User Interface Design

Part 1

User Interfaces

• “Today, user needs are recognized to be important in designing interactive computer systems, but as recently as 1980, they received little emphasis.” J. Grudin

• “We can’t worry about these user interface issues now. We haven’t even gotten this thing to work yet!” Mulligan
UI

• The User Interface today is often one of the most critical factors regarding the success or failure of a computer system
• Good UI design:
  – Increases efficiency
  – Improves productivity
  – Reduces errors
  – Reduces training
  – Improves acceptance
• Approach: The UI is the system
• Things to consider
  – Technical issues in creating the UI
  – User’s mental model
  – Conceptual model

Where is the UI?

• Seeheim Model
  – Describes the UI as the outer layer of the system
  – Agent responsible for interaction between the user and application
  – Consists of two sub-layers
    • Presentation
      – Perceptible aspects including screen design, keyboard layout
    • Dialog
      – Syntax of interaction including meta-communication (e.g. help)
      – Might include a natural language component
Seeheim Model

• Advantages
  – Could use the same outer layer for different applications
    • E.g. same look and feel for different products
  – Single application could be implemented with different outer layers
    • E.g. for different platforms, PDA, speech, etc.
• Assumed changes are likely to occur in the interface while the application remains largely unaffected

MVC

• Model-View-Controller – discussed previously
  – Similar advantages to Seeheim model
Human Factors in HCI

- Relevant disciplines
  - Humanities
    - Psychological approaches to how people remember, think, feel
    - E.g., don’t require user to remember more than 7 items at a time
  - Arts
    - Graphic arts, impact of layout, colors, spatial arrangement
    - Increasingly includes sound, music, animation, aspects of cinematography
  - Cognitive Ergonomics
    - Methods to allow humans to adapt to software artifacts
    - Try to adapt software to the task, not user to the software

Role of Models

- Models represent relevant characteristics of a part of reality that we need to understand
- But models are abstract
- Internal Models
  - Models for “execution”. Used by an agent to make decisions.
  - If a human is the agent, this is a mental model
  - If a machine is the agent, this is a program or knowledge system
- External Models
  - Models for communication.
  - Represent some formalism of the domain, e.g. automata or structure charts or UML diagrams
- Some models could be both, e.g. task knowledge models
  - E.g. knowledge about the work domain
Model of Human Information Processing

- Example of an external model
- Human Input is considered to proceed through a number of phases
  - Edge detection
    - Unstructured information structured into sketch
  - Gestalt formation
    - Small number of understandable structures formed, e.g. triangle or phoneme
  - Combination
    - Gestalts combined into groups of segments that belong together, e.g. phonemes to a word
  - Recognition
    - Segments recognized semantically, e.g. a word’s meaning, a picture of a tree
- Whole process takes less than a second and less automatic down the chain
  - Familiar stimulus is processed faster
  - So we may design our system or train our users for important signals

Model of Human Information Processing

- Human Output
  - Movement
  - Gestures, sounds, manipulations of tools
  - Human “CPU” decides on the meaning of the output, but leaves execution to motor processes that are running “unattended”
- Only in cases of problems is attention needed
  - E.g. location to click is awkward, can’t hear own voice in a spoken command
  - Limited capacity for simultaneous processing
Working Memory

• Modern psychology presumes separation from current-term and long-term memory
  – Current memory consists of 5-9 activated elements from long term memory
    • Chunking: 85884 to one chunk instead of five
  – Long-term memory is highly structured
    • Indexed by current memory at time of activation
    • Also part-of, member-of, generalization relationships between objects

Mental Models of Information Systems

• Planning the use of the technology
  – Users will apply their mental model to find out for what part of their task the system could be used and the conditions for use

• Execution of a task with a system
  – Continuous need for fine-tuning of user actions toward system events

• System has performed some task and produced output
  – The user must evaluate the results using their mental model, translate to the goals and needs of the user
  – E.g. accept slow response to query due to network congestion

• Multiple processes
  – User must cope with unexpected system events and interpret the system's behavior in relation to the intended task
Mental Models

- Just models – abstract aspects the user considers to be relevant and usable
- General characteristics:
  - Incomplete
    - Users generally aware that they do not really know all details of the system
  - They can only partly be “run”
    - May know how to express search/replace start and end situations, but not how the effect is obtained
  - They are unstable
    - Changes over time from user experiences
  - They have vague boundaries
    - People mix models, e.g. app with OS with network
  - They are parsimonious
    - People like models that are not too complicated
    - Elements of superstition for situations they do not really understand
      - E.g. manually park the hard drive prior to shutdown
- All of these characteristics can be used to help assess a UI

Design of Interactive Systems

- User Interface concept: UVM – User’s Virtual Machine
  - UVM includes the user and all systems that the user touches for the application
  - E.g. Networking, remote sources of data and computing
    - In considering a web browser, it is relevant to understand the network, caching, refreshing, reloading, etc. in terms of data and time
    - Newer applications include collaboration and groupware
Process Model for UI Design

- The book proposes a cyclical process devoted to analysis, specifications, and evaluation

  - Analysis
    - Task analysis
      - Model task situation for a single user, Task 1
        - Use ethnography, psychological knowledge, validity analysis
        - Alternate ways to perform tasks may be considered
      - Model task domain for multiple users, Task 2
        - Specifications, negotiation, compromises, constraints, feedback

  - Specification
    - Specs based on task model, includes cooperation technology and user-relevant system structures and network

  - Evaluation
    - Design decisions made, guidelines and standards should be considered. Prototyping might be considered.
Design as Multi-Disciplinary Collaboration

• Take into account individual users, clients, structure and organization of the group for the system
  – Must know individuals’ knowledge, group knowledge and dynamics

• Example: bank setting
  – Client and employee on different sides of a counter, client doesn’t know what clerk is doing on the screen
  – More service-oriented if the client and clerk look at the screen together?

• Detailed design decisions
  – An early evaluation needs to include analytical methods
    • Formal evaluation
    • Cognitive walkthroughs
    • Usability testing
      – Users in different roles
      – Ethnography, Focus, Interviews