The UNIVERSITY of VERMONT

Benjamin Fenster
CS-296 (Damon)
15 March 2005

Input / Output

I. Input Devices
- a. Two Types
  - i. Interactive: It's… err… interactive.
  - ii. Capture: Scanning of a pile of documents (minimal interaction)
  - iii. Distinction between how much processing is done at the time of interaction.
  - iv. We also always want *some* feedback.
- b. Three Kinds of Input
  - i. Selection. Pick what object is of interest.
  - ii. Action. Pull down a menu, for example.
  - iii. Attributes. Typing things (text fields)
- c. Means of Differentiation Between / Among Devices
  - i. Accuracy. Getting the value right.
  - ii. Precision.
  - iii. Accessibility (covers everything from people wearing gloves to physical handicaps).
  - iv. Physical Impact (will it lead to carpal tunnel, for example?)
  - v. Speed.
  - vi. Ease of Learning.
- d. Text
  - i. Most input has been text, historically.
  - ii. Computer languages are all text.
  - iii. Human / natural language (although almost impossible for computers to understand)
  - iv. For actions it's easy to do but hard to learn. That is, it's easy to type if you know what to type. Remembering command line arguments is hard.
  - v. For attributes it's the dominant input method.
  - vi. For selections it's terrible.
  - vii. Yields high precision – much higher than pointing (can give many decimal places using text)
  - viii. Keyboards
    1. Multicharacter: QWERTY, Devorak
    2. Chorded: Stenographers, "MIT nerds" use chorded keyboards. These take a combination of keys simultaneously. It's very fast. Better for carpal tunnel than traditional keyboards.
    3. Keypads: Smaller versions of multicharacter keyboards.
    4. They're all moderately / extremely accurate.
  - ix. Spoken
    1. Broadly accessible.
    2. Good for hands-free (e.g. an airplane mechanic using a HUD to repair a plane may be using both hands when he needs to move the page)
    3. Individual differences create problems.
    4. Software also isn't very good at understanding complexities or subtleties.
  - x. Handwriting Recognition
    1. Newton (plain printing), Palm (specialized alphabet)
    2. Low accuracy
  - xi. Scanned Text
    1. Only reasonable for OCR
    2. Modest to low accuracy
    3. Can be very fast.
- e. Position (pointing)
  - i. It's hard to tell a single selection vs. double selection vs. movement when somebody is just pointing. Need something like a button to help distinguish.

ii. Have six degrees of freedom: x, y, z, pitch, yaw, roll (to describe position and orientation).
iii. Gives a sense of control. Position is easy to move. We're also familiar with using position to change speed (e.g. for a slingshot) and even acceleration (with a gas pedal). That translates into lots of different input.
iv. Works great for selection, okay for actions (when there's a limited base of commands), bad for attributes
v. Mouse, trackball
    1. Most common inputs for position right now.
    2. High *accuracy*, low *precision*.
vi. Touchscreen
    1. Intuitive!
    2. Poor precision
vii. Stylus Pad
    1. High precision.
    2. Some are designed for artists that are even pressure sensitive.
viii. Joystick. Great for indicating velocity. Otherwise not particularly special.
ix. Eye Tracking. Good for fighter pilots, quadriplegics.
x. Scanned images
    1. Can mark up edits on an existing document (from the computer) with a blue pencil.
    2. The computer already knows what the page looked like, so it just finds the edits (delete words, et cetera) and makes them in the document.
    3. Newspapers have used this before.
xi. 3D:
    1. There isn't always an obvious use for the third dimension.
    2. Data Glove
        a. All six degrees for each finger and hand independently.
        b. Can read sign language!
    3. Motion capture, entertainment, virtual office (poor accuracy)

f. Others: Emotions? Biometrics? Brain wave capture? Neural implants?

II. Output

a. How does the computer give data to you?
b. Results, basic feedback, options for the next step (e.g. drop-down menu) are all output
c. Differentiators
    i. Speed
    ii. Bandwidth
    iii. Universal Access
    iv. Attention (how much attention is required, and can it get your attention when you're working on something else)
d. Screen
    i. Bad: ephemeral (goes away whenever the screen changes), very small relative to perception capacity, low quality.
    ii. Good: Dynamic! Means you can use movement, which increases bandwidth.
    iii. Textual
        1. Easy for users and computer both.
        2. Requires attention.
        3. Is boring!
    iv. Icons
        1. May be easier to recognize.
        2. Requires learning what each icon means.
        3. Icons are smaller, so can pack more icons than text into a toolbar.
        4. Can either support smaller or less dense screen.
    v. Visualization
        1. Using pictures
        2. Very high bandwidth

3. Easy to store / display
4. Hard for computer to generate dynamically

vi. Emotions
1. Processed effortlessly by humans.
2. Still doesn't exist in any computer.

e. 3D
i. Long-term: Live, interactive 3D holodeck.
ii. Vaguely possible now via two screens (for each eye) or polarized red + blue glasses. Computers can handle that.
iii. Computationally intensive, especially since even tiny distortions will be bothersome to the eyes.

f. Auditory
i. Privacy issues
ii. Speech (generated) is *hard* to implement
1. Can have someone record snippets and splice them together so it sounds more natural.
2. Good speech requires intonation (e.g. tone always goes up at the end of a question).
3. Can record several versions of each snippet with different intonation and splice together more intelligently, but that's still far from perfect.
iii. Sound (non-speech) can be distracting but is easy to generate

g. Touch
i. Used occasionally (force feedback, for example)
ii. Doesn't require attention, but gets attention (low attention-grabbing interaction)
iii. Steering wheel that shakes when you're falling asleep. People will instinctively grab hold of the wheel. (As opposed to a loud buzzer or something that might make people let go suddenly – that would be bad.)

h. Paper. Not ephemeral.

i. External control. Physically controlling some object.