CS 160: User Interface Design

Conceptual Models I 2/7/11
Due This Week

Today: Group Brainstorm
(Wiki and printout handed in now)

Wednesday: Individual Programming Assignment 2
(Source code, executable and video on wiki)
Individual Programming Assignment 2
Review: Task Analysis

Find some real users

Talk to them
Find out what they do now
How would your system fit in?
More on this a bit later

Are they too busy?
Buy their time
t-shirts, coffee mugs, etc.
Review: Task Analysis Questions

1. Who is going to use system?
2. What tasks do they now perform?
3. What tasks are desired?
4. How are the tasks learned?
5. Where are the tasks performed?
6. What's the relationship between user & data?
7. What other tools does the user have?
8. How do users communicate with each other?
9. How often are the tasks performed?
10. What are the time constraints on the tasks?
11. What happens when things go wrong?
Review: Master-Apprentice Model

Allows user to teach us what they do
- Skill knowledge is usually tacit (can’t put it in books)
- Sometimes literal apprenticeship is best

Matsushita Home Bakery – First automatic bread maker to have twist/stretch motion [Nonaka 95]
New Assignment out today (due 2/23)

**Contextual Inquiry and Task Analysis - Due Feb 23 (2.5 weeks)**

Find and interview 3 target users (not from class)
Analyze their tasks
Explain how your application addresses their needs
Compile a list of existing related applications
See wiki for details

**Start early – there is a lot to do**

Finding participants will take time
We will not accept late group project assignments
Topics

Personas
Affordances
Conceptual Models
Design Principles
The Action Cycle
Personas
Personas (from Cooper)

“Hypothetical Archetypes”

Archetype: (American Heritage)
An original model or type after which other similar things are patterned; a prototype
An ideal example of a type; quintessence

A precise description of user in terms of:
Capabilities, inclinations, background
Goals (not tasks)
Persona Examples

I'm Julie, an account manager. I'm responsible for the purchases for my division.

Yo, I'm Mike, I work out in the field, and I need durable tools I can throw in my truck.

Hi I'm John. I'm an engineer, and I suggest what products might work best.

Brad Colbow (http://carsonified.com/blog/design/how-to-understand-your-users-with-personas/)
Why Personas?

It’s hard to reason about users in aggregate, and impossible to please everyone.

General users have too many conflicting goals.

http://simpsons.wikia.com/wiki/File:TheHomer.png
Why Personas?

It’s easier to reason about specific fictional people.

Specific personas have clear, well-articulated goals
Defining and Using Personas

Defining them
Identify major clusters from multiple user interviews/inquiries
Synthesize their goals
Check for completeness and specificity
Specificity prevents “elastic user”
Try them out by developing narrative

Design each interface for a single primary persona
Yet other type might use the interface
<table>
<thead>
<tr>
<th>Age</th>
<th>Occupation</th>
<th>Home Life</th>
<th>Education</th>
<th>LIFESTYLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Second grade student</td>
<td>Lives with her mother, father, and younger sister in the suburbs of a large city.</td>
<td>In elementary school</td>
<td>Plays soccer, reads, and takes ballet lessons; saves her birthday money and allowance to spend at the mall.</td>
</tr>
<tr>
<td>34</td>
<td>Part-time office administrator</td>
<td>Lives with her husband and two children in a mid-sized city.</td>
<td>Has a bachelor degree</td>
<td>Enjoys crossword puzzles and reading mystery novels. Spends a lot of time driving her children to activities.</td>
</tr>
<tr>
<td>66</td>
<td>Retired accountant</td>
<td>Lives with his wife in the suburbs; has four children and six grandchildren.</td>
<td>Has an MBA</td>
<td>Likes to work in the garden and drink wine. Enjoys traveling with his wife and investing in the stock market.</td>
</tr>
</tbody>
</table>

**Activities**
- **AMANDA**: Plays soccer, reads, and takes ballet lessons; saves her birthday money and allowance to spend at the mall.
- **GLORIA**: Enjoys crossword puzzles and reading mystery novels. Spends a lot of time driving her children to activities.
- **CHARLES**: Likes to work in the garden and drink wine. Enjoys traveling with his wife and investing in the stock market.

**Ultimate Goal**
- **AMANDA**: Goal is to turn 10 so that her parents will let her baby-sit her cousins.
- **GLORIA**: Goal is to make sure her family is taken care of and to find a little time for herself and her hobbies.
- **CHARLES**: Goal is to make sure he and his wife have enough money to enjoy their retirement.
Personas vs. Observations

How do personas differ from the people you observed in your inquiry?
Affordances
“… the term **affordance** refers to the *perceived* and *actual* properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used.
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the thing could possibly be used.

Some affordances obvious
Knobs afford turning
Buttons afford pushing
Glass can be seen through

The Design of Everyday Things.
Don Norman
“… the term **affordance** refers to the *perceived* and *actual* properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used.

**Some affordances obvious**
- Knobs afford turning
- Buttons afford pushing
- Glass can be seen through

**Some affordances learned**
- Glass breaks easily

The Design of Everyday Things.  
Don Norman
Affordances

Clues about how object/interface works
Affordances

Clues about how object/interface works

Affordances
holes for insertion of fingers
blades for cutting

Implications clear for how operating parts work
Door Handles

Affordances suggest how to use the object
Door Handles

Affordances suggest how to use the object
Door Handles

Affordances suggest how to use the object
Cultural Dependencies

Affordances suggest how to use the object

Can be dependent on the
Experience
Knowledge
Culture
Cultural Dependencies

Affordances suggest how to use the object

Can be dependent on the
Experience
Knowledge
Culture
Switches (US down=off, UK down=on)
red = danger, green = go

Can make an action easy/difficult
Perceived Affordances

Affordances suggest how to use the object

Can be dependent on the
Experience
Knowledge
Culture of the actor

Can make an action easy/difficult

Affordances may be perceived without actually existing
Screen-Based Interfaces

Physical affordances

Screen, pointing device, physical buttons, keyboard
These afford touching, pointing, clicking on every pixel
Screen-Based Interfaces

Physical affordances
Screen, pointing device, physical buttons, keyboard
These afford touching, pointing, clicking on every pixel

Physical affordances of screens often unused
Screen affords touching, but most screens are not touch sensitive
Designer Controls Perceived Affordances

What are the affordances of these graphical objects?
Designer Controls Perceived Affordances

What are the affordances of these graphical objects?
Do Graphical Objects Afford Clicking?

Graphic design emphasizes affordances
Helps user recognize objects as buttons
Scrollbar Affordances?
Well-designed widgets have clear affordances e.g. resize handles:

crop handles:

motion arrows
Conceptual Models
Mental Representations

Users’ understanding of how interface works

People have preconceived models

$1 + 5 \times 7 = $
Mental Representations

Users’ understanding of how interface works

People have preconceived models

$1 + 5 \times 7 =

1 + 5 \times 7 =

Changing mental models can be difficult

For more on visual grouping and math eqns see work of Landy and Goldstone.
Interfaces Must Communicate Model

Online help / documentation useful (but shouldn’t be necessary)
Refrigerator

Problem: freezer too cold, but fresh food just right
Refrigerator Controls

Normal Settings
Colder Fresh Food
Coldest Fresh Food
Colder Freezer
Warmer Fresh Food
OFF (both)

<table>
<thead>
<tr>
<th>Setting</th>
<th>Freezer</th>
<th>Fresh Food</th>
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</thead>
<tbody>
<tr>
<td>Normal Settings</td>
<td>C and 4</td>
<td></td>
</tr>
<tr>
<td>Colder Fresh Food</td>
<td>C and 5-6</td>
<td></td>
</tr>
<tr>
<td>Coldest Fresh Food</td>
<td>B and 7</td>
<td></td>
</tr>
<tr>
<td>Colder Freezer</td>
<td>D and 6-7</td>
<td></td>
</tr>
<tr>
<td>Warmer Fresh Food</td>
<td>C and 3-1</td>
<td></td>
</tr>
<tr>
<td>OFF (both)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

What is your conceptual model?
Most Likely Conceptual Model

Independent Controls
Correct Conceptual Model

Possible solutions:
Make controls map to user’s model
Make controls map to actual system
Conceptual Models

Design Model

System Image

User’s Model
Conceptual Models

Design Model

User’s Model

System Image

Designers model may not match user’s model
Users get model from experience & usage
Users only work with system image, not with designer

What if the two models don’t match?
Preconceived Models

People have preconceived models of how things work
how does your car start?
how does an ATM machine work?
how does your computer boot?

Allow us to predict how things will work or not work
Preconceived Models

Teapot

Screw
Preconceived Models Often Wrong!

Extracted from fragmentary evidence

People find ways to explain things
Certain you’re driving on the correct road
Design Principles
1. Make Controls Visible
Poor Visibility (BMW’s iDrive)
How do you put someone on hold?
How do you set the alarm?
Primary controls are visible
But how to set a radio station preset?
Too Much Visibility?

6 remote controls for “modest” home theater
2. Make Sure Mapping is Clear

Mapping: Relationship between controls and their result

Mercedes S500 Car Seat Controller
Does it control moving sound left/right or front/back?
Stovetop Controls

**arbitrary**

24 possibilities, requires:
visible labels
memory

**paired**

2 possibilities per side
=4 total possibilities

**full mapping**

24 possibilities, requires:
visible labels
memory
Transfer Expectations

From known objects to similar new ones

Positive: previous experience applies to new situation
Negative: previous experience conflicts with new situation
What happens when disk is dragged onto trash can?
3. Provide Feedback

People press >> 1 time
Unclear if system has registered the button press
Elevator buttons light up → reducing multiple presses
Poor Feedback

Took a day for refrigerator to adjust to new settings
The Action Cycle
Conceptual Models

Design Model

System Image

User’s Model
Gulfs of Execution & Evaluation

Mental Model

Physical System

Gulf of Execution

Goals

Gulf of Evaluation

Real World
Gulf of Evaluation

Real world:

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
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<tbody>
<tr>
<td>0.67</td>
<td>0.79</td>
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<td>0.03</td>
<td>0.03</td>
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<td>0.20</td>
<td>0.54</td>
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<tr>
<td>0.51</td>
<td>0.38</td>
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<tr>
<td>0.11</td>
<td>0.33</td>
</tr>
<tr>
<td>0.46</td>
<td>0.46</td>
</tr>
</tbody>
</table>

Mental model: x,y correlated?

Evaluation
Gulf of Evaluation

Real world:

Mental model:
$x, y$ correlated?
Gulf of Evaluation

Real world:

\[ \rho = -0.29 \]

Mental model:

x, y correlated?
Gulf of Execution

Real world

Gulf

Mental model:
Draw a rectangle

Execution

Move 90 30
Rotate 35
Pen down
…
Gulf of Execution

Real world

1. Draw a rectangle
2. Rotate the shape

Mental model:
Draw a rectangle

Execution
Gulf of Execution

Real world → Gulf → Mental model: Draw a rectangle

Execution
Conceptual Models

Design Model

System Image

User’s Model
Action Cycle

Goals

Execution

Evaluation

The World

start here
Action Cycle

Goals

- Execution
  - Intention to act
  - Sequence of actions
  - Execution of actions

- Evaluation
  - Evaluation of interpretations
  - Interpreting the perception
  - Perceiving the state of the world

The World

start here
Next Time

Assignment Due Wed 2/9
Individual Programming Assignment 3
Assignment Due Wed 2/23
Contextual Inquiry and Task Analysis

Reading
Direct Manipulation Interfaces.
Hutchins, Hollan & Norman.
Sections 3 through 6.
Heuristic Evaluation.
Jakob Nielsen. (this is a short online reading)