Universidade de Aveiro
Departamento de Electrónica,
Telecomunicações e Informática

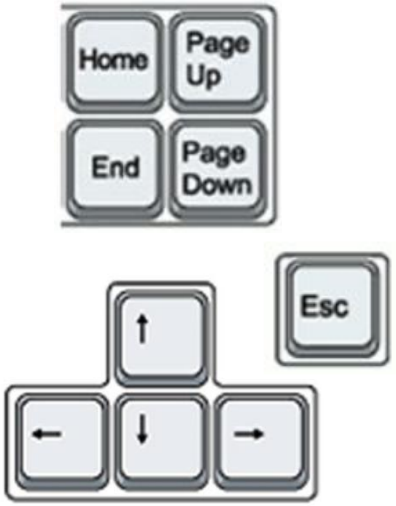
Input Devices

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
- …

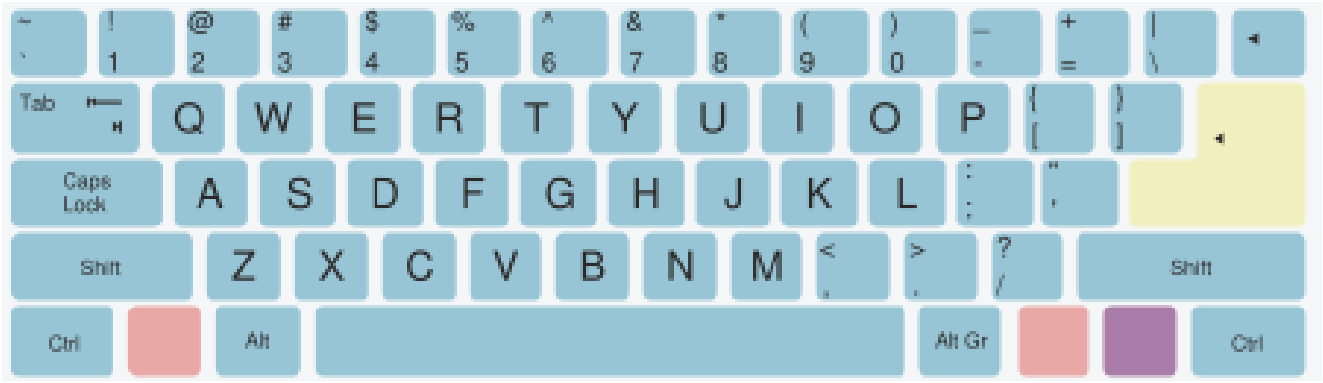
Keyboards

- 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

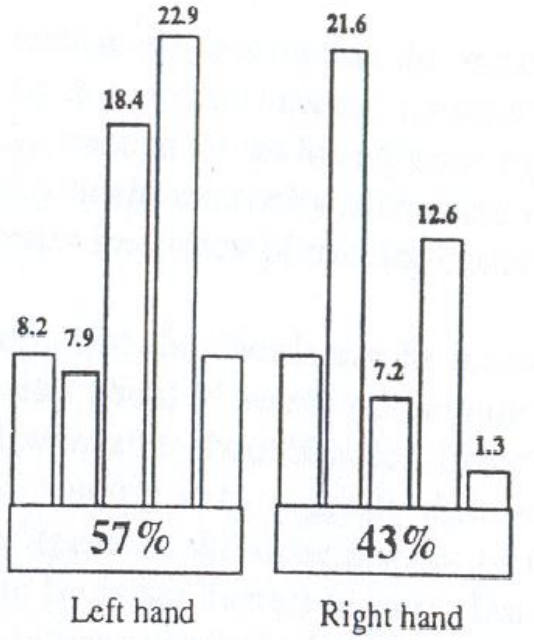
The Qwerty layout dates from the XIX century, and we still use it!

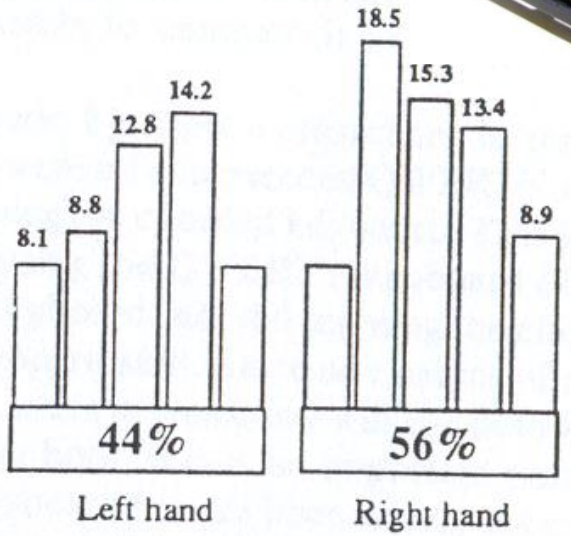


Dvorak

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

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

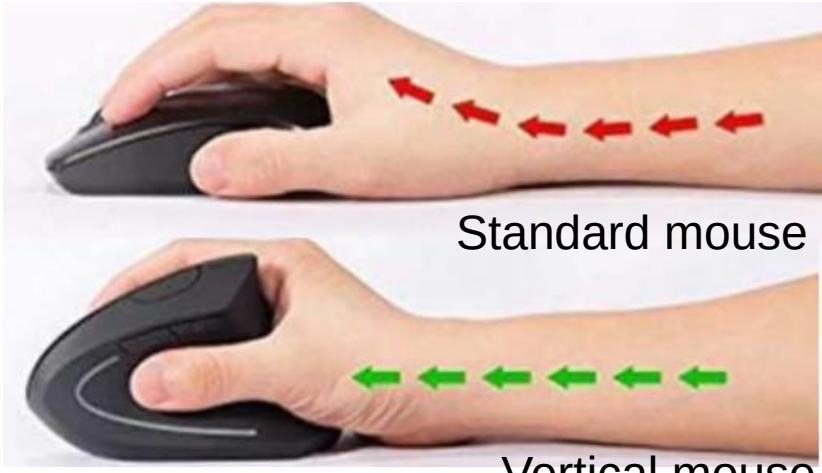
Zero tension mouse

Wireless Ergonomic Mouse

Whale mouse

Quilll mouse

Vertical mouse



Standard mouse

Vertical mouse

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

Touchscreens

- Several technologies/ very often combined with a display

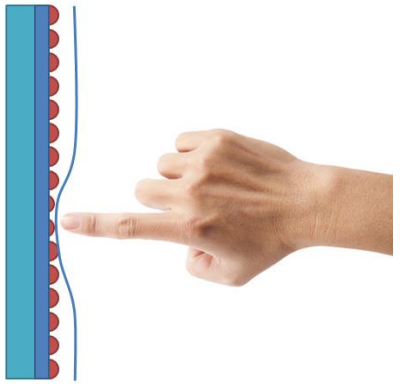
Advantages:

- Direct
- Do not need additional space

Disadvantages:

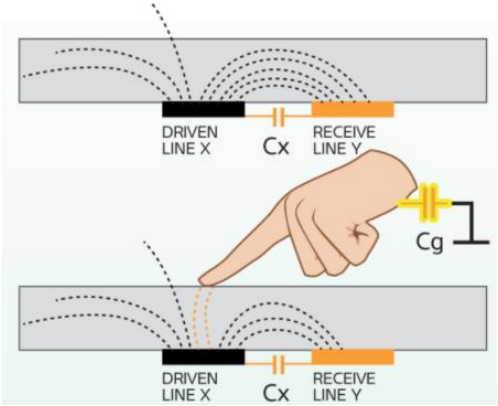
- May be tiering if used for long periods (“gorilla arm effect”)
- The finger may obstruct part of the screen
- Get dirty easily

Touchscreens



Resistive (less expensive)

Capacitive (more used in smaller screens)



https://en.wikipedia.org/wiki/Touchscreen
https://www.electronicdesign.com/technologies/displays/article/21800710/whats-the-difference-between-resistive-and-capacitive-touchscreens

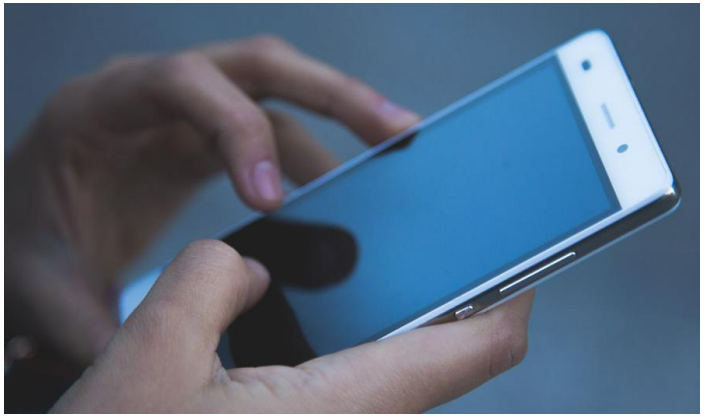
Resistive vs. Capacitive Touchscreens

Resistive touchscreen advantages include:

- Lower cost to manufacture
- Higher sensor resolution
- Fewer accidental touches
- Can sense any object touching the screen hard enough
- More resistant to the elements like heat and water

Capacitive touchscreen advantages include:

- More durable
- Sharper images with better contrast
- Provide multi-touch sensing
- More reliable
- More sensitive to light touch



http://www.makeuseof.com/tag/differences-capacitive-resistive-touchscreens-si/

More Input devices...

- cameras
- eye trackers
- trackers and sensors
- microphones
- controllers of different types
- custom made devices
- etc.

Input/output device

https://www.manus-meta.com/vr-gloves

https://www.tobii.com/products/eye-trackers/wearables/tobii-pro-glasses-3

~

Some guidelines to select these interaction devices

- Choose a device **after a careful task analysis and test**

- **Minimize hand and eyes movements**

- 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

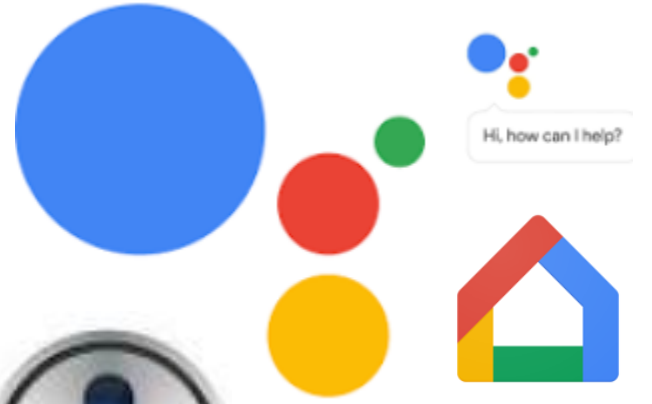
Voice recognition as input

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

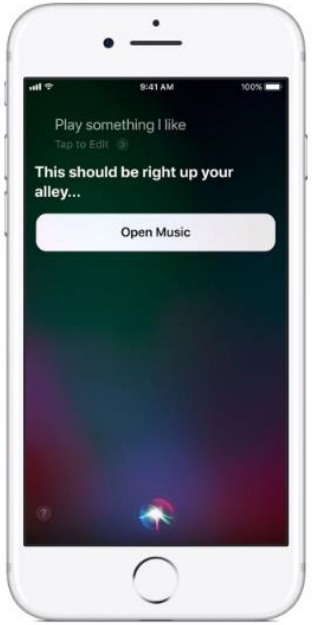
- Has inherent disadvantages:
  - Voice is transient
  - Does not have natural feedback
  - May disturb other people
  - May result in lack of privacy
  - May be slower and more tiresome (overloading STM)

- 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

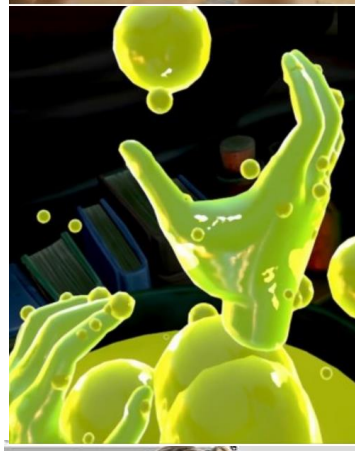
- Provide output dialog with structure to guide input
- Use a distinct and familiar vocabulary to avoid errors
- Consider voice input if technology constraints are acceptable considering:
  - Ambient noise
  - Privacy
  - Vocabulary extent
  - Error cost

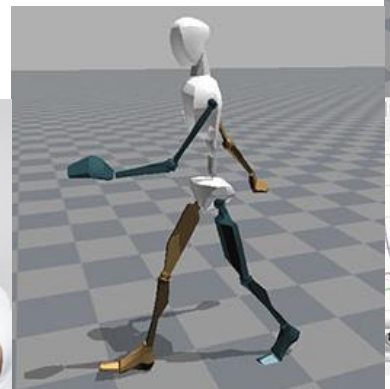
“No matter how different the technology, **the people who are using it haven’t changed**. And most usability principles have more to do with human capabilities and limitations than with technology. (Examples of such eternal design principles include error prevention, flexibility, efficiency, visibility of system status, and recognition vs. recall.)”

https://www.nngroup.com/articles/voice-interaction-ux/

Input devices for 3D user interfaces
(mostly used in Virtual Reality)

- Trackers:
  - Magnetic
  - Optical
  - Inertial, ...
- Navigation and manipulation interfaces:
  - Controllers, ...
- Gesture interfaces:
  - Gloves
  - Spatial gestures sensors, …




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
- brain-computer interfaces …

Conclusion

When choosing an input device, consider:

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