Universidade de Aveiro
Departamento de Electrónica,
Telecomunicações e Informática

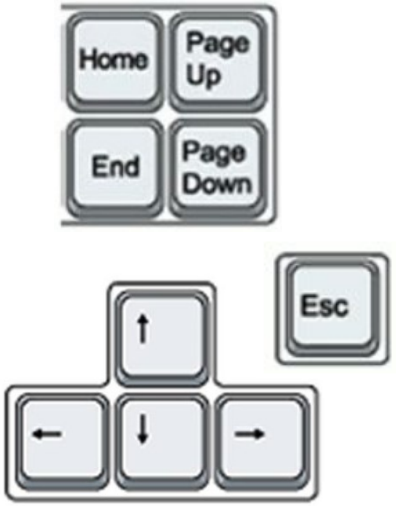
Input Devices

Main Input devices

- Keyboards
- Pointing devices
  - Mouse
  - Touch screen
  - Touch pad
  - Joy stick
  - Track ball, …
- Voice recognizers
- Eye trackers
- Motion and position trackers
- 3D input devices
- …

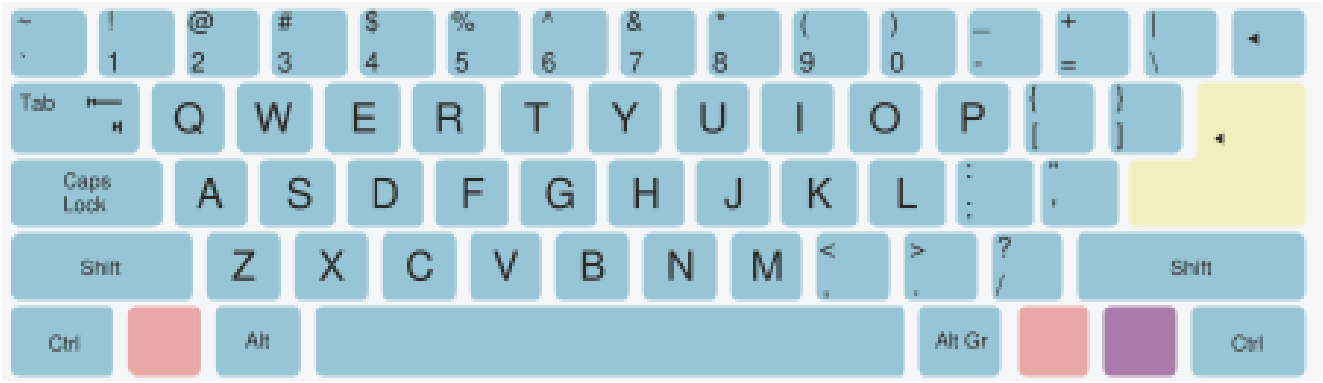
Keyboards

- Relevant issues in UI design:
  - Key layout
  - Operational characteristics:
    - Keyboard size
    - Keyboard angle
    - Hand resting area
    - Key spacing
    - Key activation force
    - Key surface and finishing
    - Key displacement
    - Activation feedback
    - Home row indicators



Keys layout

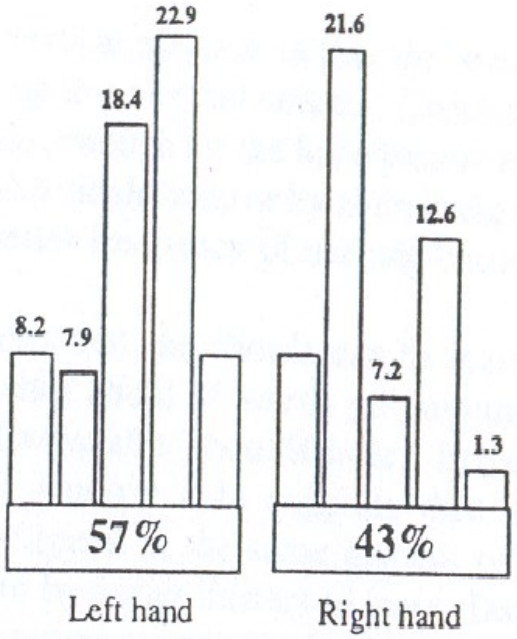
The Qwerty layout dates from the XIX century, and we still use it!

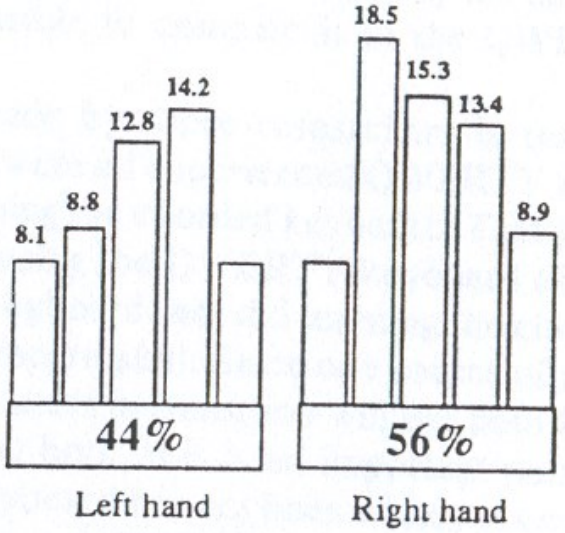


Dvorak

Combining both

Percentage of work performed by each hand (in English)





QWERTY **Dvorak**

QWERTY was devised to prevent jams in early typewriters.

http://www.dvorak-keyboard.com https://en.wikipedia.org/wiki/Dvorak_keyboard_layout

Ergonomic keyboards

Help avoid RSI (Repetitive Strain Injury) WRULD (Work Related Upper Limb Disorder) and KRP (Keyboard Related Pain)

1. Zoom
2. Customizable Hot Keys
3. Improved Number Pad
4. Ergonomic Design

https://en.wikipedia.org/wiki/Ergonomic_keyboard

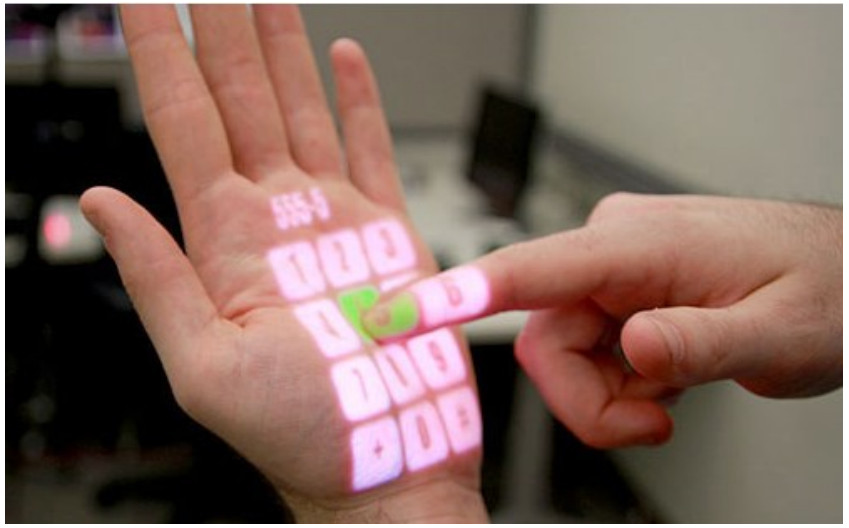
Keyboards for specific contexts of use

Chorded keyboard → used in wearable computing

https://en.wikipedia.org/wiki/Chorded_keyboard

Virtual projection keyboards:

it is possible to project a keyboard on any surface:



http://en.wikipedia.org/wiki/Projection_keyboard

https://wiki.ezvid.com/best-virtual-keyboards

Pointing Devices

They are used to:

- Point a target
- Select a target
- Drawing
- Positioning objects
- Orient and rotate objects
- Define paths among objects
- Handle text
- etc.

- Their efficiency varies according to the tasks
- Shneiderman (98) divided them into:
  - Direct control —— touch screen
    light pen (deprecated)

  - Indirect control —— mouse
    track ball
    digitizing tablet
    joystick (track point)
    touch pad

Mice

Replica of the Engelbart's mouse

Currently are optical

- Relative coordinates
- Different shapes, n. of buttons,…

Advantages:

- Direct relation between hand and cursor movement
- Allow speed control
- Allow continuous movement in all directions

/ distance
speed
\ direction

Disadvantages:

- Require hand movement between mouse and keyboard
- Additional space (footprint)
- Hand-eye coordination

http://www.dougengelbart.org/firsts/mouse.html

http://www.computerhistory.org/revolution/input-output/14/350

Trackballs

- Relative coordinates
- Many different shapes

Advantages:

- Direct relation between hand and cursor movement (speed and direction)
- Allow speed control
- Allow continuous movement in all directions
- May not need additional space (footprint)

Disadvantages:

- Require hand-eye coordination
- May require hand movement between trackball and keyboard

Ergonomic Pointing Devices

Zero tension mouse

Whale mouse

Quilll mouse

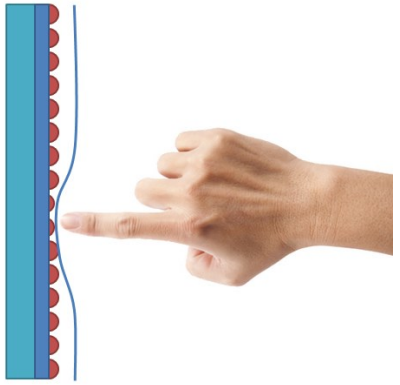
Vertical mouse

Wireless Ergonomic Mouse

Gesture pad

For users with Repetitive Strain Injury,
Carpal Tunnel Syndrome or other problems
Or to avoid these problems

Touch screens

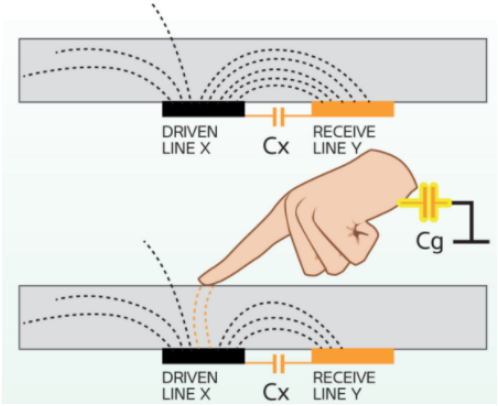


Resistive (older, less expensive)

optical

Sonic ___ stationary wave patterns

Capacitive



- Are combined with a display

https://en.wikipedia.org/wiki/Touchscreen

http://computer.howstuffworks.com/touch-screens.htm

Digitizing tablets adequate for digital art

Sophisticated models:
- Extended sizes
- Multitouch sensitive surface
- Pressure sensitive pen

http://www.wacom.com/products/pen-tablets

Some guidelines to select these interaction devices

- Choose a device after a careful task analysis and test
- Minimize hand and eyes movements
- Use cursor keys for tasks involving:
  - A lot of text manipulation
  - Traversing a structured array of discrete objects
- Use touch screens when
  - There is no training
  - Targets are large, discrete and scattered
  - Space is important
  - No (or little) text entry
  - Are not used for a long time

Voice recognition systems

- The first system was developed in 1972 at Bell Lab
- It is becoming more used
- Has two types of challenges:
  - Technological (have improved a lot …)
  - Human factors

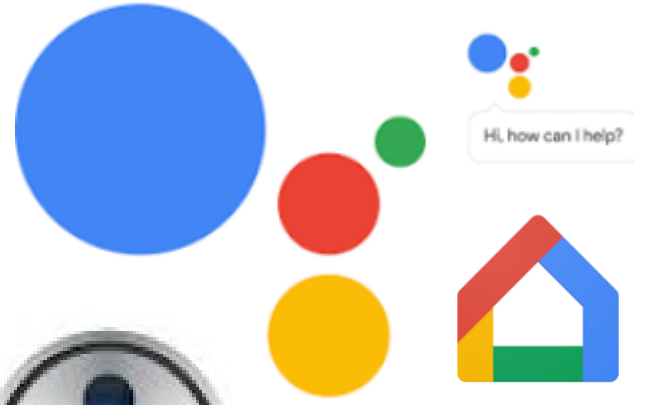
Voice recognition as input

Independently of the technology state of the art,

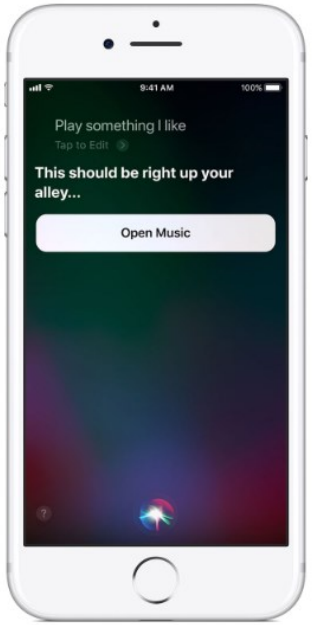
- Has advantages when the user:
  - Has physical deficiency
  - Must move around
  - Has eyes busy
  - Is in a low visibility or cluttered environment

- Has inherent disadvantages:
  - Voice is transient
  - Does not have natural feedback
  - May disturb other people
  - May result in lack of privacy
  - May be slower and more tiresome (overloading STM)

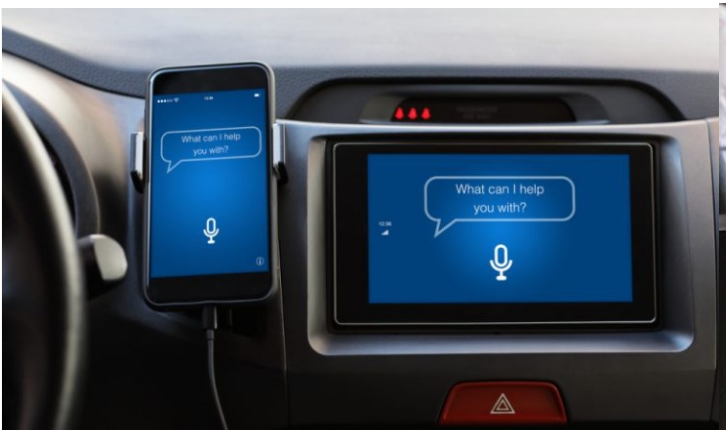
- Consider voice input when:
  - The user has to move
  - Has eyes or hands busy



- Avoid voice input when:
  - Privacy is important
  - Error taxes, even low, are not acceptable
  - Usage frequency is high
  - Speed is important



- Voice input/output has became more used

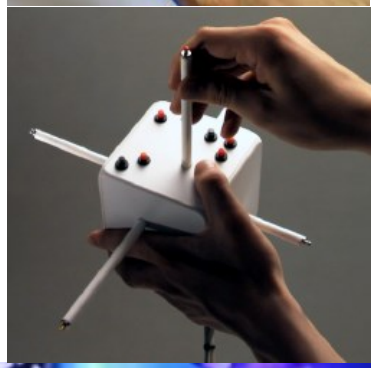


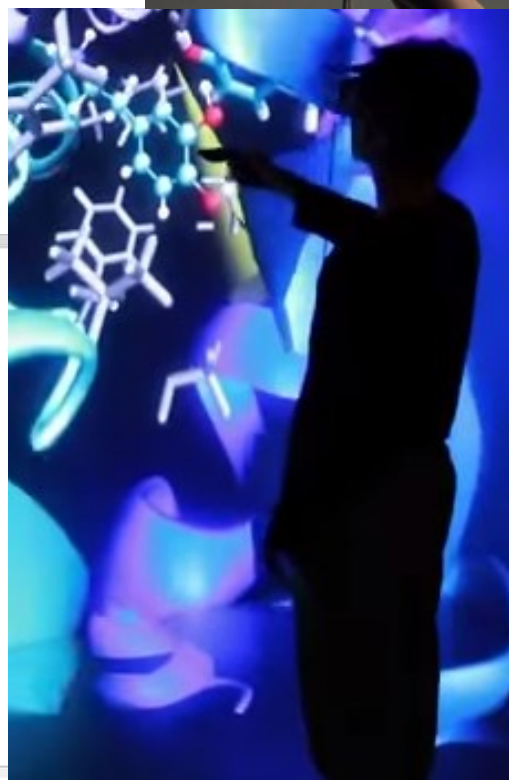
Some guidelines for voice interfaces

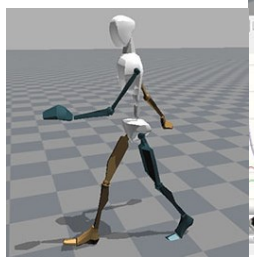
- Provide output dialog with structure to guide input
- Use a distinct and familiar vocabulary to avoid errors
- Consider voice input if technology constraints are acceptable considering:
  - Ambient noise
  - Privacy
  - Vocabulary extent
  - Error cost

Input devices for 3D interfaces

- Trackers:
  - Magnetic
  - Optical
  - Ultrasonic
  - Inertial, ...
- Navigation and manipulation interfaces:
  - Tracker-based
  - Trackballs
  - 3D mice, ...
- Gesture interfaces:
  - Gloves
  - Spatial gestures sensors
  - …







Other input devices for 3D

Tangible interfaces
and pedals

http://www.youtube.com/watch?v=zJmrcEM-uvA

Leap motion (allows for
hand gestures interfaces)
https://www.leapmotion.com/

Cyber Glove

http://www.cyberglovesystems.com/cyberglove-iii/

Depth cameras
(allows body gesture interfaces)

https://en.wikipedia.org/wiki/Kinect

https://www.vive.com/eu/
HTC Vive trackers

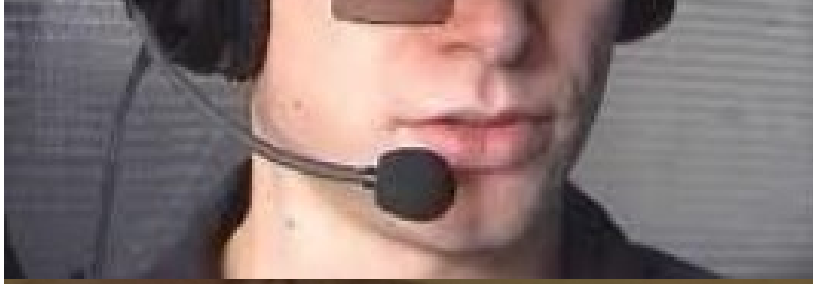
CyberTouch Glove: input + output

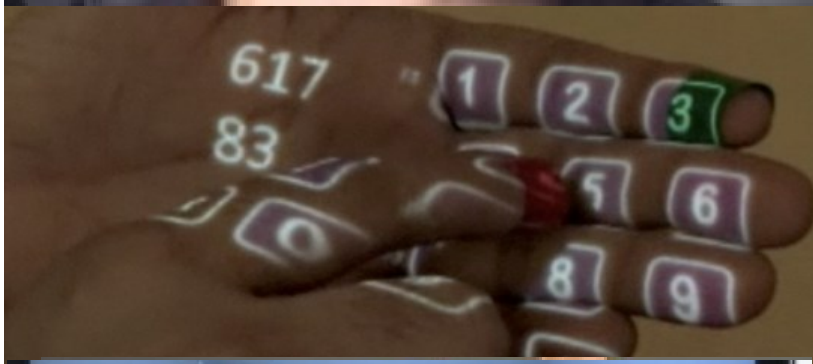
http://www.cyberglovesystems.com/cybertouch/
https://www.youtube.com/watch?v=32f2UxKjydI

What future?

It seems likely that we will use more often:

- gestures
- two hand input
- voice
- 3D pointers
- wearable devices
- whole-body environments
- tactile/force feedback, …





Conclusion

When choosing an input device, consider:

- Ergonomics / human factors
- Typical scenarios of use
- Cost
- Generality
- DOFs (Degrees Of Freedom)
- Output devices
- Interaction techniques

Technology shall not be used only because it is new and interesting!

- It is necessary to understand the usability of devices for the users and the tasks they have to perform in a specific context

Don’t forget that:

“The interface between humans and computers is harder than ever to define, we can interact with computers just by walking through a public space.”

Sellen, A., Rogers, Y., Harper, R., & Rodden, T., “Human Values in the Digital Age”, *Communications of the ACM*, *52*(3), March 2009, pp. 58–66