

User Interaction

CS 4620 lecture 21

User Interaction

- Input devices
- User-centered design
- GUIs and GUI design
- Interaction with 2D and 3D scenes

Input devices

- Discrete events
 - Keyboard
 - Function keys
 - Mouse buttons
 - Game controller buttons
 - Including multi-way controllers (pseudo-joysticks)
- Valuators: generate continuous values
 - Rotary knobs (relative or absolute)
 - Recentring or free
 - Joysticks (two valuators in one)

Input devices

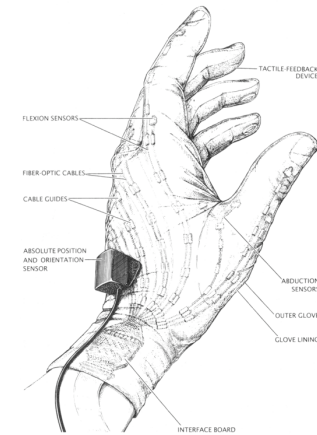
- Locators: give a continuous 2D position
 - Mechanical mouse (trackball is the same)
 - Two axes with optical encoders
 - Integrate rate of pulses on each axis
 - Result = position
 - Optical mouse
 - Image sensor looking out the bottom
 - Shift and correlate to estimate motion per frame
 - Integrate motion to get position
 - Mouse velocity scaling

Input devices

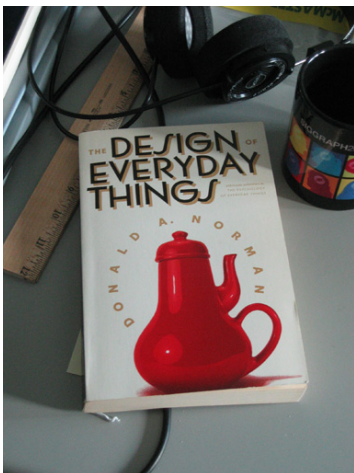
- Locators, cont.
 - Pen tablet
 - Directly senses absolute stylus position
 - Often used directly over a display
 - PDA
 - Tablet PC
 - Absolute vs. relative
 - Direct vs. indirect

Input devices

- Multidimensional controllers
 - More exotic devices
 - Spaceball
 - Data glove
 - 3D tracker
 - Magnetic
 - Acoustic
 - Optical



User-centered design



- Usability is an often undervalued objective in the design of devices
- Computers and computerized devices are some of the worst offenders!
- This section based heavily on the classic book by Donald Norman, *The Design of Everyday Things*

User-centered design

- We are often frustrated by the artifacts we build to work for us
 - door handles, water faucets, ...
 - stereos, microwaves, ...
 - airplanes, industrial equipment, ...
 - computers (always!)
- ...and we blame ourselves
 - *I'm so dumb, I always push the pull door*
 - *I would need an engineering degree to figure this thing out!*
 - *The accident was caused by pilot error*
- If we work at it, we can avoid many of these problems!

Psychopathology of everyday things

- (Norman's phrase)
- Sometimes the interaction between a device and human behavior defeats the device's purpose
- Best explored by examples

Doors: push or pull?



Doors: push or pull?



Ovens



- Two devices with the same basic function
 - one computer controlled, one not
 - one universally hated UI, one perfectly functional

Cameras



Cornell CS4620 Fall 2008 • Lecture 21

© 2008 Steve Marschner • 13

Concepts of user-centered design

- Affordances
 - objects indicate by their appearance how they can be used
- Mappings
 - when several controls, directions, etc. exist, which is which?
- Conceptual models
 - don't mislead the user about what is inside
- Visibility and feedback
 - let the user see what is going on
- Knowledge in the head vs. in the world
 - well-chosen cues help the user remember what to do
- Conventions
 - when all else fails, make the user memorize **once**

Cornell CS4620 Fall 2008 • Lecture 21

© 2008 Steve Marschner • 14

Affordances

- Which turn, which slide, which push?



Cornell CS4620 Fall 2008 • Lecture 21

© 2008 Steve Marschner • 15

Affordances

- The big jog/shuttle knob has some hidden meanings...



Cornell CS4620 Fall 2008 • Lecture 21

© 2008 Steve Marschner • 16

Mappings

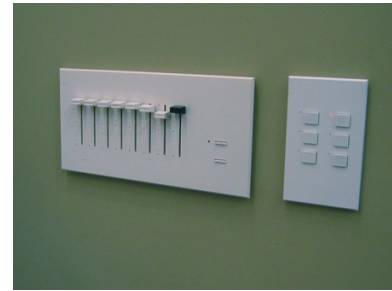
- Which control is for which burner?



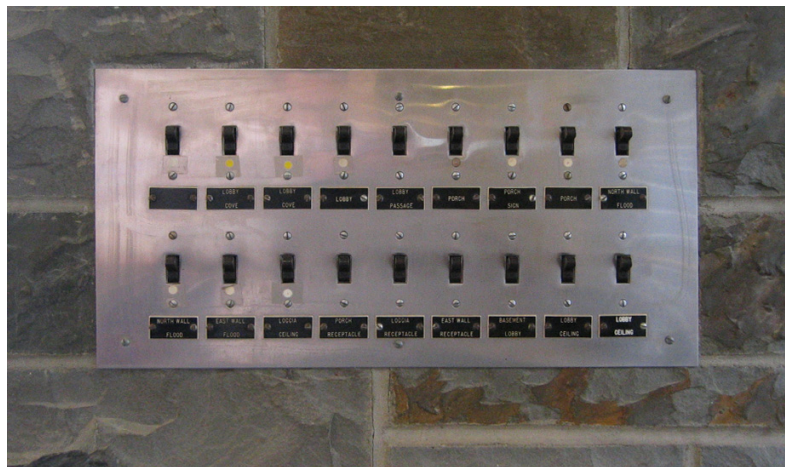
[Frigidaire]

Mappings

- Lighting controls: which switch controls what light(s)?
 - what lights are even being controlled? Which operate independently?



Mappings



Mappings

- Which way do you turn?



Conceptual models

- Norman's example: refrigerator adjustments
 - appearance: separate controls for fridge and freezer
 - reality: one cooling system, one thermostat (second control is for cold air distribution)
- My example: Microsoft word 1989 vs 2008
 - version 4: paragraph attributes associated with “paragraph mark”
 - this did lead to some surprising behavior
 - version 2007: same underlying model, but layers of “helpful” behaviors prevent users from discovering it

Visibility and feedback

- Buttons that light up when they are on can reveal state
 - and with a nice built-in mapping back to the control



- Faucet handles again...



Knowledge in the world

- Brief, well-designed markings



Standardization

- The QWERTY keyboard
 - cost to transition to a mildly better system is high
- Complex designs that are not new are not as hard



Graphical User Interfaces (GUIs)

- Using visual display coupled with pointing to present complex choices to the user
- The dominant mode of user interface today
- Many flavors exist, but all present similar widgets
 - Icons (objects)
 - Buttons (actions)
 - Menus (collections of choices/actions)
 - Lists
 - Trees
- All the same principles apply as for physical UIs
 - only you have to *create* everything: affordances, visible state, etc. don't happen naturally.

Affordances

- Pressing
 - often suggested by raised appearance



- Sliding, adjustment
 - often suggested by track



- Active vs. inactive



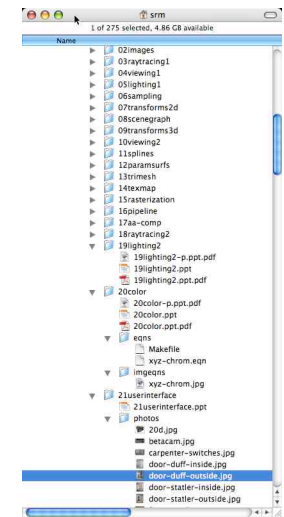
Lack of affordance

- Web links (often)
 - how do I know what I can click on?
- Window controls
 - I can grab this window anywhere to move it. How do I know this?

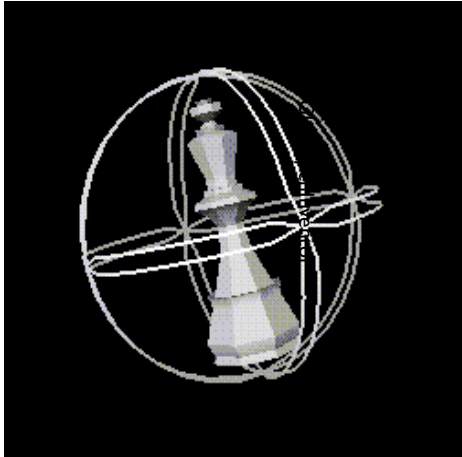


Mapping

- Scroll bars: horizontal and vertical
- Software often has very arbitrary mappings



Mappings for 3D rotation



Other features

- Feedback
 - during control operation
 - revealing control state
- Conceptual models
 - a higher level question...
- Knowledge in the world
 - drop-down menus are a nice example
 - contrast to keyboard commands that you have to just know

Basic interaction tasks

- Positioning
- Selection
 - From large/continuous set (part of image)
 - Rectangle, lasso
 - From unorganized discrete set (icons on desktop)
 - Click and modifier-click, or drag area
 - From linearly organized set
 - Selection from list box
 - From hierarchically organized set
 - Drop-down menus, trees, columnar lists, ...

3 Hierarchy UIs

