Input devices

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Main Input devices

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

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Keyboards: Relevant issues for 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

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Keyboards - Qwerty

- 1870 Christopher Sholes
- Mechanical design (typewriters) to avoid hammer jam
- Frequent letters more distant to alternate between hands

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Keyboards - Dvorak

- 1920, Dvorak
- Reduce distance to go through by fingers (42% less distance than qwerty - english)
- 5-20% faster than qwerty - english

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Keyboards - Dvorak

Dvorak

Combining both

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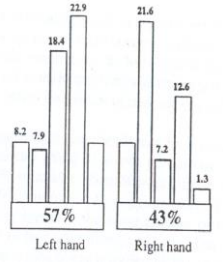
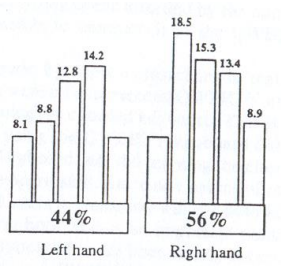
Keyboards - work performed by each finger (in English)





Teclado QWERTY **Teclado Dvorak**

http://www.dvorak-keyboard.com/

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Ergonomic keyboards

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

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

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Keyboards for specific contexts of use

Chording keyboard
used in wearable computing

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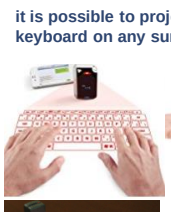
Virtual projection keyboards:

it is possible to project a keyboard on any surface



http://en.wikipedia.org/wiki/Projection_keyboard
http://www.economist.com/blogs/babbage/2012/02/virtual-devices
https://wiki.ezvid.com/best-virtual-keyboards

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Keyboard - Guidelines

- Tactil and auditory feedback important
- Some keys should be bigger (e.g. ENTER, SHIFT, CTRL)
- Some keys needs indicators (e.g. CAPS LOCK)

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- …

Pointing Devices

Used to

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

Pointing Devices

- Direct control ?
- Indirect control ?
  - mouse
  - trackball
  - touch screen
  - digitizing tablet
  - light pen / stylus
  - joystick (track point)
  - touch pad

Pointing Devices

Their efficiency varies according to the tasks
Shneiderman (98) divided them into:

- Direct control
  - touch screen
  - light pen
- Indirect control
  - Mouse
  - trackball
  - digitizing tablet
  - joystick (track point)
  - touch pad

Touch Screens

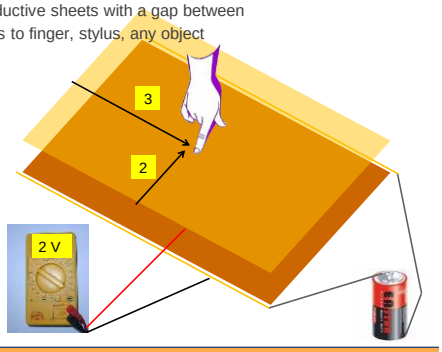
- Resistive
  - Two conductive sheets with a gap between
  - Responds to finger, stylus, any object

Older, cheapers, more common

- Capacitive
  - Human skin changes surface capacitance
  - Responds only to bare skin
- Inductive
  - EM field from tablet induces signal from stylus
  - Responds only to special stylus
- Optical
  - Camera watches the surface
  - Responds to anything

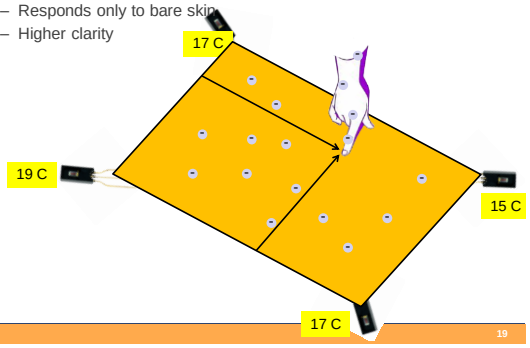
Resistive Touch Sensing

- Resistive
  - Two conductive sheets with a gap between
  - Responds to finger, stylus, any object



Capacitive Touch Sensing

- Capacitive
  - Human skin changes surface capacitance
  - Responds only to bare skin
  - Higher clarity



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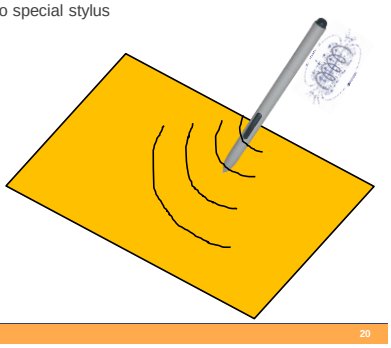
Inductive Touch Sensing

- Inductive
  - EM field from tablet induces signal from stylus
  - Responds only to special stylus



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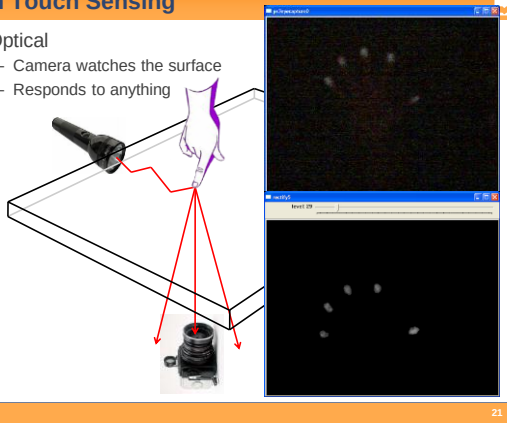
Vision Touch Sensing

- Optical
  - Camera watches the surface
  - Responds to anything



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Touch Screen: Advantages and disadvantages

- Advantages:
  - Direct hand cursor relation (distance, speed, direction)
  - No need for additional space
  - Continuous movement in all directions
- Disadvantages :
  - Lack os precisions due to finger
  - Tiring for long periods
  - Finger occlusion problem
  - Screen might get dirty
  - Other problems
    - Paralax (optical)
    - Temperature and humidity (capacitive)
    - Misalignment (resistive)

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Pointing devices

- Light pen/stylus:
  - Point to a screen area and allow selection, position, etc.
  - Direct conrol
  - Button for selection
- Problems
  - Hand oclusions
  - Hand of the keyboard
  - Hold the pen

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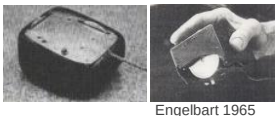
Mouse

Currently are optical
- Relative coordinates
- Different shapes, n. of buttons,…



Engelbart 1965

Advantages:
- Direct relation between hand and cursor movement (distance, speed, direction)
- Allow speed control
- Allow continuous movement in all directions

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

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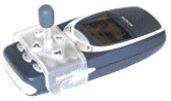
Joysticks e track balls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Trackballs

- "Upside down" mouse
- 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

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Ergonomic Pointing Devices

Zero tension mouse

Wireless Ergonomic Mouse

Vertical mouse

Whale mouse

Gesture pad

For users with RSI/CTS and other problems or to avoid these problems

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Input devices : guidelines

- 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

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Voice recognition systems

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

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Voice recognition – Technological constraints

- Research goes on and has as goals:
  - Continuous speech processing
  - Understanding of extended vocabularies
  - User independency
  - Very low error rates
  - Operation in noisy environments

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Voice recognition as input

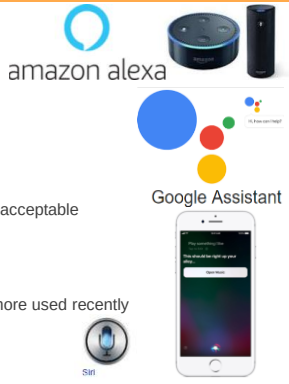
- Independently of the technology state of the art
- Has advantages when the user:
  - Has physical deficiency
  - Must move around
  - Has eyes busy
  - Is in a low visibility or cluttered environment
- Has inherent disadvantages:
  - Voice is transient
  - Does not have natural feedback
  - May disturb other people
  - May result in lack of privacy
  - May be slower and more tiresome (overloading STM)

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

Voice recognition as input

- 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 recently



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 …

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

Hardware@deti - Input

Hardware@deti - Input

- Intersense 3DOF Inertial Tracker [2009 - 1940€]
- Intersense 3DOF Inertial Track. BT [2012 -1437€]
- Wintracker [2009 - 1285€]
- Phantom Omni [2012 – ~3500€]
- Nintendo Wii [2010 – 60€]
- Kinect v1.0 (3) [2012 - 300€]
- Kinect v2.0 (1) [2014 - 300€]
- Swissranger [2012 – ~3000€]
- Leap Motion (3) [2016 – 60€]
- ~~Razor Hydra [2014 – 80€] with HW problems ☹~~
- Google tango (lease) and Lenovo [2015 – ~500€]

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Hardware@deti - Input

- Intersense 3DOF Inertial Tracker USB
- Intersense 3DOF Inertial Tracker Bluetooth

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Hardware@deti - Input

- Wintracker

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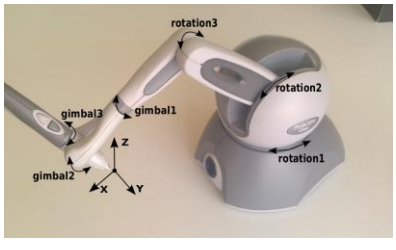
Hardware@deti - Input

- Phantom Omni



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Hardware@deti - Input

- Nintendo Wii

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Hardware@deti - Input

- Kinect v1.0 (3) and v2.0 (1)

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Hardware@deti - Input

– Leap (3)

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Hardware@deti - Input

– Razor Hydra (with HW problems ☹)

– Stem Wireless Tracking System (ordered)

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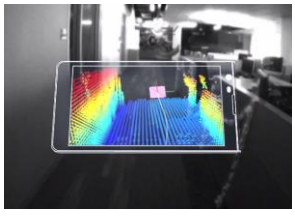
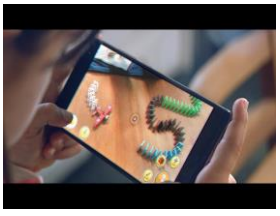
Hardware@deti - Input

– Google tango (lease)





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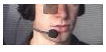
The future

- It seems likely that we will use more often:
  - gestures
  - two hand input
  - voice
  - 3D pointers
  - wearable devices
  - whole-body environments
  - tactile/force feedback



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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

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Bibliografia

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