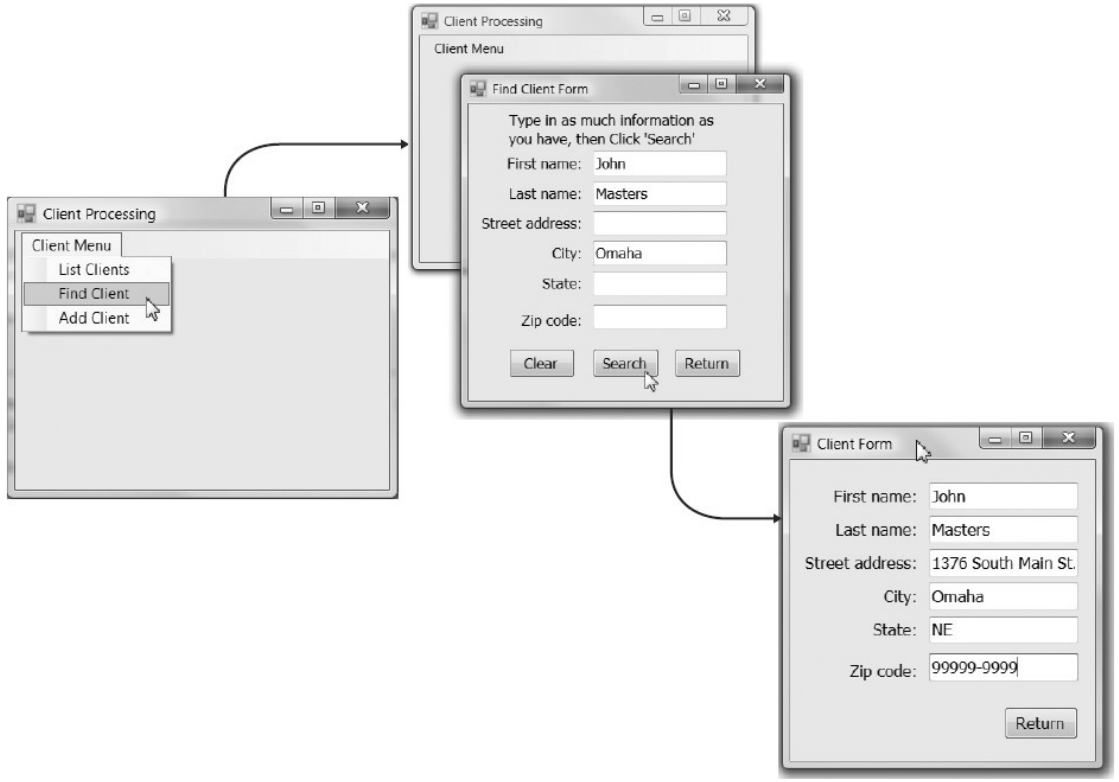


Storyboard Example



Language Prototype Example





Interface Evaluation/Testing

- Heuristic evaluation
  - Compare design to checklist
- Walkthrough evaluation
  - Team simulates movement through components
- Interactive evaluation
  - Users try out the system
- Formal usability testing
  - Expensive
  - Detailed use of special lab testing

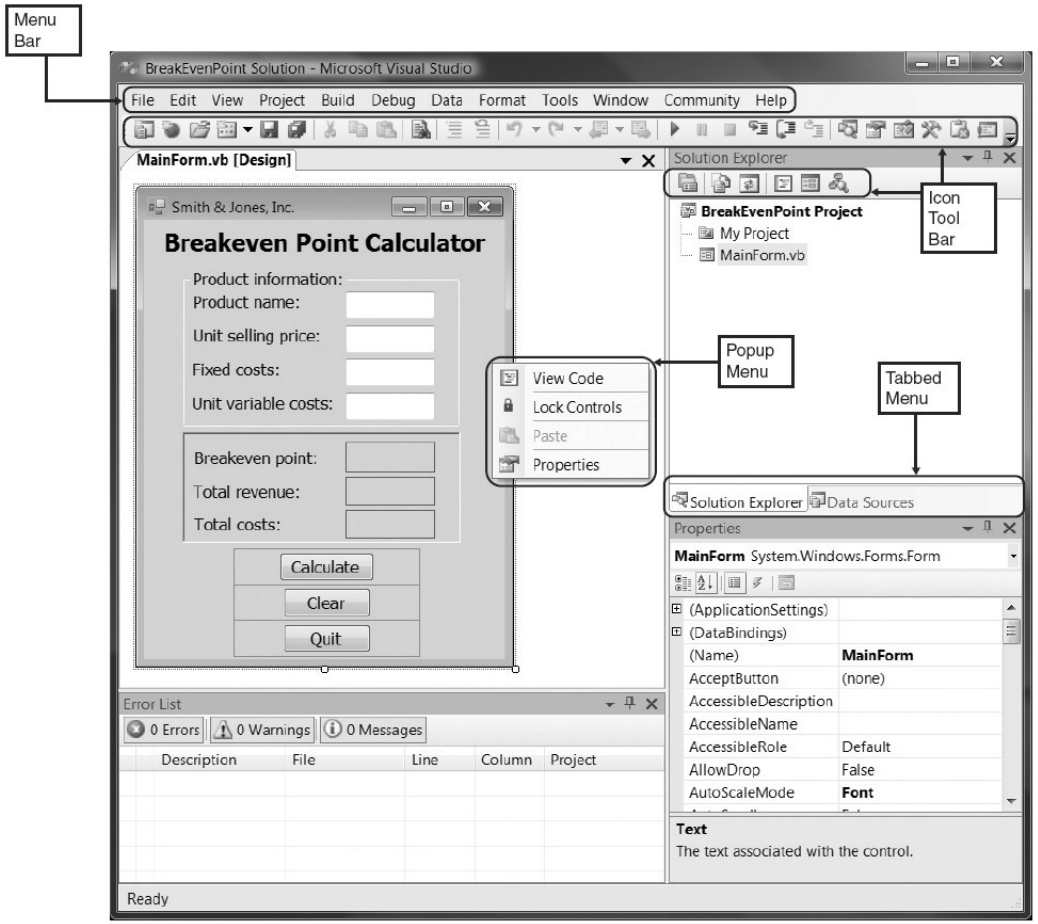
Navigation Design

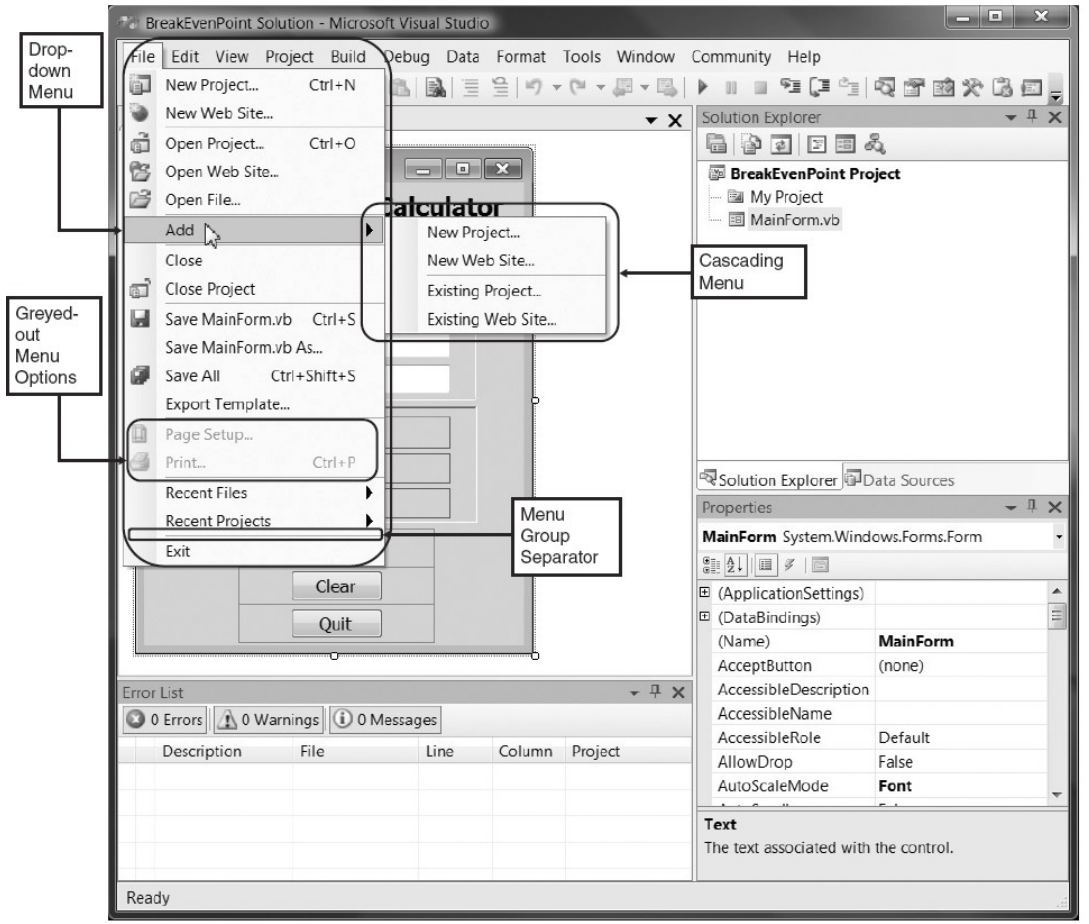
- Assume users
  - Have not read the manual
  - Have not attended training
  - Do not have external help readily at hand
- All controls should be clear and understandable and placed in an intuitive location on the screen
- Prevent mistakes
  - Limit choices
  - Never display commands that can not be used (or “gray them out”)
  - Confirm actions that are difficult or impossible to undo
- Simplify recovery from mistakes
- Use consistent grammar order (action-object, object-action)

Menu Tips

- Menus enable users to select action from an organized display of action categories and options
- Broad and shallow design is preferred
- Logical categories can be objects (customers; orders) or actions (insert, design)
- Common menu formats include menu bars, drop-down menus, popup menus, tab menus, icon tool bars, and image maps.
- Menus may become less popular with trend toward touchscreens

Common Types of Menus





Types of Menus

Type of Menu	Description	When to Use
Menu bar	List of commands at the top of the screen. Always on screen.	Main menu for system
Drop-down menu	Menu that drops down immediately below another menu. Disappears after one use.	Second-level menu, often from menu bar.
Hyperlink menu	A set of items arranged as a menu, usually along one edge of the screen.	Main menu for Web-based system.
Embedded hyperlinks	A set of items embedded and underlined in text.	As a link to ancillary, optional Information.
Pop-up menu	Menu that pops up and floats over the screen. Disappears after one use.	As a shortcut to commands for experienced users.
Tab menu	Multipage menu with one tab for each page that pops up and floats over the screen. Remains on screen until closed.	When user needs to change several settings or perform several related commands.

Types of Menus Continued

Type of Menu	Description	When to Use
Tool bar	Menu of buttons (often with icons) that remains on the screen until closed.	As a shortcut to commands for experienced users.
Image map	Graphical image in which certain areas are linked to actions or other menus.	Only when the graphical image adds meaning to the menu.

Message Tips

- Common message types include:
  - Error message
  - Confirmation message
  - Acknowledgment message
  - Delay message
  - Help message
- Strive for clear, concise, and complete messages
- Should be grammatically correct and free of jargon and abbreviations (unless they are the users')
- Avoid negatives and humor (it gets old)

Types of Messages

Type of Message	Description	When to Use
Error message	Informs the user that he or she has attempted to do something to which the system cannot respond.	When user does something that is not permitted or not possible.
Confirmation message	Asks the user to confirm that he or she really wants to perform the action selected.	When user selects a potentially dangerous choice, such as deleting a file.
Acknowledgment message	Informs the user that the system has accomplished what it was asked to do.	Seldom or never; users quickly become annoyed with all the Unnecessary mouse clicks.
Delay message	Informs the user that the computer system is working properly.	When an activity takes more than seven seconds.
Help message	Provides additional information about the system and its components.	In all systems.

Input Design

- The goal is to simply and easily capture accurate information for the system
- Reflect the nature of the inputs
- Find ways to simplify their collection

Use Online and Batch Processing Appropriately

- ***Online processing*** immediately records the transaction in the appropriate database
- ***Batch processing*** collects inputs over time, holds them temporarily, and then processes all the transactions at one time in a batch
- Batch processing simplifies data communications and other processes; but master files are not updated real time

Capture Data at the Source

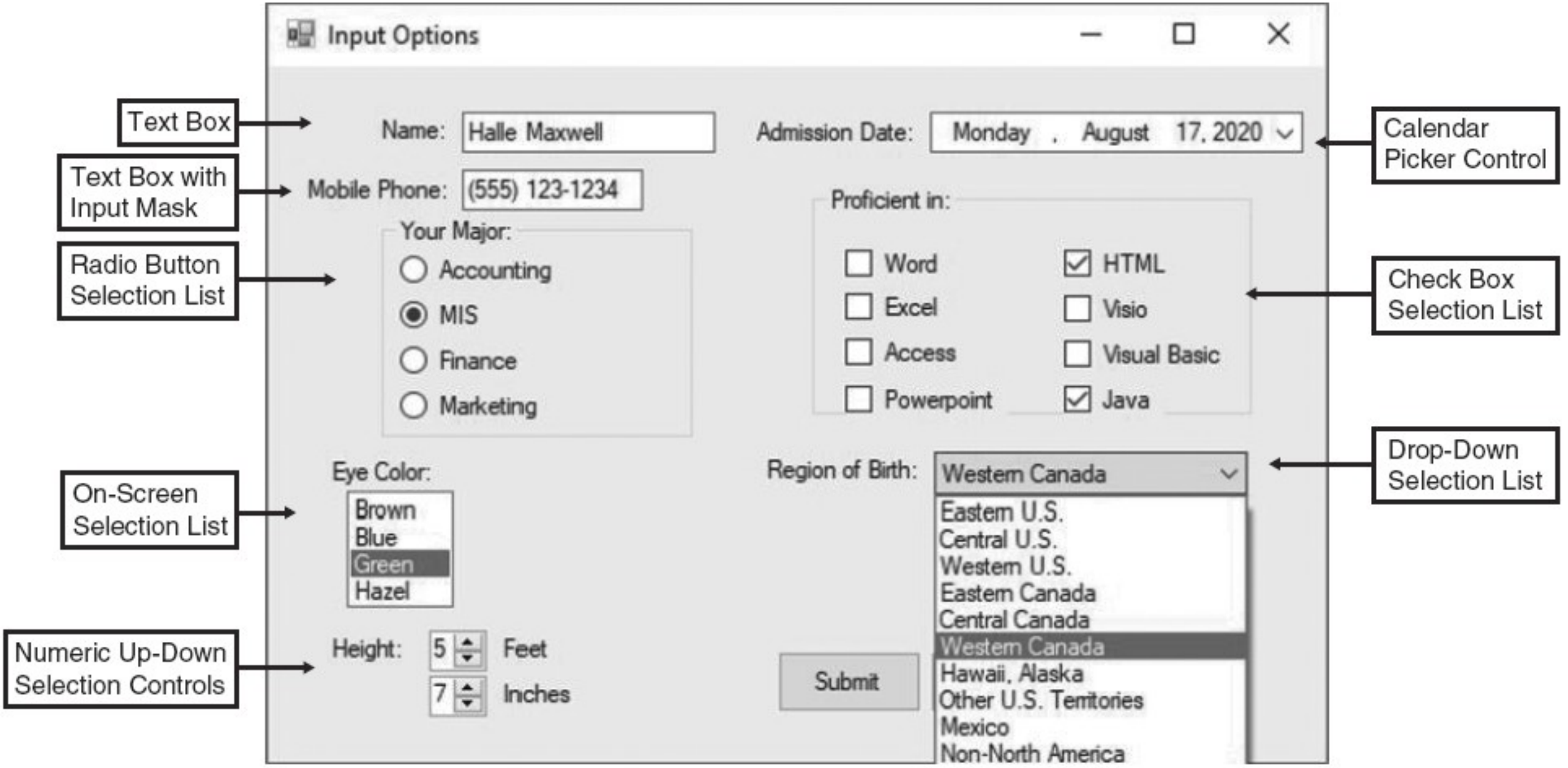
- Reduces duplicate work
- Reduces processing time
- Decreases cost
- Decreases probability of error

Source Data Automation

- Bar code readers / scanners
- Optical character recognition
- Magnetic stripe readers
- Smart cards
- RFID (Radio Frequency Identification) tags

Minimize Keystrokes

- Keyboard entry is slow and error-prone
- Never ask use to key-enter information that can be obtained other ways
  - Lookups
  - Dropdown lists
  - Default values



Types of Selection Controls

Type of Control	Description	When to Use
Check box selection list	Presents a complete list of choices, each with a square box in front.	When several items can be selected from a list of items.
Radio button selection list	Presents a complete list of mutually exclusive choices, each with a circle in front.	When only one item can be selected from a set of mutually exclusive items.
On-screen selection list	Presents a list of choices in a box.	Seldom or never—only If there is insufficient room for check boxes or radio buttons.
Drop-down selection list	Displays selected item in one-line box that opens to reveal list of choices.	When there is insufficient room to display all choices.
Combo box selection list	A special type of drop-down List box that permits user to type as well as scroll the list.	Shortcut for experienced users.
Up-down numeric control	Scroll arrows move up or down through numeric range.	When entering a numeric value.

Input Validation

- Apply a judicious amount of input validation to ensure accuracy
- Types include:
  - Completeness check
  - Format check
  - Range check
  - Check digit check
  - Consistency check
  - Database checks

Types of Input Validation

Type of Validation	Description	When to Use
Completeness check	Ensures that all required data have been entered.	When several fields must be entered before the form can be processed.
Format check	Ensures that data are of the right type (e.g., numeric) and in the right format (e.g., month, day, year).	When fields are numeric or contain coded data.
Range check	Ensures that numeric data are within correct minimum and maximum values.	With all numeric data, if possible.
Check digit check	Check digits are added to numeric codes.	When numeric codes are used.
Consistency checks	Ensure that combinations of data are valid.	When data are related.
Database checks	Compare data against a data base (or file) to ensure that they are correct.	When data are available to be checked.

Output Design

- Understand report usage
  - Reference or cover-to-cover?
  - Frequency?
  - Real-time or batch reports?
- Manage information load
  - All needed information, no more
- Minimize bias
- Utilize various report types (detail, summary, exception, graphical) and media to satisfy users' output requirements

Types of Report

Type of Report	Description	When to Use
Detail report	Lists detailed information about all the items requested.	When user needs full information about the items.
Summary report	Lists summary information about all items.	When user needs brief information on many items.
Turnaround document	Outputs that “turn around” and become inputs.	When a user (often a customer) needs to return an output to be processed.
Graphs	Charts used in addition to and instead of tables of numbers.	When users need to compare data among several items.

Chapter Review

- Identify and describe the five basic rules of user interface design.
- Describe the concept of usability with respect to a system's user interface. Why is this concept important to the interface designer?
- Explain three unique aspects of designing for a touch screen user interface.
- Discuss the five components of the user interface design process.
- Explain the unique issues associated with design of the system's navigation mechanism.
- Discuss ways to improve the quality of input data captured by the system.
- Explain the best ways to produce output from the system.

Key Terms

- Acknowledgment message
- Action–object order
- Aesthetics
- Bar code reader
- Batch processing
- Batch reports
- Bias
- Breadcrumbs
- Button
- Check box selection list
- Check digit check
- Completeness check
- Confirmation message
- Consistency
- Consistency check
- Content awareness
- Database check
- Default value
- Delay message
- Density
- Detail report
- Drop-down menu
- Drop-down selection list
- Ease of learning
- Ease of use
- Edit check
- Error message
- Exception report

Key Terms Continued

- Field label
- Fields
- Form
- Format check
- Grammar order
- Graph
- Graphical user interface (GUI)
- Help message
- Heuristic evaluation
- Hot keys
- HTML prototype
- Human–computer interaction (HCI)
- Image map
- Information load
- Input mechanism
- Interactive evaluation
- Interface action
- Interface design prototype
- Interface evaluation
- Interface icon
- Interface metaphor
- Interface object
- Interface standards
- Interface structure design
- Interface structure diagram (ISD)
- Interface template

Key Terms Continued

- Language prototype
- Layout
- Magnetic stripe readers
- Menu
- Menu bar
- Navigation mechanism
- Object–action order
- Online processing
- On-screen selection list
- Optical character recognition
- Output mechanism
- Personas
- Pop-up menu
- Radio button selection list
- Radio frequency identification
- (RFID) tag
- Range check
- Real-time information
- Real-time reports
- Report
- Screen
- Site map
- Smart card
- Source data automation
- Storyboard
- Summary report
- System interface
- Tab menu
- Text box
- Three-clicks rule

Key Terms Continued

- Tool tip
- Transaction processing
- Turnaround document
- Usability
- Usability testing
- Usage level
- Use scenario
- User experience (UX)
- User interface
- Validation
- Walk-through evaluation
- Web pages
- White space
- Wireflow diagram
- Wireframe diagram