Human Computer Interaction

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Input & Output Devices

Input & Output

What are some input and output devices you've used?

Input

Properties of Input Devices

1. **Property sensed**
2. No. of dimensions
3. Device acquisition time
4. Indirect vs. Direct
5. Control-Display Gain
6. Absolute vs. Relative
7. Discrete vs. Continuous

Property Sensed

Devices can sense binary triggers, position, motion/force (1D, 2D, or 3D), changes in angle or rotation, acceleration, pressure, light, swipes, etc.

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Number of Dimensions

- e.g., a button has 1 dimension
- e.g., mice sense 2 linear dimensions
- e.g., a knob senses one angular dimension
- e.g., VR headset has 3 dimensions

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Device Acquisition Time

Average time to move one’s hand to a device is called acquisition time

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Indirect Input Devices

User interacts with a remote object that interacts with onscreen objects. This method usually requires feedback to show user where they are pointing

Indirect Input Devices (e.g., mice)

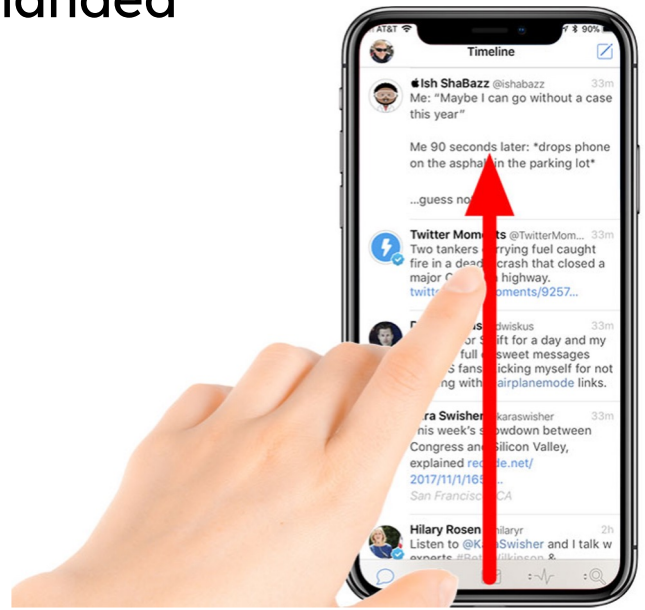
- e.g., mice (since late 1960s)
  - Sensors for x-y motion
  - Moving device corresponds to on-screen movement
  - Requires eye-hand coordination
- e.g., trackballs
  - Called “upside down” mouse
  - Rotating ball – 1 to 15cm
  - Requires less desk space because, unlike the mouse you don’t move the input device

Direct Input Devices

User interacts directly w/ onscreen objects by touching them. Usually does not require additional feedback.

Direct Input Devices (e.g. touch screen)

- User interacts directly with on-screen objects by touching them
- Can use one-handed or two-handed
- Single finger or multi-finger



Direct Input Devices (e.g., stylus)

- Allows for pointing, writing and drawing directly on screen
- May require 2 hands to interact with device
- Most don’t support “hover”
- Can use gestures, which have learning curve

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Control-Display (C-D) Gain

- Gain is defined as distance moved by an input device, divided by the distance moved on the display – *“If I move the mouse an inch, how many pixels will it move the cursor?”*
- Setting that can be set and manipulated by the user
- Why would someone want to change this setting?

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Absolute Input Devices

- Senses position
- One-to-one mapping from device position to cursor position (e.g., touchscreen, pen input)
- Bounded input range (cannot handle infinite moves)

Relative Input Devices

- Senses motion
- Maps movement into rate of change of input (e.g., joystick or TrackPoint)
- Not bounded (can handle infinite moves)

Properties of Input Devices

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7. **Discrete vs. Continuous**

Discrete Input Devices

Binary input, as with keys or buttons or tap gestures (e.g., keyboards, touch-sensitive devices)

Continuous Input Devices

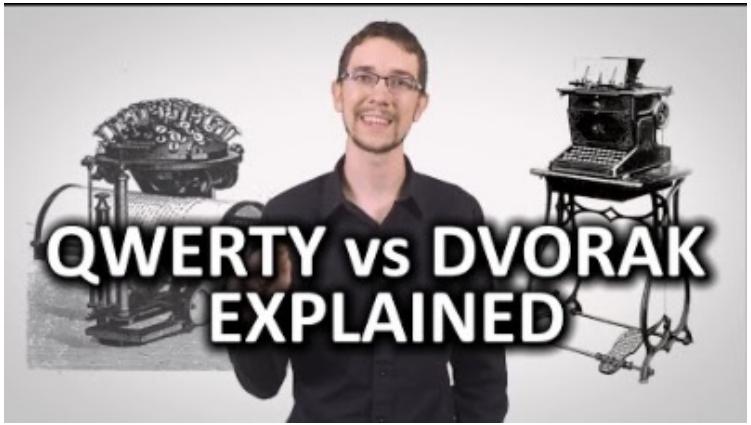
Continuous entry device involves sensing in a continuous range (e.g., mouse, trackball, digital pen)

Text Input

Textual Input: QWERTY Keyboard

- QWERTY is the de facto standard layout worldwide (with variations and additions)
- Lots of stories about its origin
- Others (like Dvorak) are faster, better
- Why do we keep it?

Textual Input: QWERTY vs DVORAK



QWERTY vs DVORAK explained

https://www.youtube.com/watch?v=tIJNusYZXMA

Speed test

https://www.youtube.com/watch?v=7TVKvZkbndc

Other Text Entry Devices

Keyboards

“Soft” (aka touch screen)

Ergonomic

Other layouts (e.g., DVORAK, Colemak)

Chorded (e.g., court stenography)

Other Text Input Devices

Gestural entry (e.g., Swype, 8pen, Graffiti)

Voice

Accessible options (braille, Orbitouch, breath selection, eye tracking)

Braille keyboard

Output

What are different types of output?

- Visual
- Audio
- Haptic
- Smell

Visual Output

- Many devices with screens these days:
  - small mobile devices
  - large screens
  - wearable displays
- Many types of visual output:
  - static images
  - movies
  - interactive visualizations
- Many resolutions:
  - few pixels to millions of pixels
  - two colors or millions of colors

Visual Output

- Pros
  - **immediate recognition (vision is visceral)**
  - massively parallel sense, synthesize/pattern recognize efficiently
- Cons
  - **requires sighted people to attend to it / must be in line of sight**
  - can be imperceptible to people who are blind or low vision
  - it can be distracting, especially for people with ADHD
  - can be dangerous for someone with epilepsy

Auditory Output

- Music, Speech, natural sounds, beeps, “**earcons**”
- Usually for alerting and feedback

Auditory Output

- Pros
  - **you don’t have to be monitoring it (secondary task)**
  - Stereo or even 3D audio (spatial info can be communicated)
  - good for blind users (in the dark, not attending to it as a primary task)
- Cons
  - **you have to be able to hear it (ambient sound can be bad)**
  - might be able to ignore sound more than light
  - can only focus on so many sounds at one time

Haptic Output

- Vibration from motors
- Usually for alerting and feedback
- “**Tactons**”- discrete units of recognizable vibrations

Haptic Output

- Pros
  - **can be more private**
  - people w/ sensory disabilities might benefit
  - can support secondary monitoring
- Cons
  - **may not be able to transmit much information**
  - have to learn tactons
  - might not be able to feel vibration
  - may be over-sensitive to haptics

Give Users Input / Output Options!

Input

- buttons
- touch, gestures
- audio, voice
- camera
- peripherals

Output

- haptic touchscreen
- display - video, …
- audio
- light

Braille Keyboard Input

https://www.youtube.com/watch?v=CoD9fMk2534

Refreshable Braille Display

https://www.youtube.com/watch?v=QhJO93VhuMs

Activity 22
15 minutes

A22: Design a Remote

- In pairs, design a TV remote for young children
- Sketch your design with minimal text callouts to indicate features
- Submit individually to Canvas

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Materials in this course were compiled from courses taught by: Matt Bietz, Stacy Branham, Tyler Fox, Elena Agapie, Nigini Oliveira, Katharina Reinecke, Andrew Davidson, Jennifer Turns, Daniel Epstein, Andrea Hartzler. Thank you to all.