COMP6115

Object Oriented Analysis and Design

Session #10

Human–Computer Interaction Layer Design

Learning Outcomes

LO1: Identify the basic concept of advance topic in Object Oriented Analysis and Design

LO2 : Use the knowledge to develop documentation for object oriented software analysis and design using Unified Modelling Language

LO3 : Analyze any problem in any software application and find out the alternative solutions using object oriented analysis and design approach

Chapter 10:

Human–Computer Interaction Layer Design

Objectives

- Understand several fundamental user interface (UI) design principles.

- Understand the process of UI design.

- Understand how to design the UI structure.

- Understand how to design the UI standards.

- Understand commonly used principles and techniques for navigation design.

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Objectives (cont'd)

- Understand commonly used principles and techniques for input design.

- Understand commonly used principles and techniques for output design.

- Be able to design a user interface.

- Understand the effect of nonfunctional requirements on the human-computer interaction layer.

Introduction

- Interface Design defines how the system will interact with external entities (e.g., customers, users, other systems)

  – *System Interfaces* are machine-machine and are dealt with as part of systems integration

  – *User Interfaces* are human-computer and are the focus of this chapter

- Principles for UI design

- The UI design process

- Navigation, Input, Output Design

- Mobile & social media UI design

- Non-functional requirements and UI design

- Layout of the screen, form or report

- Content Awareness—how well the user understands the information contained

- Aesthetics—how well does it appeal to the user

- User Experience—is it easy to use?

- Consistency—refers to the similarity of presentation in different areas of the application

- Minimal User Effort—can tasks be accomplished quickly?

Layout

- The arrangement of items on the screen
- Like items are grouped into areas
  - Areas can be further subdivided
  - Each area is self-contained
  - Areas should have a natural intuitive flow
    - Users from western nations tend to read from left to right and top to bottom
    - Users from other regions may have different flows

General Layout
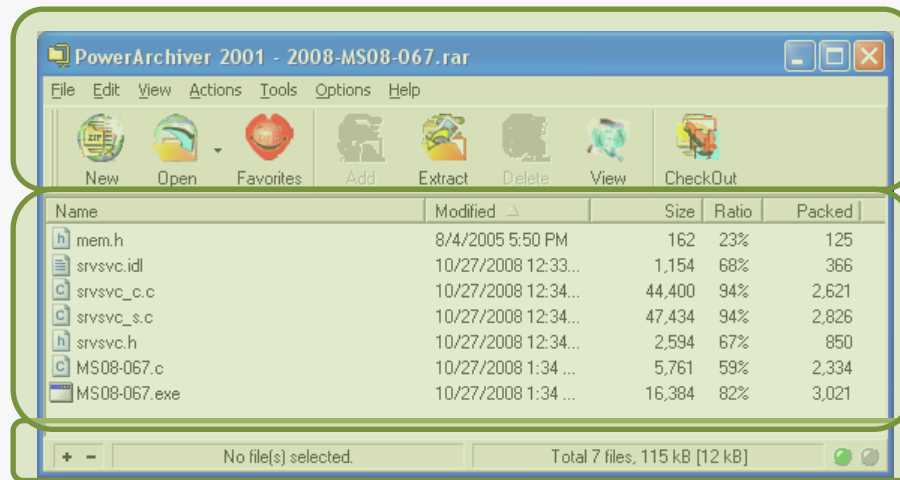
Navigation Area

Reports & Forms Area

Status Area

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Content Awareness

- Applies to the interface in general, to each screen, to each area on a screen and to sub-areas as well

- Include titles on all interfaces

- Menus should show where the user is and how the user got there

- All areas should be well defined, logically grouped together and easily discernible visually

Aesthetics

- Interfaces should be functional, inviting to use, and pleasing to the eye
- Simple minimalist designs are generally better
- White space is important to provide separation
- Acceptable information density is proportional to the user's expertise
  - Novice users prefer lower density ($< 50\%$)
  - Expert users prefer higher density ($> 50\%$)
- Text design: size, serif vs. sans serif, use of capitals
- Color and patterns (e.g., don't use *red* & *blue*)

User Experience

- Ease of learning
  - Significant issue for inexperienced users
  - Relevant to systems with a large user population
- Ease of use
  - Significant issue for expert users
  - Most important in specialized systems
- Ease of learning and use of use are related
  - Complementary: lead to similar design decisions
  - Conflicting: designer must choose whether to satisfy novices or experts

Consistency

- Extremely important concept in making the system simple
  - It allows the users to *predict what is going to happen*
  - All parts of the system work in the same way
  - Users learn how one portion works and immediately apply it to others
- Key areas of consistency are
  - Navigation controls
  - Terminology—use the same descriptors on forms & reports

Minimal User Effort

- Interfaces should be designed to minimize the effort needed to accomplish tasks

- A common rule is the *three-clicks rule*

  – Users should be able to go from main menu of a system to the information they want in no more than three mouse clicks

User Interface Design Process

➢ Use case driven, incremental and iterative process

- – Examine use case and sequence diagrams
- – Develop use scenarios hat describe commonly employed patterns of actions. It may uncover additional requirements
- – Once a basic set of use scenarios have been developed, the actual user interfaces are designed
- – Designed interfaces are evaluated to determine if they are satisfactory and how they can be improved
- – Interface design process is repeated in a cyclical process until no new improvements are identified.

Use Scenario Development

- Use scenarios outline the steps performed by users to accomplish some part of their work

- A use scenario is *one* path through an essential use case

- Presented in a simple narrative description

- Document the most common cases so interface designs will be easy to use for those situations

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Navigation Structure Design

- The navigation structure defines
  - The basic components of the interface
  - How they work together to provide functionality to users
- Windows Navigation Diagrams (WND)
  - Similar to a behavioral state machine
  - Shows the relationship between all screens, forms, and reports used by the system
  - Shows how the user moves from one to another
  - Boxes represent components
  - Arrows represent transitions from and to a calling state

Windows Navigation Diagrams

- Like a state diagram for the user interface
  - Boxes represent components
    - Window
    - Form
    - Report
    - Button
  - Arrows represent transitions
    - Single arrow indicates no return to the calling state
    - Double arrow represents a required return
  - Stereotypes show interface type

Sample Windows Navigation Diagram
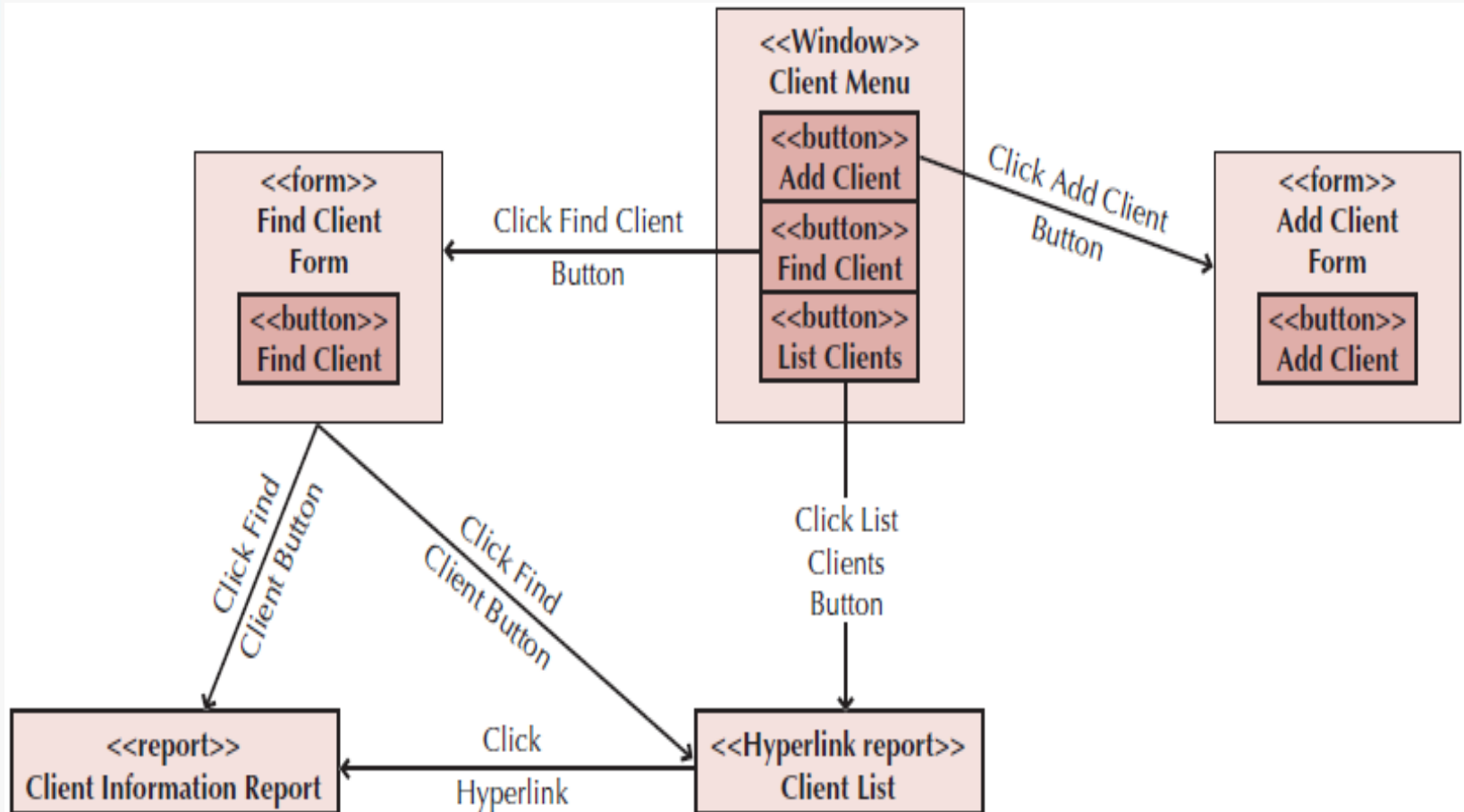
Interface Standards Design

- Interface standards are basic design elements found across the system user interface

- Standards are needed for:
  - Interface metaphor: defines how an interface will work (e.g., the shopping cart to store items selected for purchase)
  - Interface objects
  - Interface actions
  - Interface icons
  - Interface templates

Interface Design Prototyping

- Mock-ups or simulations of computer screens, forms, and reports
- Four common approaches (listed in increasing detail)
  - Storyboard: hand drawn pictures of what the screens will look like
  - Windows layout diagram: a computer generated storyboard that more closely resembles the actual interface
  - HTML prototype: web pages linked with hypertext
  - Language prototype: more sophisticated than HTML
    - Built in the programming language with no real functionality
    - User does not have to guess about the final appearance of the screen

Interface Evaluation

- Goal is to understand how to improve the interface design before the system is complete

- Have as many people as possible evaluate the interface

- Ideally, interface evaluation is done while the system is being *designed—before it is built*
  - Help identify and correct problems early
  - Designs will likely go through several changes after the users see it for the first time

Approaches to UI Evaluation

- Heuristic—compare the design to known principles or rules of thumb

- Walkthrough evaluation—design team presents prototype to the users & explains how it works

- Interactive—the users work with the prototype with a project team member

- Formal Usability Testing—performed in labs with users on a language prototype

Common Sense Approach to User Interface Design

- Users should not have to think about how to navigate the user interface
- The number of clicks should relate to the complexity of the task and should be unambiguous
- Minimize the number of words on the screen

Navigation Design

- The component that enables the user to navigate through the system
- Also provides messages of success or failure of actions performed
- Make it simple so that the user never really notices
- Basic principles:
  - Prevent the user from making mistakes
  - Simplify recovery for the user when mistakes are made
  - Use a consistent grammar order

    (e.g., File ► Open vs. Open ► File)

Types of Navigation Controls

- Language
  - Command language—user types in a command to be executed
  - Natural language—system interprets the user's language
- Menus
  - User is presented a list of choices
  - Comes in different forms (e.g., menu bars, popups, drop downs)
- Direct manipulation (e.g., drag and drop)
- Voice recognition systems

Messages

- How the system informs the user of the status of an interaction
  - Error messages—user did something that is not permitted
  - Confirmation messages (e.g., "Are you sure?")
  - Acknowledgment messages (e.g., "Order entered")
  - Delay messages—provides feedback to the user that the process is running
  - Help messages—provides additional information about the system to assist the user in performing a task

- Done using WNDs and real use-cases
- Real use-cases are implementation dependent
  - Detailed description of how to use the implemented system
  - Essential use-cases evolve into real use cases by specifying them in terms of the actual user interface
  - For multi platform applications, e.g., desktops, tablets, and smartphones, real use cases will need to be developed for each platform on which the use case is being deployed.

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Input Design

- Screens that are used to input data
- Data can be structured or unstructured
  - Structured: Dates, names, products, etc.
  - Unstructured: Comments, descriptions
- Basic principles
  - Online vs. batch processing
  - Capture data at the source (e.g., barcode vs. RFID)
  - Minimize keystrokes (e.g., by using defaults for frequently used values)

Types of Inputs

- Free form controls
  - Text boxes for alphanumeric information
  - Number boxes with automatic formatting
    - Example: Enter a phone number as 3451236789; automatically formats as (345)-123-6789
  - Password boxes that hide characters with stars and do not allow cutting or copying
- Selection boxes
  - Check boxes when several items can be selected
  - Radio buttons when items are mutually exclusive
  - List boxes to present a set of choices
  - Sliders—a pointer that can be moved along a scale

Input Validation

- Data should be validated prior to entry to ensure accuracy
- Do not accept invalid data (e.g., input text when a number is required)
- Validation checks:
  - Completeness
  - Format (e.g. MM/DD/YYYY)
  - Range (e.g. a number falls within a minimum and maximum value)
  - Check sum digit—reduces errors in entering numbers
  - Consistency—data are related
  - Database check—does not violate entity or referential integrity

Output Design

- Reports produced from the data generated by the system

- Basic principles:

  – Report usage and its frequency will affect its layout

  – Manage the information load in a report— provide only what is needed and place most important information near the top

  – Minimize bias, especially in graphical displays (charts)

Types of Outputs

- Detail reports—users need full information
- Summary reports—details are aggregated (e.g., sums, averages)
- Exception reports
- Turnaround documents—outputs turn around and become inputs
- Graphs—for easy visual comparison
- Media for reports can be electronic (seen on the screen) or hard copy (printed on paper)

Mobile Computing and UI Design

- Smaller devices have limited space, touch screens and haptic feedback

- Necessitate design from the ground up, not simply porting a web interface already designed for a larger computer

- Capabilities of devices varies widely and are used everywhere under highly variable conditions (ambient light and noise levels)

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Suggestions for Mobile Design

- Focus on user needs, not user wants

- Remove all "fluff" from big websites

- Utilize the capabilities of the device (e.g., built-in GPS, accelerometers, etc.)

- Make things vertically scrollable, not horizontally

- Reduce interactions with the network to the extent possible

- Make use of reusable patterns (e.g., vertically stacking web pages)

- Designs for touchscreens (designer needs to consider tapping, pinching, spreading, flicking, scrolling (one-finger vs. two-finger), and dragging ,etc…)

Social Media and UI Design

- Social media presents alternative opportunities and challenges
  - Facebook, Twitter, Flickr™, YouTube™
  - Wikis, blogs
- Who is the target audience?
- What is the purpose of the application? (e.g., marketing channel)
- Which type of social media works best for your functional requirements?

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Guidelines for Social Media

- Post and update information often
- Use a combination of push and pull approaches
- Keep your sites synchronized to the extent possible
- Allow customers to share your content
  – Provide a voting or "like" mechanism to encourage customers to become involved in your site
- Design the site for longer term engagement
- Build a sense of community—users "belong" to something
- Take into account international and cultural issues

International & Cultural Issues in UI Design

- Websites have a global presence
- Considerations:
  - Multilingual requirements
  - The meaning of certain colors
  - Cultural differences
    - Power distance
    - Uncertainty avoidance
    - Individualism vs. collectivism

Non-Functional Requirements

- Operational Requirements—choice of hardware and software platforms
    - Technologies that can be used (e.g. GUI, 2 or 3 button mouse)
- Performance Requirements
    - Mobile computing and web browsing inject additional performance obstacles
- Security Requirements
    - Appropriate log on controls and possibly encryption
    - Wireless networks are especially vulnerable
- Political & Cultural Requirements
    - Date formats, colors, and currencies

Summary

- Principles of User Interface Design
- User Interface Design Process
- Navigation Design
- Input Design
- Output Design
- Mobile Computing and UI Design
- Social Media and UI Design
- International & Cultural Issues and UI Design
- Nonfunctional Requirements

References

Denis, Wixom,Tegarden. (2015). Systems Analysis and Design: An Object-Oriented Approach with UML. 5th edition. ISBN: 978-1-118-80467-4, John Wiley & Sons, Inc, Denver (USA)