User Interaction

CS 465 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)
    - Recentering or free
  - Joysticks (two valuators in one)

Input devices

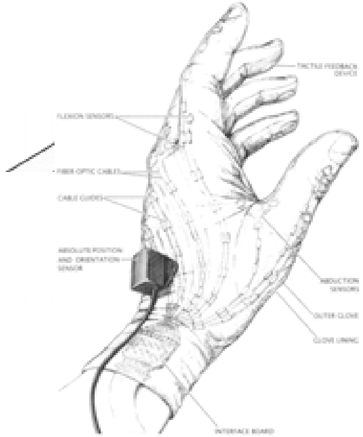
- Locators: give a continuous 2D position
  - Mechanical mouse (trackball is the same)
    - Two axes with optical encoders
      - Integrate rate of pulses on each axis
      - Result = position
  - Optical mouse
    - Image sensor looking out the bottom
      - Shift and correlate to estimate motion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

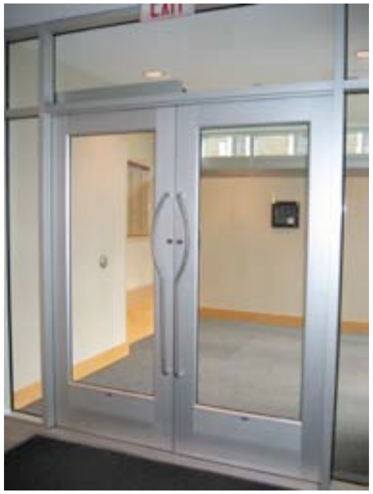
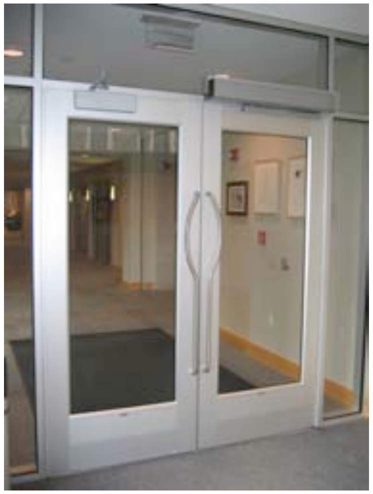
User-centered design

- 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!

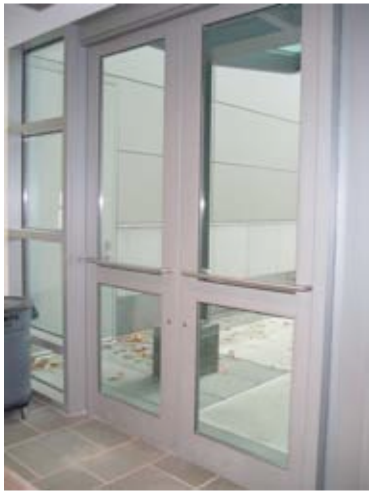
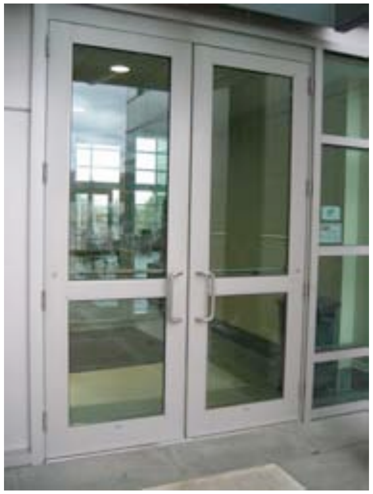
Psychopathology of everyday things

- (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

[Peter Lausch]

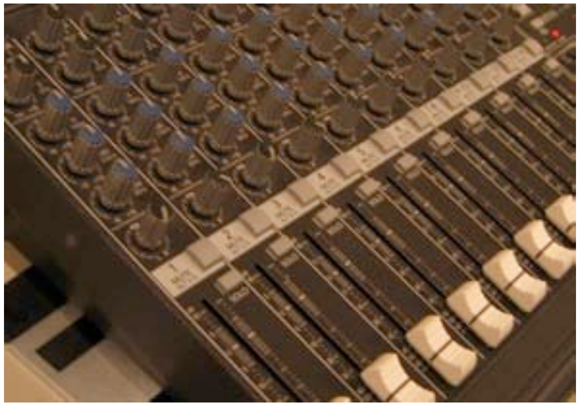
[DPReview]

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**

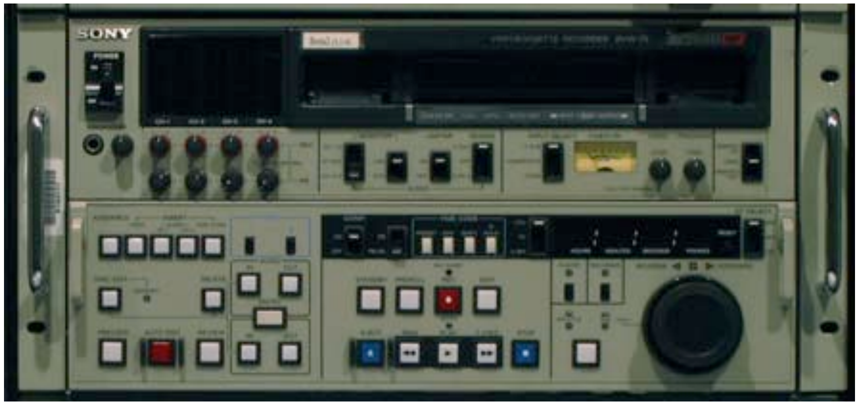
Affordances

- Which turn, which slide, which push?



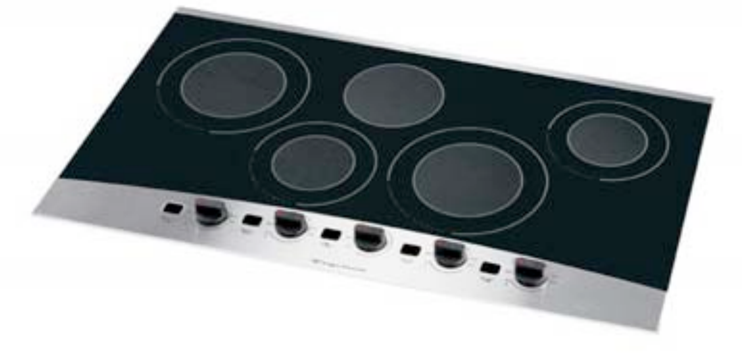
Affordances

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



Mappings

- Which control is for which burner?

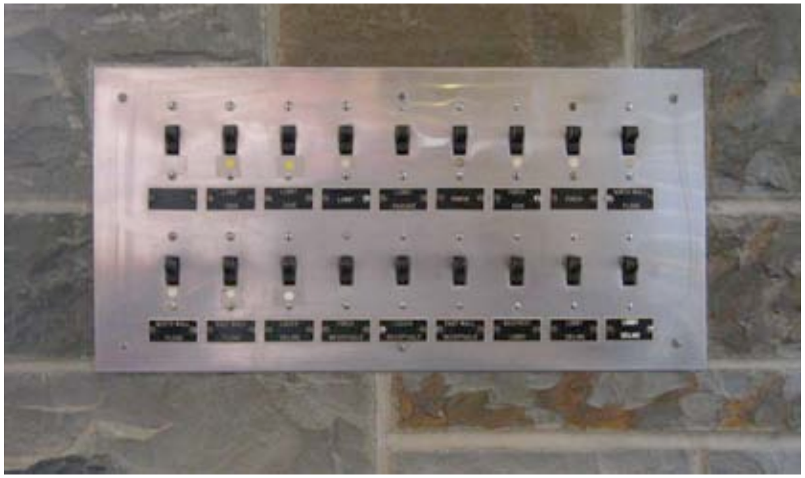


[Frigidaire]

Mappings

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

Mappings



Mappings

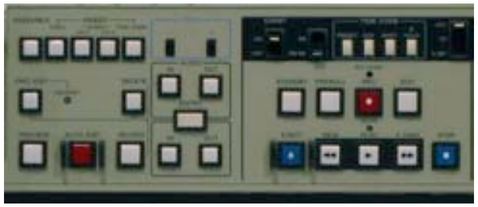
- Which way do you turn?

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 2006
  - version 4: paragraph attributes associated with “paragraph mark”
    - this did lead to some surprising behavior
  - version 2004: 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

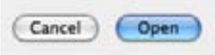
- The QWERTY keyboard
  - cost to transition to a mildly better system is high
- Complex designs that are not new are not as hard

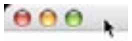
Graphical User Interfaces (GUIs)

- 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.

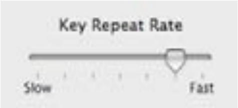
Affordances

- Pressing
  - often suggested by raised appearance

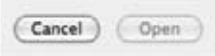




- Sliding, adjustment
  - often suggested by track

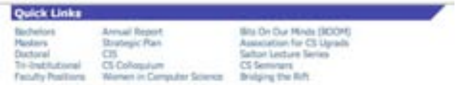


- Active vs. inactive



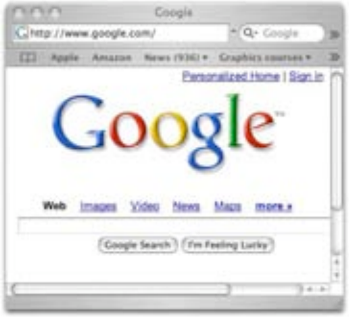
Lack of affordance

- Web links (often)



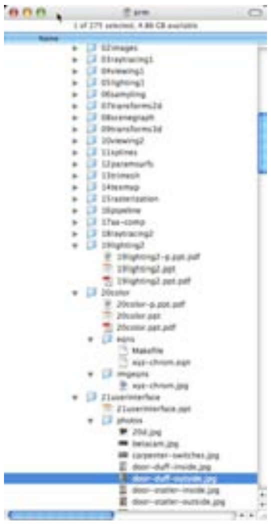
Quick Links		
Bachelors	Annual Report	Bits On Our Minds (BOOM)
Masters	Strategic Plan	Association for CS Ugrads
Doctoral	CIS	Salton Lecture Series
Tri-Institutional	CS Colloquium	CS Seminars
Faculty Positions	Women in Computer Science	Bridging the Rift

  - 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



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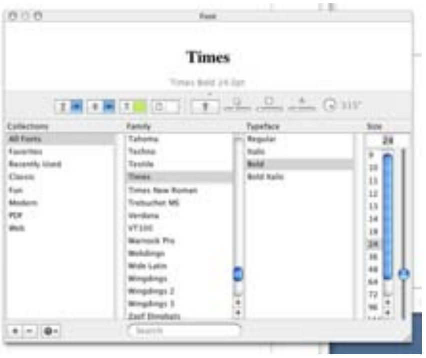
Other features

- 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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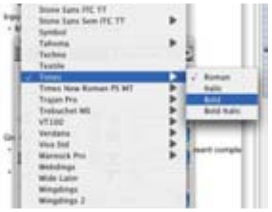
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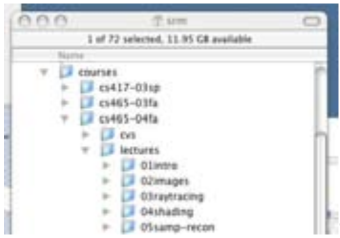
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