Perception
HCI, Advanced Input Devices

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Objectives

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- Advanced control/Input devices and technologies.
- The state-of-the-art systems. [1] [2] [3]

[1] D.A. Bowman, E. Kruijff, J.J. LaViola, I. Poupyrev, 3D User Interfaces: Theory and Practice, Addison Wesley Professional, 2005.

[2] Course notes, "3D User Interfaces", CS, Columbia Univ..

[3] Course notes, "Introduction to Human-Computer Interaction Design", CS, Stanford Univ..

Input Device Issues

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- What actions does it afford?
- What resolution/sensitivity does it offer?
- What dexterity does it require/allow?
- What is it efficient/inefficient at doing?
- What interaction techniques is it suitable for?
- What are its ergonomic advantages and problems?

Dimensions of Performance

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- Continuous vs. discrete
- Resolution and accuracy
- Sampling rate and latency
- Noise, aliasing and nonlinearity
- Direct vs. Indirect
- Absolute vs. relative
- Control-to-display ratio
- Physical property sensed
- Position, motion, force
- Degrees of freedom

Symbolic Input

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- Task of entering
  - Text
  - Numbers
  - Symbols
- Desktop symbolic input
- Mobile symbolic input
  - Standing, walking, communicating
- 3D UI symbolic input
  - Tracked, gestural, etc.

Symbolic Input (cont.)

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- Conditions for 3D environment
  - Mobile users
    - Not seated: standing, crouching,...
    - About to move
    - Actively moving ?
    - No dedicated desk surface
    - Hands busy or full
    - Eyes busy, occluded, or in low light
    - .....

Classic Keyboards

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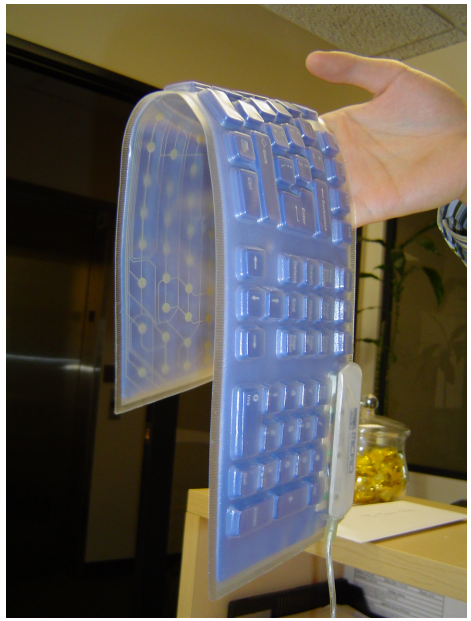

Some Ergonomic Issues

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- Hand position - Freedom of hand for positioning device
- Touch typing vs. hunt and peck
- Repetitive stress / fatigue
- One handed use
- Need for support
- .....

Mobile (Chord, Multi-press,...)

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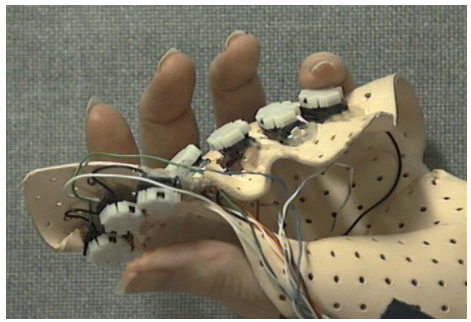

Advanced Symbolic Input

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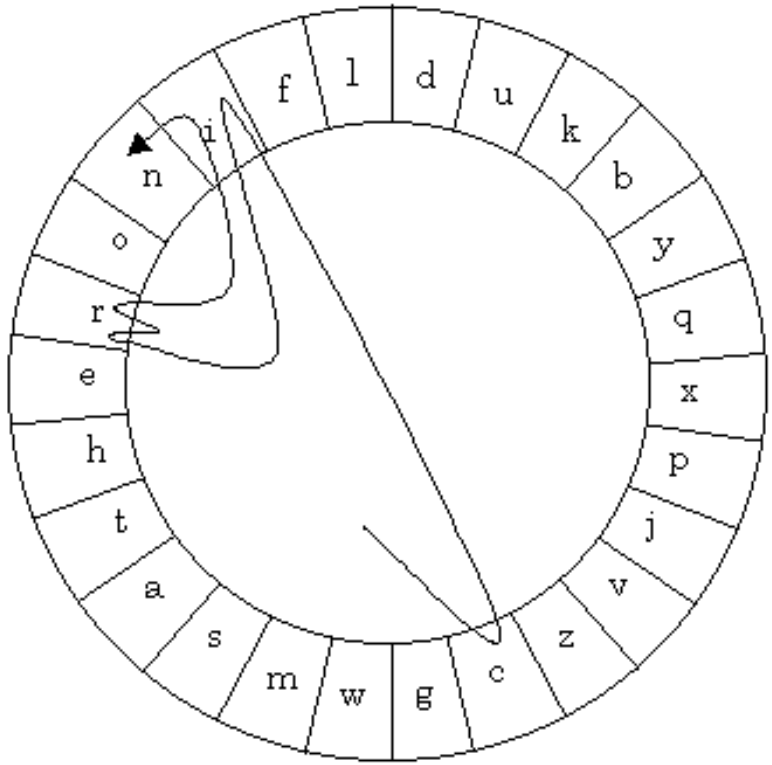

Mankoff et al.

Advanced Symbolic Input

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- Data gloves
  - Key poses or continuous sign recognition.
  - HMM-based recognition
  - Learnability
  - .....

Advanced Keyboards

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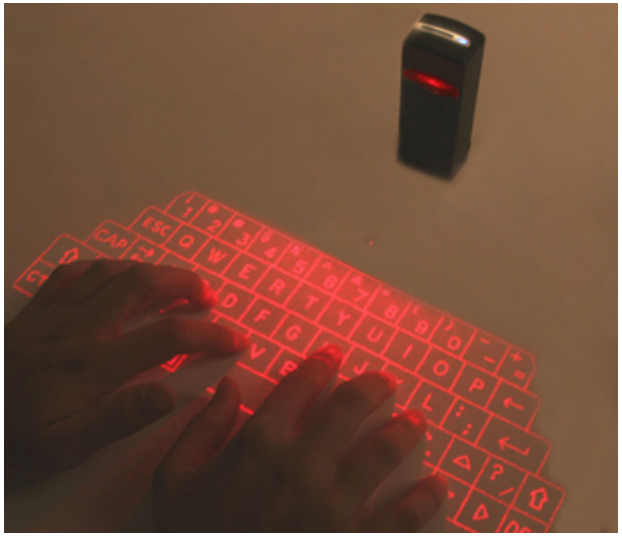

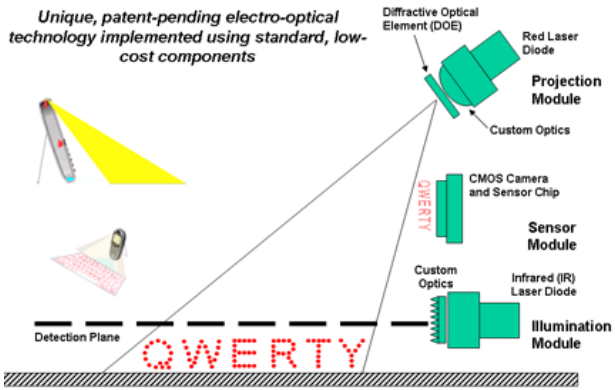

- Virtual Keyboard

Pointing Devices

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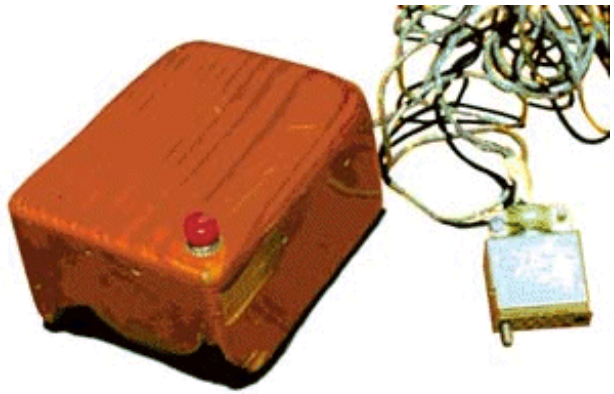
- Target acquisition
- Steering / positioning
- Tracking
- Freehand drawing
- Drawing lines
- Tracing and digitizing
- Clicking, Double-clicking, dragging
- Gesture

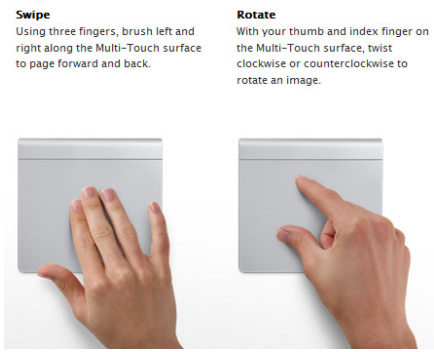
Indirect Pointing Devices

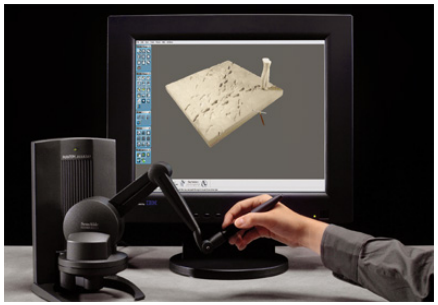


first mouse, 1964

- Keys (discrete)
- Mouse
- Joystick
- Trackball
- Touchpad
- Tablets (non-display)

Trackball, Trackpad, Trackpoint





- What is Sensed ?
  - Motion (e.g., mouse)
  - Position (e.g., trackpad)
  - Force (e.g., trackpoint)

Tracking Pointers

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Figure 3 The Emotiv headset alone (a) and on a user (b) simplifies the acquisition of EEG signals by standardizing the placement of electrodes and by including proprietary algorithms that allow for differences in brain waves due to folds in the brain.

Fitts Law

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- $MT = a + b \times log_2(A/W + 1)$
  - a : the start/stop time of the device
  - b : the inherent speed of the device
  - A : the distance from the starting point to the center of the target
  - W: the width of the target (along the axis of motion)
- Target acquisition time is proportional to the log of the ratio of the Distance to the Width of the target.
- Applies to position control devices
  - Same for direct and indirect

Pen/Touch Input

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- Good for pointing and drawing
- Natural for gestures
- Possibility of multiple pointers
- Not an efficient way for text entry (even if it's improving)
- Handwriting

Touch Screen

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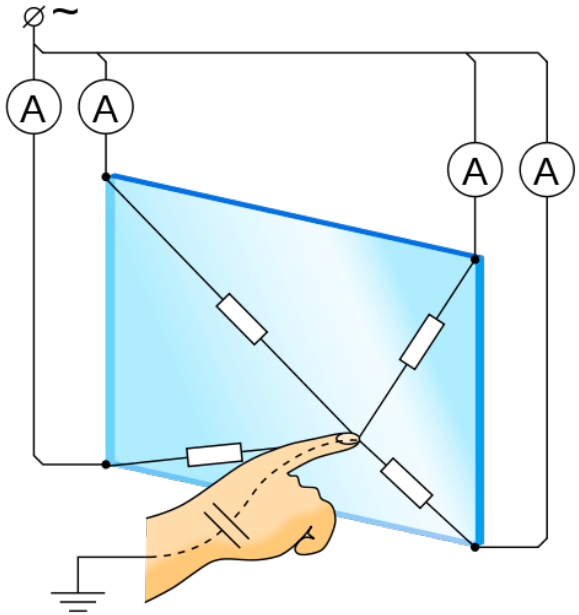

Multi-Touch Screen

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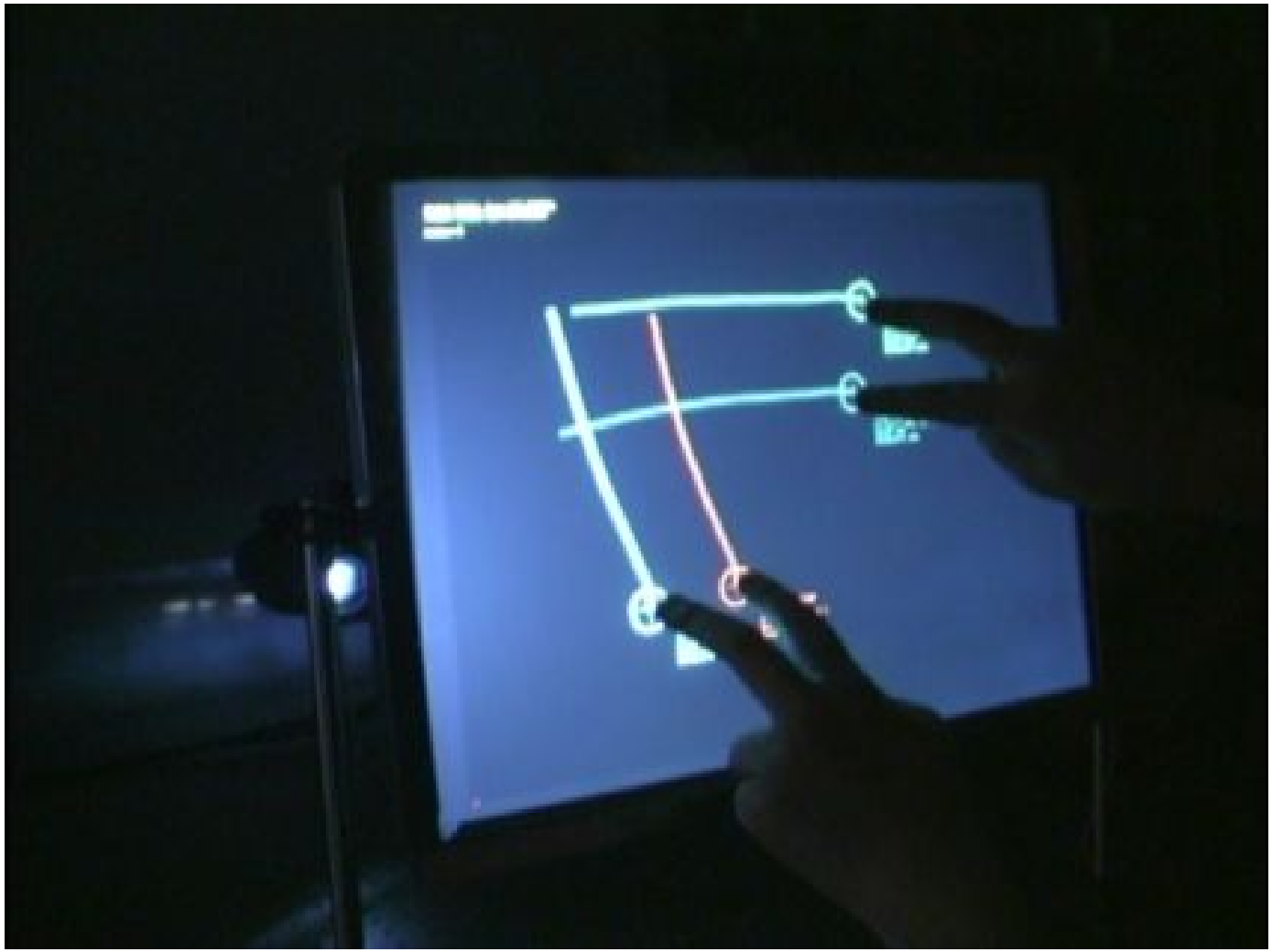

Tangible or Mixing Interaction

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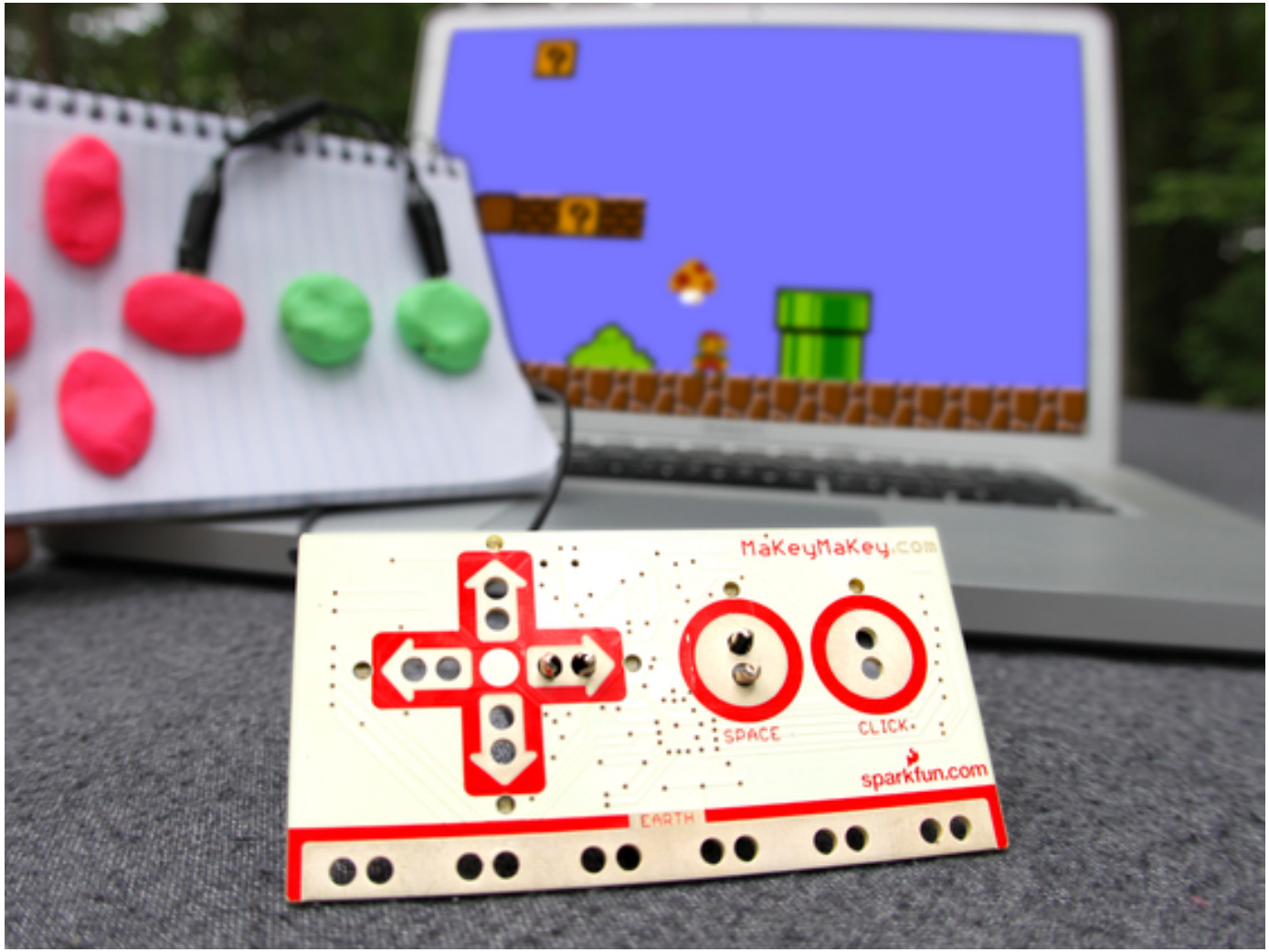

Tangible UI

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