chapter 5

interaction design basics

Interaction design: A sub-discipline of design which examines the role of embedded behaviors and intelligence in physical and virtual spaces as well as the convergence of physical and digital products.

Sometimes referred to by the acronym “iD,” interaction design has developed as a field of study in universities such as MIT, Carnegie-Mellon University, Malmö, etc.


Interaction Design; Overview

1. The design process
   - what it is, design process
2. Navigation design (web and other systems)
   - finding your way around a system, 4 golden rules
3. Screen design/layout, e.g. physical controls
   - grouping, alignment, columns, space
4. Affordances and mappings
   - what kind of action does a system invite to?
   - matching conceptual model with user mental model
5. Iteration and prototyping
   - never get it right first time!

what is design?

It is achieving goals within constraints

- goals - purpose
  - who is it for, why do they want it
- Constraints
  - materials (cheap-expensive),
  - platforms (wide-spread, robust)
- trade-offs
  - materials (price vs. durability),
  - platforms (popularity vs. safety)

1. The Design process

Steps …

- requirements
  - what is there and what is wanted …
- analysis (e.g. task analysis)
  - ordering and understanding
- design
  - what to do and how to decide
- iteration and prototyping
  - getting it right … and finding what is really needed!
- implementation and deployment
  - making it and getting it out there
2. Navigation design

Most systems offer a navigation function.

Backwards Web navigation

WebFlow Navigation Manager framework (WFNM) is a server-side navigation history of Web pages.

To better understand the motivation behind WFNW, look at this example. Imagine a Web application with the navigation described in Figure 1. The application consists of four pages: b1, b2, b3, and b4.

Frameworks like Struts or JavaServer Faces can be configured, typically through an XML configuration file, to manage the forward navigation among these pages. But such frameworks typically do not handle dynamic backwards navigation.

Four golden rules for navigation design; may apply to local and global structures

- knowing where you are
- knowing what you can do
- knowing where you are going
  – or what will happen
- knowing where you've been
  – or what you’ve done

where you are

shows path through web site hierarchy
Navigation of knowledge structures

Knowledge mapping links:
- Walden’s Paths: http://www.csdl.tamu.edu/walden/
- VR-VIBE: http://www.crg.cs.nott.ac.uk/research/technologies/visualisation/vrbv
- The Task Gallery: http://www2.iicm.edu/keith/papers/vis97/ipyr.html

KnowledgeMap project (Fjeld et al., 2002)
3D representation of textbooks

Inspiration …

and paper sketches

KnowledgeMap project (Fjeld et al., 2002)
3D representation of textbooks (->math.)

3. Screen design and layout

basic principles
- grouping, structure, order
- alignment
- use of white space

available tools
- grouping of items
- (order of items)
- (decoration - fonts, boxes etc.)
- alignment of items
- white space between items

basic principles
- ask
  - what is the user doing?
- think
  - what information, comparisons, order
- design
  - form follows function
grouping and structure

logically together ⇒ physically together

Billing details:
Name
Address ...
Credit card no

Delivery details:
Name
Address ...

Order details:
item size 10 screws (boxes)
cost 1.005763 2.0175 497.6256
cost 3.71 56.34 20/67

alignment - numbers

think purpose!
which is biggest?
532.56 179.3 256.317 15 73.948 1035 3.142 497.6256

alignment - numbers

visually:
long number = big number
align decimal points
or right align integers

627.865 1.005763
382.583 2502.56
432.935 2.0175
652.87 56.34

multiple columns

• scanning across gaps hard:
  (often hard to avoid with large data base fields)

  sherbert 75
toffee 120
chocolate 35
fruit gums 27
coconut dreams 85

multiple columns - 2

• use leaders

  sherbert 75
toffee 120
chocolate 35
fruit gums 27
coconut dreams 85

multiple columns - 3

• or greying  (vertical too)

  sherbert 75
toffee 120
chocolate 35
fruit gums 27
coconut dreams 85
multiple columns - 4

• or even (with care!) ‘bad’ alignment

| sherbert  | 75 |
| toffee    | 120 |
| chocolate | 35 |
| fruit gums| 27 |
| coconut dreams | 85 |

Using white space: space to separate

Using white space: space to structure

Using white space: space to highlight

Example: Physical controls of a microwave oven

• grouping of items
  - defrost settings
  - type of food
  - time to cook

physical controls

• grouping of items
• order of items
  1) type of heating
  2) temperature
  3) time to cook
  4) start
physical controls
- grouping of items
- order of items
- decoration
  - different colours for different functions
  - lines around related buttons (temp up/down)

physical controls
- grouping of items
- order of items
- decoration
- alignment
  - centred text in buttons
  - ? easy to scan ?

physical controls
- grouping of items
- order of items
- decoration
- alignment
- white space
  - gaps to aid grouping

4. Perceptual ecology and affordances
(introduced as approach to “Task Analysis”)
- Founded by J. J. Gibson (WWII pilot),
  applied on technology by D. Norman (80’s)
- ‘ecological optics’
- not just retinal image, but ‘ambient optic array’
  - depth perception of images/reality
- surfaces
- texture gradients

The ‘visual cliff’

Optic flow field

The optic flow field is described as a two-dimensional motion field, specifying the direction of travel of the observer (O), here parallel to the ground surface.

Gibson proposed that the information was present everywhere in the optic flow field (i.e. irrespective of the moving observer’s direction of gaze).
Affordances

- No need for cognitive processes to interpret visual input
- End product of perception is not an internal representation of the world, but...
- Detection of **affordances**
- (Not the same as mental model)

Affordances

- What you can do with it

<table>
<thead>
<tr>
<th>Object</th>
<th>Affordance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree stump</td>
<td>Sitting on</td>
</tr>
<tr>
<td>Fruit</td>
<td>Eating</td>
</tr>
<tr>
<td>Thunder</td>
<td>Fear</td>
</tr>
<tr>
<td>Stairs</td>
<td>Climbable</td>
</tr>
</tbody>
</table>

D. Norman: Technology affordances (80's)

Definition of technology affordances

- Perceived and actual properties of things
- 'Fundamental properties that determine just how the thing could possibly be used'

Question:
- How can technology affordances be designed?

Mappings

Make explicit the relationship between controls and functions
Mapping: Good or Bad UI Example?

http://www.system-concepts.com/articles/bloopers/article0044.html

Mapping: Bad UI Example

- This picture shows an oven hob. Which of the controls (numbered 1-4) would you use to light the hob at the back right (arrowed)?
- The answer is number 4, yet most people guess 2.
- The cause of this design blooper is the mismatch between the user’s mental model and the designer’s conceptual model.

Mapping: Bad UI Example

- Users tend to hold the following mental model about the way the mapping works:
  --The top two controls map to the top two gas hobs, and the bottom two controls map to the bottom two gas hobs. So the correct knob is number 2.
- But the designers at Ariston had a different model. In their conceptual model, the mapping works in the following way:
  --The first knob controls the hob at the back left and then the others follow in an anti-clockwise direction. So the last gas hob in the anti-clockwise sequence (arrowed) is controlled by the last knob (number 4).

Mapping: Good UI Example

It is not easy to map a set of one-dimensional controls to a set of two-dimensional objects. To help people use this hob, we would recommend matching the conceptual model to the user’s mental model.

The designers could emphasise this by offsetting controls 1 & 3 slightly to the left, and controls 2 & 4 slightly to the right. The match could be enhanced further by including a gap between each pair.

Constraints (1/3): Physical constraints

The technology/function is designed so that you can only physically interact with it in ways which will result in the intended action

Constraints (2/3): Logical constraints

Exploit people’s common-sense reasoning about the relationships between objects/actions
Constraints (3/3) : Cultural constraints

Learned arbitrary conventions that are well understood by a community of users

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NTNU, Trondheim
Anecdote

Telenor phoned an NTNU professor in Trondheim, who picked up his calculator and told how phone keys should be layout

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Affordances and mappings: some issues

- What is directly perceived and what is learned?
- Is perception of an affordance just visual, or does it include auditory and tactile perception?
- How can we reduce cognitive load through designing affordances?
- Don't we just 'get used to things' anyway?

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5. Iteration and prototyping

Iteration: Repeating a set or rules or steps over and over, one step is called an iterate.
http://www-istp.gsfc.nasa.gov/stargaze/Sgloss.htm

Prototype: Prototypes or prototypical instances combine the most representative attributes of a category. They are the best examples among the members of a category and serve as benchmarks against which the surrounding "poorer" instances are categorized.
http://en.wikipedia.org/wiki/Prototype

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Why Do We Prototype?

- Get feedback on our design faster – saves money
- Experiment with alternative designs
- Fix problems before code is written
- Keep the design centered on the user

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Fidelity in Prototyping

- Fidelity refers to the level of detail
  - High-fidelity: prototypes look like the final product
  - Low-fidelity: artists renditions with many details missing
Low-fidelity Sketches / Paper prototypes

The Basic Materials
- Large, heavy, white paper (11 x 17)
- 5x8 in. index cards
- Tape, stick glue, correction tape
- Pens & markers (many colors & sizes)
- Overhead transparencies
- Scissors, X-acto knives, etc.

Constructing the Model
- Set a deadline
  - don’t think too long - build it!
- Draw a window frame on large paper
- Put different screen regions on cards
  - anything that moves, changes, appears/disappears
- Ready response for any user action
  - e.g., have those pull-down menus already made
- Use photocopier to make many versions

Preparing for a Test
- Select your users
  - understand background of intended users
  - use a questionnaire to get the people you need
  - don’t use friends or family
- Prepare scenarios that are
  - typical of the product during actual use
  - make prototype support these (small, yet broad)
- Practice to avoid “bugs”

Conducting a Test
- Four test-subjects (minimum)
  - greeter - puts users at ease & gets data
  - facilitator - only team member who speaks
    - gives instructions & encourages thoughts, opinions
  - computer - knows application logic & controls it
    - always simulates the response, w/o explanation
  - observers - take notes & recommendations
- Typical session is 1 hour
  - preparation, the test, debriefing
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Low-fidelity / paper prototyping

Paper prototype of typical forms-filling screen.

Low-fidelity / paper prototyping

Paper prototype of a tabs-based design.

Low-fidelity / paper prototyping

Typical set-up of the usability laboratory for a test session with a paper prototype.

Low-fidelity / paper prototyping

User test of a low-fidelity paper prototype of a website.

Low-fidelity / paper prototyping

User test of a paper prototype of a device-based interaction (here: a mobile phone).

Low-fidelity / paper prototyping

Testing hardware user interfaces: mockup of a kiosk.
Real-life low-fidelity/paper prototyping:


Paper: http://portal.acm.org/citation.cfm?id=358916.361981