Chapter 2: Guidelines, Principles, and Theories

Designing The User Interface

Guidelines

- Shared language
- Best practices
- Critics
  - Too specific, incomplete, hard to apply, and sometimes wrong
- Proponents
  - Encapsulate experience

Navigating the interface

- Sample of the National Cancer Institutes guidelines:
  - Standardize task sequences
  - Ensure that embedded links are descriptive
  - Use unique and descriptive headings
  - Use check boxes for binary choices
  - Develop pages that will print properly
  - Use thumbnail images to preview larger images
Accessibility guidelines

- Provide a text equivalent for every non-text element
- For any time-based multimedia presentations, synchronize equivalent alternatives
- Information conveyed with color should also be conveyed without it
- Title each frame to facilitate identification and navigation

Organizing the display

- Smith and Mosier (1986) offer five high-level goals
  - Consistency of data display
  - Efficient information assimilation by the user
  - Minimal memory load on the user
  - Compatibility of data display with data entry
  - Flexibility for user control of data display

Getting the user’s attention

- Intensity
- Marking
- Size
- Choice of fonts
- Inverse video
- Blinking
- Color
- Audio
**Principles**
- More fundamental, widely applicable, and enduring than guidelines
- Need more clarification
- Fundamental principles
  - Determine user’s skill levels
  - Identify the tasks
- Five primary interaction styles
- Eight golden rules of interface design
- Prevent errors
- Automation and human control

**Determine user’s skill levels**
- “Know thy user”
- Age, gender, physical and cognitive abilities, education, cultural or ethnic background, training, motivation, goals and personality
- Design goals based on skill level
  - Novice or first-time users
  - Knowledgeable intermittent users
  - Expert frequent users
- Multi-layer designs

**Identify the tasks**
- Task Analysis usually involve long hours observing and interviewing users
- Decomposition of high level tasks
- Relative task frequencies

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<tr>
<th>Task</th>
<th>Frequency</th>
<th>Novice</th>
<th>Knowledgeable</th>
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</table>
Choose an interaction style

- Direct Manipulation
- Menu selection
- Form filling
- Command language
- Natural language

Spectrum of Directness

Which one do you prefer?
The 8 golden rules of interface design

1. Strive for consistency
2. Cater to universal usability
3. Offer informative feedback
4. Design dialogs to yield closure
5. Prevent errors
6. Permit easy reversal of actions
7. Support internal locus of control
8. Reduce short term memory load

Prevent errors

- Make error messages specific, positive in tone, and constructive
- Mistakes and slips (Norman, 1983)
- Correct actions
  - Gray out inappropriate actions
  - Selection rather than freestyle typing
  - Automatic completion
- Complete sequences
  - Single abstract commands
  - Macros and subroutines

Friendly interfaces

- Microsoft pioneered friendly interfaces for technophobes - ‘At home with Bob’ software
- 3D metaphors based on familiar places (e.g. living rooms)
- Agents in the guise of pets (e.g. bunny, dog) were included to talk to the user
  - Make users feel more at ease and comfortable
Why was Clippy disliked by so many?
Was it annoying, distracting, patronising or other?
What sort of user liked Clippy?

Automation and human control

|||
Automation and human control (cont.)

- Successful integration:
  - Users can avoid:
    - Routine, tedious, and error prone tasks
  - Users can concentrate on:
    - Making critical decisions, coping with unexpected situations, and planning future actions

Automation and human control (cont.)

- Supervisory control needed to deal with real world open systems
  - E.g. air-traffic controllers with low frequency, but high consequences of failure
  - FAA: design should place the user in control and automate only to improve system performance, without reducing human involvement

Automation and human control (cont.)

- Goals for autonomous agents
  - knows user's likes and dislikes
  - makes proper inferences
  - responds to novel situations
  - performs competently with little guidance
- Tool-like interfaces versus autonomous agents
- Avatars representing human users, not computers, more successful
Automation and human control (cont.)

- User modeling for adaptive interfaces
  - keeps track of user performance
  - adapts behavior to suit user's needs
  - allows for automatically adapting system
    - response time, length of messages, density of feedback, content of menus, order of menu items, type of feedback, content of help screens
  - can be problematic
    - system may make surprising changes
    - user must pause to see what has happened
    - user may not be able to
      - predict next change
      - interpret what has happened
      - restore system to previous state

Automation and human control (cont.)

- Alternative to agents:
  - user control, responsibility, accomplishment
  - expand use of control panels
    - style sheets for word processors
    - specification boxes of query facilities
    - information-visualization tools

Virtual agents

- What do the virtual agents do?
- Do they elicit an emotional response in you?
- Do you trust them?
- What is the style of interaction?
- What facial expression do they have?
- Are they believable, pushy, helpful?
- Would it be different if they were male? If so, how?
Rea the realtor

- Rea showing user an apartment
- Human-like body
- Uses gesture, non-verbal communication (facial expressions, winks) while talking
- Sophisticated AI techniques used to enable this form of interaction

Conversation with Rea

- Mike approaches screen and Rea turns to face him and says:
  - Hello. How can I help you?
- Mike: I’m looking to buy a place near MIT.
- Rea nods, indicating she is following.
- Rea: I have a house to show you. (picture of a house appears on the screen)
- Rea: it is in Somerville.
- Mike: Tell me about it.
- Rea looks up and away while she plans what to say.
- Rea: It’s big.
- Rea makes an expansive gesture with her hands.
- Mike brings his hands up as if to speak, so Rea does not continue, waiting for him to speak.
- Mike: Tell me more about it.
- Rea: Sure thing. It has a nice garden...
- Would you buy a house from her?

What makes an agent believable?

- Believability refers to the extent to which users come to believe an agent’s intentions and personality
  - Appearance is very important
    - Are simple cartoon-like characters or more realistic characters, resembling the human form more believable?
  - Behaviour is very important
    - How an agent moves, gestures and refers to objects on the screen
    - Exaggeration of facial expressions and gestures to show underlying emotions (c.f. animation industry)
Automation and human control (concluded)

Features to aid in universal access
Above: Mac OS X system preference settings
Right: Windows Vista/7 Control Panel

Theories

- Beyond the specifics of guidelines
- Principles are used to develop theories
- Descriptions/explanatory or predictive
- Motor task, perceptual, or cognitive

Explanatory and predictive theories

- **Explanatory theories:**
  - Observing behavior
  - Describing activity
  - Conceiving of designs
  - Comparing high-level concepts of two designs
  - Training

- **Predictive theories:**
  - Enable designers to compare proposed designs for execution time or error rates
Perceptual, Cognitive, & Motor tasks

- **Perceptual or Cognitive subtasks theories**
  - Predicting reading times for free text, lists, or formatted displays

- **Motor-task performance times theories:**
  - Predicting keystroking or pointing times

Taxonomy (explanatory theory)

- Order on a complex set of phenomena
- Facilitate useful comparisons
- Organize a topic for newcomers
- Guide designers
- Indicate opportunities for novel products.

Conceptual, semantic, syntactic, and lexical model

- **Foley and van Dam four-level approach**
  - **Conceptual level:** User's mental model of the interactive system
  - **Semantic level:** Describes the meanings conveyed by the user's command input and by the computer's output display
  - **Syntactic level:** Defines how the units (words) that convey semantics are assembled into a complete sentence that instructs the computer to perform a certain task
  - **Lexical level:** Deals with device dependencies and with the precise mechanism by which a user specifies the syntax

- **Approach is convenient for designers**
  - Top-down nature is easy to explain
  - Matches the software architecture
  - Allows for useful modularity during design
Stages of action models

- Norman’s seven stages of action
  - Forming the goal
  - Forming the intention
  - Specifying the action
  - Executing the action
  - Perceiving the system state
  - Interpreting the system state
  - Evaluating the outcome

- Norman’s contributions
  - Context of cycles of action and evaluation.
  - Gulf of execution: Mismatch between the user’s intentions and the allowable actions
  - Gulf of evaluation: Mismatch between the system’s representation and the users’ expectations

Stages of action models (cont.)

- Four principles of good design
  - State and the action alternatives should be visible
  - Should be a good conceptual model with a consistent system image
  - Interface should include good mappings that reveal the relationships between stages
  - User should receive continuous feedback

- Four critical points where user failures can occur
  - Users can form an inadequate goal
  - Might not find the correct interface object because of an incomprehensible label or icon
  - May not know how to specify or execute a desired action
  - May receive inappropriate or misleading feedback

Consistency through grammars

**Consistent user interface goal**
- Definition is elusive - multiple levels sometimes in conflict
- Sometimes advantageous to be inconsistent.

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<th>Inconsistent A</th>
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<td>kill/create paragraph</td>
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</tr>
</tbody>
</table>
Consistency through grammars (cont.)

**Inconsistent action verbs**
- Take longer to learn
- Cause more errors
- Slow down users
- Harder for users to remember

The disappearance of syntax

- Users must maintain a profusion of device-dependent details in their human memory.
  - Which action erases a character
  - Which action inserts a new line after the third line of a text file
  - Which abbreviations are permissible
  - Which of the numbered function keys produces the previous screen.

The disappearance of syntax (cont.)

- Learning, use, and retention of this knowledge is hampered by two problems
  - Details vary across systems in an unpredictable manner
  - Greatly reduces the effectiveness of paired-associate learning
- Syntactic knowledge conveyed by example and repeated usage
- Syntactic knowledge is system dependent
The disappearance of syntax (concluded)

- Minimizing these burdens is the goal of most interface designers
  - Modern direct-manipulation systems
  - Familiar objects and actions representing their task objects and actions.
  - Modern user interface building tools
  - Standard widgets

Contextual Theories

- User actions are situated by time and place
  - You may not have time to deal with shortcuts or device dependent syntax, such as on mobile devices, when hurried
  - Physical space is important in ubiquitous, pervasive and embedded devices, e.g. a museum guide stating information about a nearby painting

- A taxonomy for mobile device application development could include:
  - Monitor and provide alerts, e.g. patient monitoring systems
  - Gather information
  - Participate in group collaboration
  - Locate and identify nearby object or site
  - Capture information about the object and share that information