Input Devices
Main Input devices

- Keyboards
- Pointing devices
  - Mouse
  - Touch screen
  - Touch pad
  - Joy stick
  - Track ball, ...
- Character recognizers
- 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
Keyboards

- Alphanumeric
- Numeric
- Functions
- Cursors
Keyboards

Cursors

Numeric

Alphanumeric

home row indicators
Keys layout

Qwerty

Dvorak

Combining both
Portuguese Keyboards

http://en.wikipedia.org/wiki/Portuguese_keyboard_layout
Percentage of work performed by each hand (in English)

QWERTY
QWERTY was devised to prevent jams in early typewriters.

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

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

Virtual (on screen) keyboards

Allow a user to enter characters
http://en.wikipedia.org/wiki/Virtual_keyboard

May be used for security reasons
Keyboards for specific contexts of use
Virtual projection keyboards

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

One handed cord keyset:

Code for “a”

An early keyboard (left) and lettercodes (right)

Modern device used in wearable computing

http://handykey.com/index.html
A curiosity: Keyless Keyboard

It does not imply finger nor wrist motion

And allows good typing speed after training

http://orbitouch.com/
Keyboards evolve...


http://www.youtube.com/watch?v=oyLC5UeCbsA

http://dl.acm.org/citation.cfm?id=2470733&dl=ACM&coll=DL&CFID=351524605&CFTOKEN=49071188
Innovation: A Motion Sensing Mechanical Keyboard

Combining motion gestures on and directly above the keys with regular tactile typing

https://www.youtube.com/watch?v=Y3dUeGNIX4M
A Motion Sensing Mechanical Keyboard (cont)

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

  – Indirect control  mouse
    track ball
digitizing tablet
joystick (track point)
touch pad
Mice

Mechanic
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

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

http://www.dougengelbart.org/firsts/mouse.html
http://www.computerhistory.org/revolution/input-output/14/350
Optical mouse

No sphere

Sensor works on most surfaces

Other examples:
Inflated mouse (more portable)

http://www.youtube.com/watch?v=qTA30qUSnqU
Trackball

- “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
Trackballs
Joysticks
Ergonomic Pointing Devices

Zero tension mouse

Wireless Ergonomic Mouse

Gesture pad

Quill mouse

Whale mouse

For users with RSI/CTS and other problems
Digitizing tablets

Advantages:
- Direct relation between hand and cursor motion
- Speed control
- Continuous motion in all directions
- May have high resolution

Disadvantages:
- Hand movement between keyboard and tablet
- Additional space (footprint)

These disadvantages may be overcome using a pen “on the screen”
Adequate for digital art

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

http://www.wacom.com/products/pen-tablets
“On the screen” - > touch screen is most adequate for specific tasks: e.g. Seismic Interpretation

Interaction mapping:

Touch screens

Resistive (older, less expensive)

optical

Sonic ___ stationary wave patterns

Capacitive

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

http://inst.eecs.berkeley.edu/~ee16a/sp15/Labs/touchscreen/ee16a_touchscreen_lab3.html
A resistive touch screen has two flexible sheets of material that have an electronically resistive coating. A gap separates the two sheets.

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

Advantages:

- Direct relation between hand and cursor movement
- Do not require additional space
- Allow continuous movement in all directions

Disadvantages:

- Finger may be too large for needed accuracy
- Tiresome over long usage time
- Finger may hide relevant information
- Screen may get dirty
- Other problems due to parallax (optical), temperature and humidity (capacitive), misalignment (resistive)
Other input devices ...

Tangible interfaces and pedals

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

Kinect (allows gesture interfaces)


Leap motion

https://www.leapmotion.com/

Cyber Glove

https://www.youtube.com/watch?v=k2nuXX2thBA#t=63

HTC Vive

https://www.vive.com/eu/
To detect hand gestures: Leap motion controller

like Kinect, but offering finger gesture recognition
Input + output:
Using a touchscreen banch for a virtual autopsy

https://www.tii.se/inside-explorer-at-the-british-museum
Input + Output: Using a force-feedback glove in Physical Therapy

A stroke patient interacts with a virtual reality environment using a glove to "pour tea" during a therapy session

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
Voice recognition systems

• The first system was developed in 1972 at Bell Lab

• It is becoming more used

• Has two types of challenges:
  – Technological
  – Human factors
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
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
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:
  – User training
  – Ambient noise
  – Vocabulary extent
  – Error cost
Input devices for 3D interfaces

• Trackers:
  – Mechanical
  – Magnetic (AC, DC)
  – Optical
  – Ultrasonic
  – Inertial, ...

• Navigation and manipulation interfaces:
  – Tracker-based
  – Trackballs
  – 3D mice, ...

• Gesture interfaces:
  – Cyberglove
  – Spatial gestures sensors
  – ...

CyberTouch Glove

http://www.cyberglovesystems.com/cybertouch/
https://www.youtube.com/watch?v=32f2UxKjydI
Every year there are new devices …

Gest is a wearable device that allows you to control your computer or mobile device with your hands

http://www.highsnobiety.com/2015/11/01/gest/

April, 2016
Gest Final Update:  
Did not go further!
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:

- Cost
- Generality
- DOFs (Degrees Of Freedom)
- Ergonomics / human factors
- Typical scenarios of use
- Output devices
- Interaction techniques
“The interface between humans and computers is harder than ever to define, we can interact with computers just by walking through a public space.”

• Technology shall not be used only because it is new!

• It is necessary to understand the usability of devices for the users and the tasks they have to perform
Main Bibliography: books

