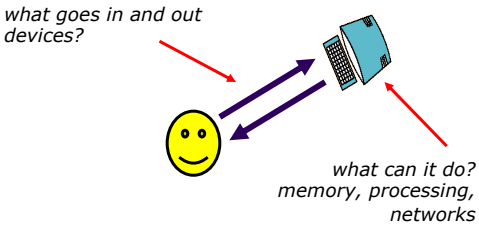
Computer

1

Computer

- to understand human–*computer* interaction
  … need to understand computers.

- Computers' main components:
  - Input devices
  - Output devices
  - Memory
  - Processing

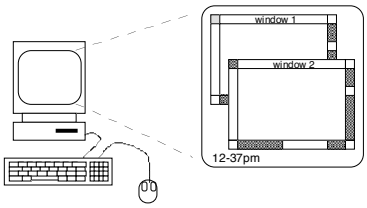


- Storage capacity and computational power is determinant in the design.

2

Computer

- A typical computer (interface)
  - screen, or monitor, on which there are windows
  - keyboard
  - Mouse



  - Variations
    - Desktop/laptop
    - Tablet
    - Smartphone
    - …
- Devices influence the style of interaction.

3

Computer

4

Computer

How many computers

– in your home?

- Hands up...
  ... none, 1, 2 or 3!

– in your pocket?

are you thinking of . . . PC, laptops, tablets?

5

Computer

How many computers…

in your house?

- PC
- TV, PlayStation, cable/satellite TV
- microwave, cooker, washing machine
- AC
- security system

can you think of more?

in your pockets?

- phone,
- camera
- watch
- electronic car key
- USB memory

try your pockets and bags

6

Computer (text entry)

- Keyboard ergonomics
  - Key shape
  - Distance between keys
  - Key movement on pressing
  - Location of “important “ keys
  - Size of important keys
  - ...

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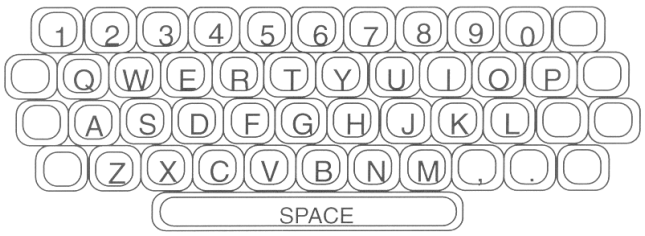
Computer (text entry)

- Keyboard
  - Most common device for text entry.
  - Key presses closes connection causing a character code to be sent to the computer.
  - Layout standard: QWERTY
    - It is not optimal for typing
    - Mechanical typewriters.



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Computer (text entry)

- Other types of keyboards
  - DVORAK
    - Similar to QWERTY, but assigns the letters to different keys
    - biased towards right-handed people
    - most frequently typed letters are in the middle of the typing area
    - Minimize the number of keystrokes made with the weak fingers
    - 10-15% of speed improvement
    - Fatigue reduction


Dvorak Keyboard Layout

  - Alphabetic
    - letters are arranged alphabetically across the keyboard
    - Not faster for properly trained users.
    - ... not even for novice or occasional users.

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Computer (text entry)

- Other types of keyboards
  - Phone pad and T9 entry
    - use numeric keys with multiple presses
      2 – a b c 6 - m n o
      3 - d e f 7 - p q r s
      4 - g h i 8 - t u v
      5 - j k l 9 - w x y z
      hello = 4433555[pause]555666
      surprisingly fast!
    - T9 predictive entry
      - type as if single key for each letter
      - use dictionary to 'guess' the right word
        hello = 43556 … but …

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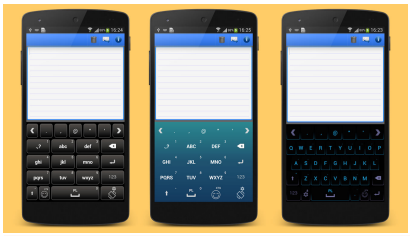
Computer (text entry)

- Virtual keyboards
  - Mobile devices
  - Casual use
  - Save space
  - Reduce the risk of keystroke logging



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Computer (text entry)

- Other types of keyboards
  - 3D laser virtual keyboard (http://www.celluon.com)
    - Recognize finger's position and movement
    - Portable
    - Bluetooth and USB

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Computer (text entry)

- Handwriting recognition
  - Natural interaction
  - Individual letters may have different shapes when in a word.
  - Calligraphic differences.
  - Stroke information (the way in which a letter is draw) is more important than the letter shape.
  - Devices with handwriting recognition must capture the stroke information, not just the final character shape.
  - Pen-based systems → mobile computing

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Computer (text entry)

- Voice recognition
  - Promising, but still with limited usage
  - Problems:
    - Recognition rates of 97% - a letter error in every 30, or one spelling mistake every six or so words.
    - Background level of noise
    - Pronunciation inaccuracies
    - Accent
    - Privacy
    - ...
  - Usage: telephone information systems, navigation.

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Computer - Pointing

- Mouse
  - Common (it doesn't mean intuitive!)
  - Easy to use (...but need some practice)
  - 2D movement
  - Buttons (more and more!)
  - No arm fatigue (if used in the proper way)
  - Indirect manipulation device (may cause synchronization problems between eye and hand)
  - No need for space on the screen (only the cursor)
  - Accurate (depends on quality…)
  - Quick
  - Cheap

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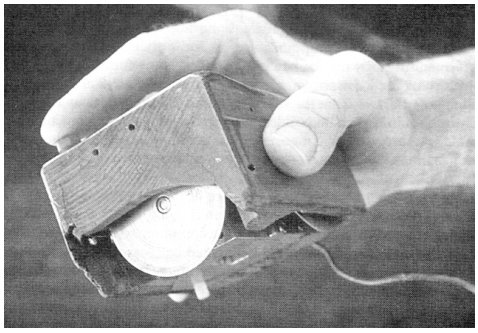
Computer - Pointing

First MOUSE
(Douglas Engelbart)



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Computer - Pointing

- Touchpad
  - small touch sensitive tablets (takes little space)
  - used mainly in laptop computers
  - need some practice

- TrackPoint (Pointing stick)
  - for laptop computers
  - miniature joystick in the middle of the keyboard

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Computer - Pointing

- Trackball
  - like an upside-down mouse
  - indirect manipulation
  - accurate
  - selection buttons
  - requires no additional space to operate (use with notebooks)

- Digitalizing tablet
  - indirect manipulation
  - high resolution
  - several sizes
  - can be used for text entry and for handwriting recognition (if supported by character recognition SW)
  - used for digitizing maps
  - requires a large amount of desk space

Computer - Pointing

- Touchscreen
  - Direct manipulation
  - Advantages: quick, requires no external device; good for selection of items; good for use in mobile context and in hostile environments (acts as input and output device).
  - Disadvantages: the fingers leave greasy marks on the screen; quite inaccurate; may cause arm fatigue; the user needs to be close to the screen, pointing can obscure the display.
  - Multi-touch gestures: tap, swipe, pinch
  - 3D touch

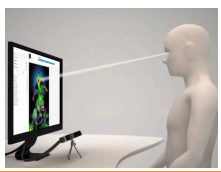
Computer - Pointing

- Joystick
  - Indirect manipulation device
  - Takes little space
  - Controlled by
    - Movement (*Absolute*)
    - Pressure (*Isometric*)
  - Selection buttons
  - Takes little space on the screen (only the cursor)
  - Cheap
  - Usage: games, users with special needs.

Computer - Pointing

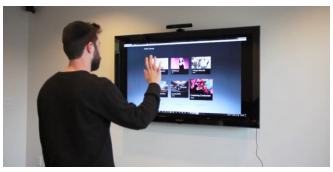
- Dataglove
  - Lycra glove with optical-fibber
    - Detects the joint angles of the fingers
    - Ultrasound to determine 3D position, as well as angle of roll.
    - Intuitive and natural use
    - Difficult to use in conjunction with a keyboard
    - Possible force-feedback
    - Expensive
    - Potential usage: Gesture recognition, Manipulation of virtual environments, …

- Eye track
  - uses the eye movements to move the cursor
  - lots of potential, expensive.



Computer - Sensors

- Gesture recognition



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Computer - Sensors

- Sensors all around us
  - car courtesy light
  - ultrasound detectors – security
  - RFID security tags in shops
  - temperature, weight, location
  - ...

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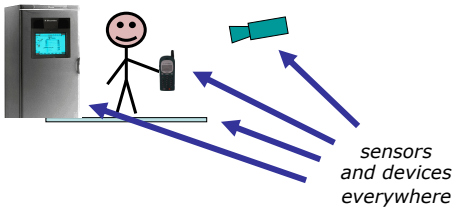
Computer – Sensors

- GPS
- IR
- Bluetooth
- Accelerometer
- Gyroscope
- NFC
- ...



→ ubiquitous computing

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Computer - Sensors

- Ubiquitous computing

  Ubiquitous computing is built on top of the idea that computing moves off the desktop, into the surrounding environment, working in the periphery of our attention.

  Mark Weiser's vision:

  Computers should weave into human's lives, being as invisible as possible, instead of being the main focus of attention.

  Weiser, M.:The computer for the 21st century. Scientific American, 265, 3, 94-104 (1991).

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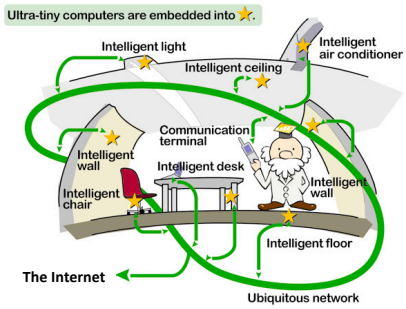
Computer - Sensors

- Ubiquitous computing
  - Anytime
  - Everywhere
  - Transparency



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Computer – Output devices

- Displays
  - Resolution
  - Colour depth
  - Size
  - Aspect ratio

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Computer – Output devices

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Computer – Output devices

- Flexible displays

Philips

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Computer – Output devices

- Output alternatives
  - HMD (Virtual and augmented reality)

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Computer – Output

- Sound
  - Beeps
  - Used for alert
  - Confirmation of actions (ex: keyclick)
- Touch (haptic devices)
  - Games...vibration, force feedback
  - Simulation...feel the real tools
- Smell, taste
  - Current technology still limited

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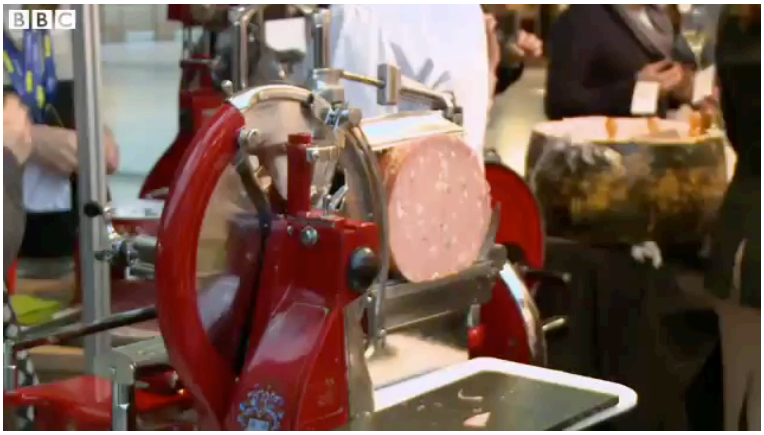
Computer – Output



https://www.youtube.com/watch?v=J-3zVLQ9naE

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Computer – Memory

- MEMORY
  - STM: RAM
  - LTM: Hard disk
  - Multimedia data take a lot of storage
  - The more you have the more you need.

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Computer – Processing

- PROCESSING
  - Speed of processing can seriously affect the user interface …and UX
  - Designers tend to assume fast processors, and make interfaces more and more complicated – Myth of the infinite fast machine
  - Problems with too slow processing:
    - overshooting: buffered keystrokes
    - icon wars: user clicks on icon, nothing happens, clicks on another, then system responds and windows fly everywhere.
  - Problems with too fast processing:
    - too fast scroll

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Computer – Processing

- Limitation on interactive performance
  - **Computation bound**
    - Computation takes to much time causing frustration for the user (show progress bar).
  - **Graphics bound**
    - updating displays can take a lot of effort for the CPU (use a graphic co-processor)
  - **Network capacity**
    - interaction performance can be reduced by slow network speed (use compression).

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Computer

- Multiple devices
- There is no “perfect” device
- Criteria
  - Appropriateness for task
  - Ergonomics
  - Efficiency

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Interaction styles

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Interaction styles

- Interaction can be seen as the dialog between the user and the computer.
- The choice of the interaction style may have a deep effect on the nature of the dialog.
- Common interaction styles:
  - Command line
  - Menus
  - Forms and spreadsheets
  - Question/answer and query dialog
  - Natural language
  - WIMP
  - Point & click
  - 3D interfaces
  - Augmented reality
  - ...

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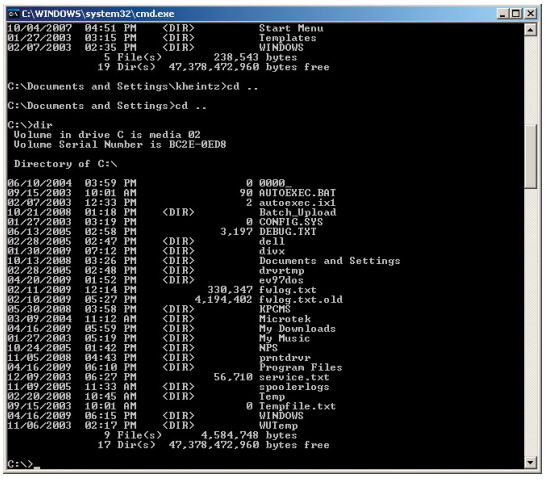
Interaction styles

- COMMAND LINE
  - Way of expressing instructions to the computer directly.
  - Flexible: specification of command parameters.
  - Offers direct access to system's functionality.
  - Suitable for repetitive tasks.
  - Commands are difficult to learn and memorize.
  - Command names/abbreviations should be meaningful!
  - Better for expert users than novices.
  - Can be used as a complement to menu-based interfaces.
  - Quick and efficient for experienced users
  - Ex: Unix system, MS DOS (remember?)

Interaction styles



Interaction styles

- MENUS
  - Set of option displayed on the screen.
  - Options are visible => no need to remember the commands (recognition versus recall).
  - Options should be meaningful.
  - Option selection by: numbers, letters, arrow keys, mouse.
  - Often options are hierarchically grouped => attention to the grouping and naming of the menu option.

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Interaction styles

- MENUS
  - Ex:

```
PAYMENT DETAILS                P3-7

please select payment method:
 1. cash
 2. cheque
 3. credit card
 4. invoice

 9. abort transaction
```


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Interaction styles

- MENUS
  - Structure = task structure
    - Minimize tree depth (balanced menu structure)
  - Order of options
    - Alphabetic
    - Random (worst)
    - Frequency of use
  - Selection of options
  - Navigation between menus

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Interaction styles

- FORMS
  - primarily used for data entry or retrieve.
  - screen like a paper form.
  - the user fills in appropriate values in the empty fields and the data is then send to the application and stored in the right place.
  - provide explicit context.
  - inflexible.
  - requires good design.
  - should allow for corrections.
  - should allow easy movements around the form.
  - mandatory fields should be designated.

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Interaction styles

- FORMS (layout)
  - Draw to support task
    - Paper form
  - Group and sort semantic related fields by:
    - Sequence of use
    - Frequency of use
    - Relative importance (mandatory first)

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Interaction styles

- FORMS (data fill)
  - Allow auto complete from prefix
  - Use “combo boxes” for fields with predefined options
  - Show sub-fields (16:30:34), but only require the values (163034)
  - Provide default values

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Interaction styles

- FORMS (navigation)
  - Place cursor in the most probable field
  - Support movement between continuous fields
  - Enable and disable fields according to previous data entries
  - Protect unchangeable fields

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Interaction styles

- SPREADSHEET
  - first spreadsheet VISICALC, followed by Lotus 1-2-3 MS Excel most common today
  - sophisticated variation of form-filling.
    - grid of cells contain a value or a formula
    - formula can involve values of other cells
      e.g. sum of all cells in this column
    - user can enter and change data, spreadsheet maintains consistency

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Interaction styles

- QUESTION / ANSWER
  - combines characteristics of menus and forms
  - the user is guided, step by step, through the interaction, via series of questions
  - suitable for novice or casual users and restricted domains (ex: expert systems)
  - easy to learn and use, but limited in functionality
- QUERY LANGUAGES
  - used to retrieve data from a database.
  - queries style is close to natural language
    - but require specific syntax
    - and knowledge of the database structure
  - requires some experience and expertise.

Interaction styles

- NATURAL LANGUAGE
  - Familiar => attractive.
  - User do not have to remember command; users won't get lost in a hierarchy of menus.
  - Speech recognition or typed natural language.
  - Problems:
    - vague
    - ambiguous
    - appropriate for creative expression; computers require precise instructions.
      - Ex: teacher pointed the student with the pen
        - » teacher pointed the student who has the pen?
        - » teacher used the pen to point the student?
    - words can have different meanings according to the context.
  - Can use only a restricted subset of the language.

Interaction styles

- WIMP (Windows, Icons, Menus, Pointers)

  (or Windows, Icons, Mice ad Pull-down menus)

  – default style for majority of interactive computer systems, running on PCs and desktop machines

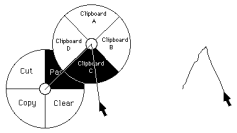
- POINT & CLICK
  – closely related with the WIMP style
  – used for:
    - WWW browsers
    - multimedia
    - hypertext
  – minimal typing

Interaction - WIMP

- Menus
  – Choice of operations or services offered on the screen (recognition vs recall).
  – Required option selected with pointer
  – Problem:
    - take a lot of screen space.
  – Solutions:
    - pop-up: menu appears when needed

Interaction - WIMP

- Kinds of menus
  - Menu at the top of the screen
    - Drop-down menu: Mouse click reveals menu (Ex: “File”, “Edit”, …).
    - Fall-down menu: similar to drop-down menus, but the menu automatically appears when the mouse pointer enters the title bar, no need for clicking
  - Contextual menu appears where you are
    - Pop-up menu: appears when a particular area of the screen is clicked, disappear as soon as the mouse button is released.
    - Pie menu
    - HMM (Hierarchical Marking Menu).
  - Cascading menus (Ex: START do Windows).



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Interaction - WIMP

- Menus
  - different kings of menus can be used in the same application.
  - keyboard accelerators
    - key combinations - same effect as menu item
      - two kinds
        - » active when menu open – usually first letter
        - » active when menu closed – usually Ctrl + letter

      usually different !!!

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Interaction - WIMP

- Menus design issues
  - which kind to use
  - what to include in menus at all
  - words to use (action or description)
    - meaningful labels should be used
  - how to group items
    - grouping should be consistent across applications
    - many items can be grouped under more then one heading
    - menu items should be ordered according to importance and frequency of use; opposite functionalities should be kept apart.
  - choice of keyboard accelerators

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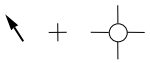
Interaction - WIMP

- Pointers
  - cursor can have a wide variety of shapes, often used to distinguish modes.



  - cursor hot-spot should be clear from the appearance of the cursor (specially for precision tasks).

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Interaction - WIMP

- Buttons
  - individual and isolated regions within a display that can be selected to invoke an action.
  - push buttons – similar to control panel buttons.
  - toggle Buttons – used to toggle between 2 states.
    Ex: Bold.
  - *Radio Buttons*
    - set of mutually exclusive choices
  - *Check Boxes*
    - set of non-exclusive choices

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Interaction - WIMP

- Toolbar
  - collection of small buttons, each with icons.
  - each buttons corresponds to a common action.
  - often customizable:
    - choose *which* toolbars to see
    - choose *what* options are on it
  - learn the meaning of icons on toolbars?
    - put the icons on the menus in the same way that accelerator key are written there.

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Interaction - WIMP

- Palette
  - Normally a collection of icons, representing the possible actions, as well as the current and available modes.
  - Can be shown or hidden
  - Ex: drawing program
    - colour palette
    - tools palette

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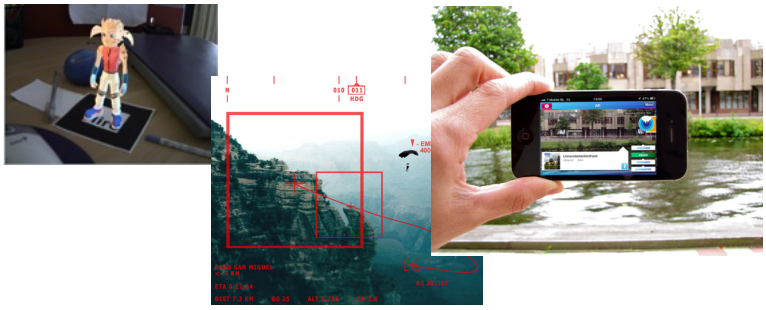
Interaction - AR

- Augmented and virtual reality
  - The real world seen by the user is augmented with virtual objects that coexist in the same space and provide additional information.



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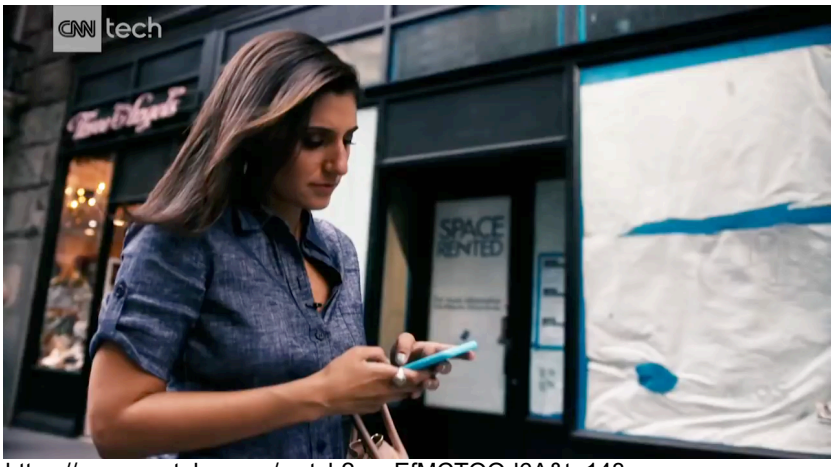
Interaction - AR



https://www.youtube.com/watch?v=_EfMCTOQd6A&t=148s

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Interaction - Tangible

- Tangible User Interfaces (TUI)
  - Users interact with digital information through the physical environment.
  - Augment the real physical world by coupling digital information to everyday physical objects and environments.
  - Hiroshi Ishii: Tangible bits

    seamless coupling between the worlds of bits and atoms

    http://tangviz.cct.lsu.edu/papers/ishii-chi97-tangible-bits.pdf

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Interaction - Tangible

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Interaction - Tangible

- Tangible User Interfaces (TUI)

Reactable
http://www.reactable.com/

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Interaction – Presenting information

- The way of presenting information on screen depends on the:
  - kind of information: text, numbers, images, drawings, maps, video, tables,…
  - available technology: type of display (size, resolution, colour,…), VR,…
  - purpose of the use.
- Ex: Explorer – different file ordering when you want to know the:
  - day of the last update of a specific file (alphabetic order of file names),
  - what was the last file to be updated (order by date).
- Tufte's books

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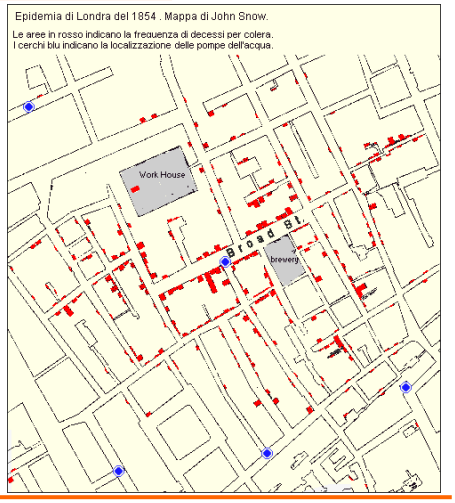
Interaction – Presenting information

- Spatial data visualization



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Interaction – Presenting information

- Aesthetic
  - Beautiful ≠ useful
  - + attractive → + satisfaction → + productivity
  - Balance in colours and contrasts
  - Consistency of design (buttons, menus).

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Reading

- Cliff Kuang,
  Why a New Golden Age for UI Design Is Around the Corner. Wired, , 2013.
  http://www.wired.com/design/2013/08/design-and-the-digital-world/

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Watching

- Designing for Ubiquitous Computing
  http://research.microsoft.com/apps/video/default.aspx?id=188797
- CHI 2011 Invited Talk: Bill Buxton - An Informal Walk through 35 Years of Interactive Devices
  https://www.youtube.com/watch?v=AsOFkHFEs-A

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