Interaction Design (Rosson, CH5)

Specify mechanisms for accessing & manipulating task information

Into design

Which task objects & actions to show

How to represent

Interaction design

Do right things at right time (execution of task)

Fig 5.1 Gulf of Execution (slide 2)

Real world goal (task goal) → translate to system goal → elaborate to action plan (what steps)

Irregularity in last month budget

Examine Excel sheet

Point at Excel icon, double click, point to cell, ...

Grasp mouse until cursor over icon, double click, ...

Feedback important!

As we execute task, visual changes appear & process stalls over

Focus on WIMP (windows, icons, menus, pointers)

In context of designing sequence of user/system exchanges

- intuitive
- pleasant
- fluid
1) Selecting System Goal

translate real world goal into software-oriented system goal

semantic directness (slide 3)

degree of translation required from a user's conceived goal to action need to achieve the goal based on how that action is supported by system features

goal — minimize cognitive effort

interaction styles (slides 4-5)

provide behavioral view of how user communicates w/ system

look & feel of the interaction goals
Typed Command
- alpha numeric strings rep commands/parameters/options
  - speed, power/fluexability, easy to implement
  - recall, no visual cues, error, learnability

Form (Fill-in)
- fill in blank, predefined fields
  - simplifies data entry, recognition
  - space, rigid

Menu
- set of option, display, user selects
  - good for novice, exploration, set of decision provided, low error
  - scalability, slow, limited space

Direct manipulation
- analog of real world objects
  - visual cues, feedback, exploration, recognition
  - implementation, limited space, not always direct analog
Opportunistic Goals

User goals that are formulated on the spot in reaction to
prominent system events or displays that suggest those
goals.

Ex. arrival of new mail - user stops current tasks
to check new message

Opportunism common when novice users confused /distracted
and look to system to figure what to do next.

Planning an Action Sequence

Steps needed to achieve system goals → action plan

- Experienced users do not consciously plan steps
- Novice users / complex task the UI can help to figure out
  what steps are next

→ make actions obvious
  → based on user's previous experiences / mental model
  → system feedback (reinforce vs. revise mental model)
  → affordances (same physical analogies)
WIMP interface guides user through action sequences by simplifying process.

- User can see icons (no need to remember vocabulary.)
- More specific choices shown as progress (knowledge of next step only)

Possible to have long sequence of steps - what to do?

George Miller
The Magical Number Seven, Plus or Minus Two
1956

Studies of human memory limited.

We can handle more info by organizing into familiar, manageable units \( \rightarrow \) "chunk" it.

Organization of interrelated information into a unit.

Names, phone #, dates, ...

Fig 5.2 Interface control helps to chunk interaction (slide 11).

- 7 pieces of info needed by the system (left side of fig)
- User sees 3 chunks: ① selection, ② access & settings, ③ setting indentation
Chunking helps aid learning. Application of action plan

- arbitrary chunking / ignore natural boundaries
do more harm

Consistency (internal & external) important too

select object

\[ \downarrow \]

select attribute to change

vs.

select attribute to change

\[ \downarrow \]

select object

→ flexibility

we tend to like to pursue multiple goals at once

\[ \uparrow \]

increase control / decision process

problems must track where they are in one action sequence when return from another

provide multiple overlapping windows, tiled display, or modes (restrict interaction state where must finish before moving on)
Executing an Action Sequence

sequence of physical actions

in some applications we have limited control — window system / libraries / company specs

→ directness

how well does it meet performance requirements?

mapping of physical movement to task input requirements → articulatory directness

Table 5.1 shows common input devices, & physical characteristics / applications

pragmatics of user interaction device →

how does input device differ & change the way a user interacts w/ system to perform tasks. (phys behavior required)

→ feedback & undo.

system generated information lets user know if input being processed / result produced / error

how much is needed? tradeoff w/responsiveness of system

Errors still occur → tradeoff speed & accuracy
(overshoot icon, click when not wanted)
Fitts' Law - time and accuracy of pointing depend on target size and distance

(one of the few constants in ergonomics—previous guidelines on how to design interface elements)

when errors occur—
- Stale can easily be restored from
  - Overshoot w/mouse, re-click
  - Wrong character, delete if typist
- Ends in substantial change to system (data modified)
  - Digital system enables reversibility
    undo — granularity?
    undo the undo or redo

→ Optimizing performance

- Make execution efficient.

- Balance between ease of learning & power

  GUI easier to learn
  command line faster

Keyboard shortcuts - keyboard equivalents for one or more levels of menu navigation

Macros - series of commands stored as a "chunk"
  & execute freq combinations quickly
  customizable

Menu design / UI design - how long it takes to reveal menu
  drag printer to item
defaults - choices or inputs suggested by the system also provides clues to what is normal behavior at this point / what is expected input
careful - opt if one execution path can impact others

Science Fair

For interaction design elaborate scenario to describe user inputs & system responses (give idea of sw spec)

dialog design step-by-step exchange between human & system
how to manipulate / select data
tightly interleaved w/ activity & information design (slides)

explore functionality in activity scenario
activities transformed in new ways of behaving

objects / actions possible in system represented arranged to facilitate perception & understanding

interaction design - mechanisms for accessing & manipulating task info
How to show interaction?

Interaction scenario specify system input/output actions ('clicking on x') mapped to a device/image/ICON

Using user-system conversation method develop storyboard

user input
events

system responses:

text description of each side of conversation or = simple sketches of screen at each point in dialog w/ annotations of what user sees /does.
Task goal: There is a problem with last month’s budget. I better check the column sums

I opened an Excel file and selected the cell that should contain a sum equation

I see the equation and it looks okay, so I will move on

I need to open that Excel file to check the equations

Pointer over icon, icon highlighted, rectangle with text appears, pointer at bottom of column, highlighted symbols appear in box above column

Grasp mouse, move cursor to icon, click twice rapidly, move pointer to new position, click once

Point at the Excel icon, double-click to open, point to cell at bottom of first column, click to highlight, read equation
Selecting a system goal

Last month's budget...?

- high semantic directness
- low semantic directness
Interaction Styles

• Typed-Command Languages
  – Alphanumeric strings represent commands, parameters, and/or options
  – Typed in by user

• Advantages
  – Speed (for advanced users)
  – Powerful (many combinations of commands)
  – Easy to implement

• Drawbacks
  – Recall vs. recognition
  – Heavy memory load
  – Little/nothing visible
  – High error rate
  – Learnability

Resources
• http://www.interaction-design.org/encyclopedia/interaction_styles.html
Interaction Styles

• Forms (Fill-in)
  – Fill in the blank
  – Predefined form field filled in by user

• Advantages
  – Simplifies data entry
  – Recognition vs. Recall

• Drawbacks
  – Space requirement
  – Rigid (not flexible)

Resources
• http://www.interaction-design.org/encyclopedia/interaction_styles.html
Interaction Styles

• Menus
  – Set of options displayed on the screen
  – User selects command and observes the effect

• Many different types
  – Push-button
  – Radio-button
  – Check-button
  – Pull-down menus
  – Pop-up menus
  – Option menus
  – Toggle menus
  – Cascading menus
  – Pie menus
  – Pallet Menus
  – Embedded Menus
  – Dynamic Menus

Resources
• http://www.interaction-design.org/encyclopedia/interaction_styles.html
Interaction Styles

- Advantages
  - Ideal for novice users
  - Affords exploration
    - users can "look around" in the menus for the appropriate command instead of memorizing them
  - Structures decision making
  - Easy support of error handling

- Drawbacks
  - Scalability
    - Too many choices for increasingly complex systems
  - Slow for frequent user
  - Not be suited for small graphic displays

Resources
- http://www.interaction-design.org/encyclopedia/interaction_styles.html
Interaction Styles

• Direct Manipulation
  – Built from objects that are direct analogs of objects and actions in the real world

• Advantages
  – Visually presents task concepts (semantic directness)
  – Constant feedback
  – Easy to learn, encourages exploration
  – Errors can be avoided more easily
  – Recognition vs. Recall

• Drawbacks
  – More difficult to implement
  – Not suitable for small graphic displays
  – Spatial and visual representation is not always preferable (too many negatively impacts)
  – Direct analog to task not always available

Resources
• http://www.interaction-design.org/encyclopedia/interaction_styles.html
“Chunking”

- Breaks up information into units or chunks
- Easier to commit to working memory
- Work with text, images, sounds, and more

• Related Reference

Hello

15206212434
1 (520) 621-2434
Figure 5.2
User interface controls organize complex plans into smaller, more manageable sequences of actions

1. Select text
   The example in the figure continues through the cycle to emphasize the important role of system feedback. While the execution takes place, some visual changes appear; when the file is opened, a new figure (the window) is seen. These changes are interpreted with respect to the spreadsheet context, and ultimately with respect to the budget question.

2. Open Paragraph settings

3. Set indentation

   1. Specify test selection start
   2. Specify text selection end
   3. Select Format Menu
   4. Select Paragraph option
   5. Set Special to First Line
   6. Type value for First Line
   7. Accept new settings
Figure 5.2 – Redefined (arbitrary chunks)

1. Specify test selection start
2. Specify text selection end
3. Select Format Menu
4. Select Paragraph option
5. Set Special to First Line
6. Type value for First Line
7. Accept new settings
# Table 5.1
Example input devices with different operational characteristics

<table>
<thead>
<tr>
<th>Device</th>
<th>Input Characteristics</th>
<th>Sample Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Button</td>
<td>Simple discrete input</td>
<td>Command execution or attribute specification</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Spatial array, small-finger movement, allows combination of key presses, discrete</td>
<td>Open-ended continuous symbolic input</td>
</tr>
<tr>
<td>Mouse</td>
<td>Grasped with hand, one or more buttons, large arm movement, analog</td>
<td>Pointing and selecting in a 2D space</td>
</tr>
<tr>
<td>Trackball</td>
<td>Grasped and rolled with hand, constrained movement in horizontal plane, one or more buttons, analog</td>
<td>Panning (rolling over) large maps or other 2D surfaces</td>
</tr>
<tr>
<td>Joystick</td>
<td>Grasped with hand, pushed or twisted, one or more buttons, constrained movement in three dimensions, analog</td>
<td>Setting direction of movement in virtual space, continuous zooming</td>
</tr>
<tr>
<td>Data glove</td>
<td>Tracking of finger and hand position in three dimensions</td>
<td>Grabbing and positioning objects in virtual space</td>
</tr>
</tbody>
</table>
Interface Pragmatics
Physical behaviors required by the user interface

The example in the figure continues through the cycle to emphasize the important role of system feedback. While the execution takes place, some visual changes appear; when the file is opened, a new figure (the window) is seen. These changes are interpreted with respect to the spreadsheet context, and ultimately with respect to the budget question.
Fitts’ Law

• Time to acquire target is a function of distance & size of target

• Fun experiments
  – http://fww.few.vu.nl/hci/interactive/fitts/
  – http://www.tele-actor.net/cgi-bin/fitts/applet1.pl
  – http://www.tele-actor.net/cgi-bin/fitts/applet2.pl

\[
T = \log_2 \left( \frac{D}{W} + 1 \right)
\]

\(T\) = average time to complete movement
\(D\) = distance from start to center of target
\(W\) = width of target
Virtual Science Fair Design

<table>
<thead>
<tr>
<th>VSF Information</th>
<th>Real-World Metaphor</th>
<th>VSF Activity Design</th>
<th>VSF Information Design</th>
<th>VSF Interaction Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructing an exhibit is like writing a ....</td>
<td>Lab journal</td>
<td>Informal personal notes</td>
<td>Loosely organized pages with handwriting, sketches</td>
<td>Open to a page, read whole page, turn page to continue</td>
</tr>
<tr>
<td>Documentary</td>
<td>Carefully constructed “story” of how the project happened</td>
<td>Movie or animated sequence of screens and audio</td>
<td>Buttons to start/stop play; pause or replay is desired</td>
<td></td>
</tr>
</tbody>
</table>

- **Activity Design**
  - Explore system functionality in activity scenario
  - Activities should transform tasks into new ways of behaving
- **Information Design**
  - Objects/actions possible in a system are represented and arranged to facilitate perception and understanding
- **Interaction Design**
  - Mechanisms for accessing and manipulating task information
Figure 5.7
Simple Storyboard sketching interactions with the miniature windows

1. Alicia and Delia look at the Excel charts Sally has prepared.

2. The Excel application is launched on the data files Sally has provided; Delia works with Excel independently of the exhibit.

3. The exhibit window surfaces, with the Excel miniature still selected.

Delia double-clicks on the Excel miniature …

Delia clicks on any part of the exhibit to reactivate it …

Alicia clicks the miniature for the slide show of the star model …
Figure 5.7
Simple Storyboard sketching interactions with the miniature windows

4. An animated demo of stars forming and repositioning is displayed.

5. Alicia and Delia see Sally’s instructions about how to run her star simulation.

6. The exhibit window surfaces, with the star model still selected, and the final frame of the animation in view.

Alicia double-clicks on the star model to see what will happen ...

They take a look, then use the close box to dismiss the star simulation ...
Additional story board examples
Cocktail bar and mobile cocktail catering service

Additional story board examples
Cocktail bar and mobile cocktail catering service - CONT

Storyboard Example

Android mockup template