Chapter 1

Introduction to HMI

Course inspired by:

- Computer Science Laboratory in Image and Information Systems (LIRIS)
- French-speaking Human-Computer Interaction Association

Course Plan

- Introduction to HMI
- Evolution of HMI

Did you say HMI?

- HMI
  - Human Machine Interface
  - Human-Machine Interactions
- But also
  - Human-Machine Communication
  - Man – Machine Dialogue

Human Machine Interaction (HCI) – What is it?

Finding the right design

http://www.baddesigns.com/examples.html

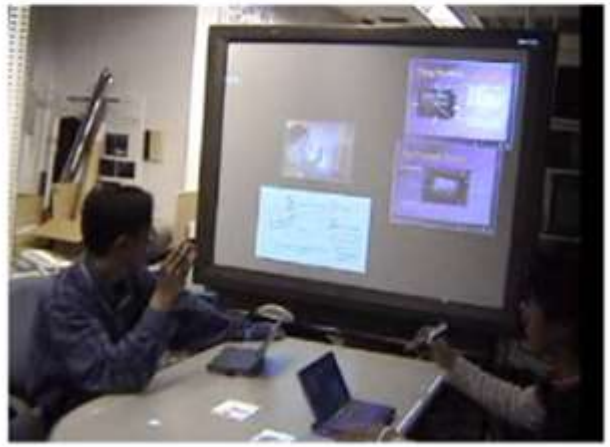
Human Machine Interaction (HCI) – What is it?

Functionality versus Simplicity

Human Machine Interaction (HCI) – What is it?

Industry versus Research

Microsoft Surface (2008)



Augmented Surface (Rekimoto 1999)

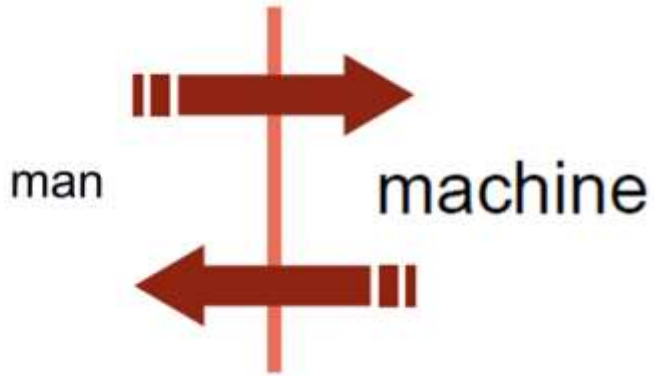
Videos:

`videos/tabletop/ms-surface.mp4`

`videos/tabletop/1999-augmented-surfaces.mpg`

HMI - definitions

- Human Machine Interface
  - set of hardware and software devices allowing a user to interact with an interactive system



- Human-machine interaction
  - all aspects of the design, implementation and evaluation of interactive computing systems

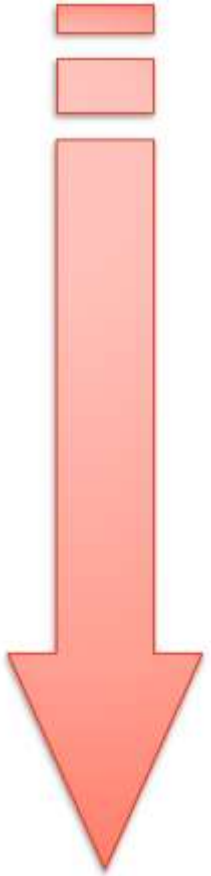
HMI - definitions

- Human-machine interaction
  - The design, implementation and evaluation of interactive computer systems intended for human users as well as the study of the main phenomena surrounding them
- An interactive system is a system whose operation depends on information provided by an external environment that it does not control
- Interactive systems are also called open, as opposed to closed - or autonomous - systems whose operation can be entirely described by algorithms

Interface ≠ Interaction

User consideration

- Techno-centric approach
  - focused on the machine and its possibilities
  - the user must adapt to the machine



- Anthropo-centric approach
  - centered on people and their needs
  - the machine must adapt to the user

Adapt the HMI (1)

User Characteristics

- physical differences
  - age
  - disability
- knowledge and experience
  - in the domain of the task (novice, expert, professional)
  - in IT, on the system (occasional, daily use)
- psychological characteristics
  - visual/auditory, logical/intuitive, analytical/synthetic…
- socio-cultural characteristics
  - direction of writing
  - date format
  - meaning of icons, colors

Adapt the HMI (2)

Context

- general public (offer immediate handling)
- leisure (make the product attractive)
- industry (increase productivity)
- critical systems (ensure zero risk)

Task characteristics

- repetitive, regular, occasional, sensitive to changes in the environment, constrained by time, risky…

Technical constraints

- platform
- memory size
- screen, sensors, effectors
- reuse of old code

HCI, multidisciplinary field

- Computer science
  - programming
  - AI
  - speech synthesis and recognition, natural language
  - picture
  - system…
- Cognitive psychology
- Cognitive ergonomics, software ergonomics
- Educational sciences, didactics
- Anthropology, sociology, philosophy, linguistics…
- Communication, graphics, audiovisual, design

HMI and programming

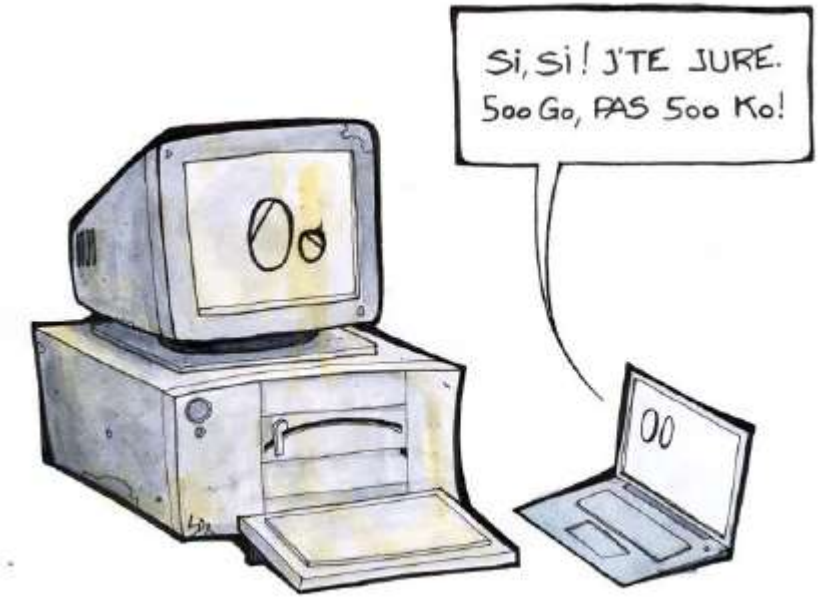
- Most computer applications are interactive
- The HMI is often a key element of the software (in + or -)
- Interaction design represents more than 50% of the development cost
- The HMI can represent 80% of the code of an application
  - it can be modified/reconstructed multiple times
  - importance of independence interface / core of the system

Implementation of interactive software

- It is
  - difficult, long, expensive
  - requires an early, methodical, iterative, experimental approach
- It's not _
  - an aesthetic operation of the screen
  - a matter of taste, common sense, intuition
- Method ?
  - no turnkey solution
  - theoretical, experimental benchmarks, know-how, questions
  - compromises

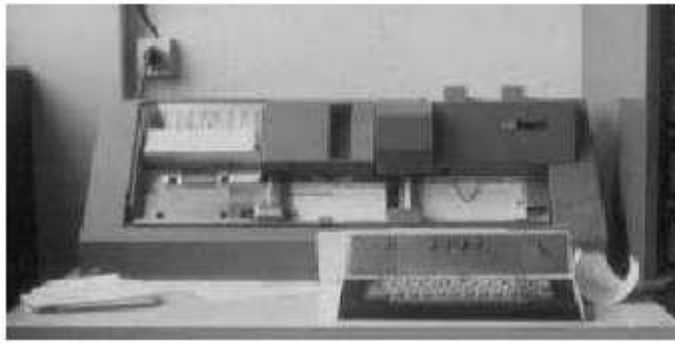
Course Map

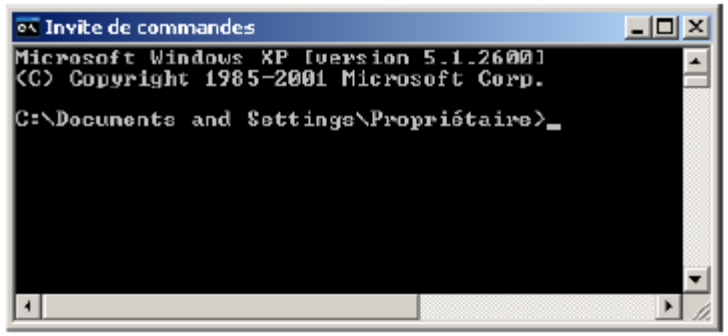
- Introduction to HMI
- Evolution of HMI

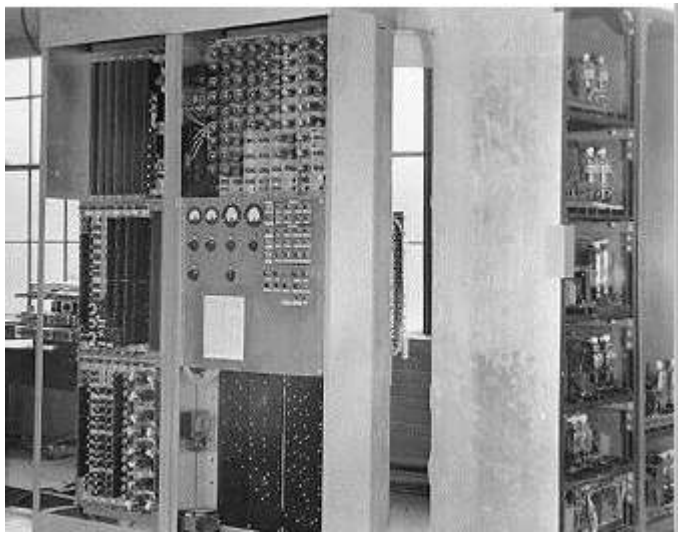


History
1945-1970: the premises

- Limited input-output devices
  - card punches/readers
  - dashboards (lights)
  - printers
- Command languages

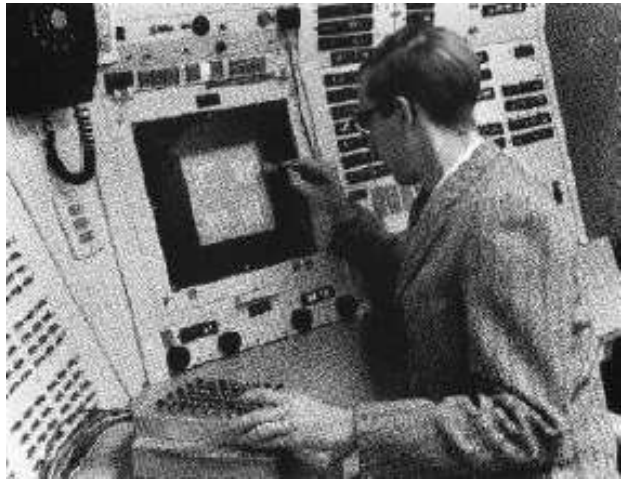






History
1970s: “modern” computers

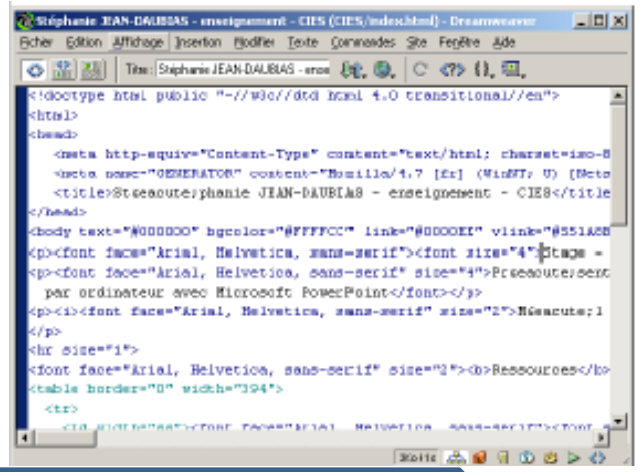
- “New” input-output devices
  - 1963: graphic screen and optical pen
  - 1968: first mouse
  - 1980: consumer applications
  - direct handling
    - remain our reference

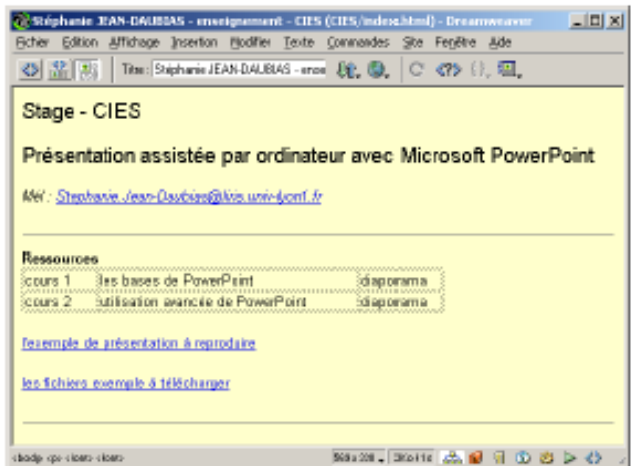


Xerox 8010 Star Apple Lisa Macintosh Windows 3.0
1981 1982 1984 1990

Evolution of interfaces

- More user-friendly systems that are easy to understand and use
- Graphical interfaces
  - direct handling
    - direct action for objects represented on the screen
  - WYSIWYG
    - What You See Is What You Get
    - ACAI : Display As Printed





Output devices

- Screens


- 3D printers

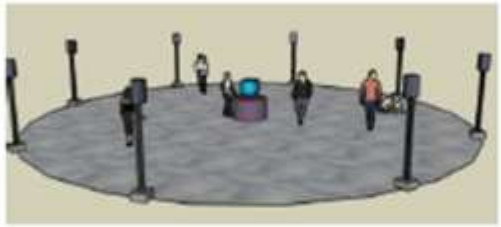


- Tactile feedback, force feedback

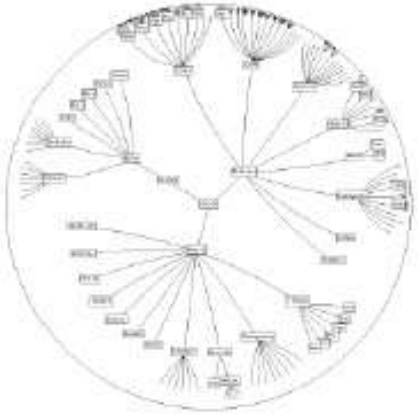



- Text-to-speech sound


- Spatial sound, 3D sound
  - announcement ahead: future
  - announcement behind: past




Output: 2D information visualization



fisheye : focus + contexte

Output: 3D information visualization

Input devices (1)

- Keyboard (azerty, Dvorak...)


- Mouse, trackball, joystick, touchpad






Input devices (2)

- Voice recognition, sound recognition



- Temperature sensors, hygrometry, air composition...



- Odor, movement, altitude sensors...




2D visual input devices

- 2D barcodes for text, web, email, card...


- Touch screen


- Optical pencils

- Linear, handwriting recognition


3D visual input devices

- Position, direction, speed sensors

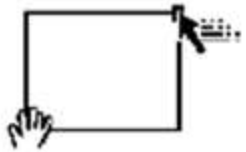





Input Devices – Multimodality

Combination of entry means

- two-handed interaction



- "put that here": voice + gesture

Virtual reality

- Computer simulation of an environment in which the subject has the impression of evolving
  - immersion in a 3D world
  - user represented by an avatar

Augmented reality, mixed reality

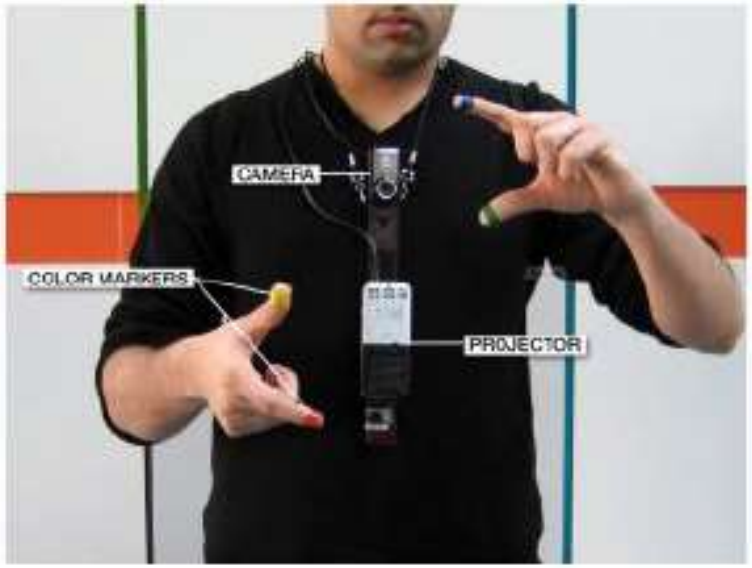
- Superposition of the image of a virtual model on an image of reality
  - the virtual is integrated into the real
  - in real time
  - on screen

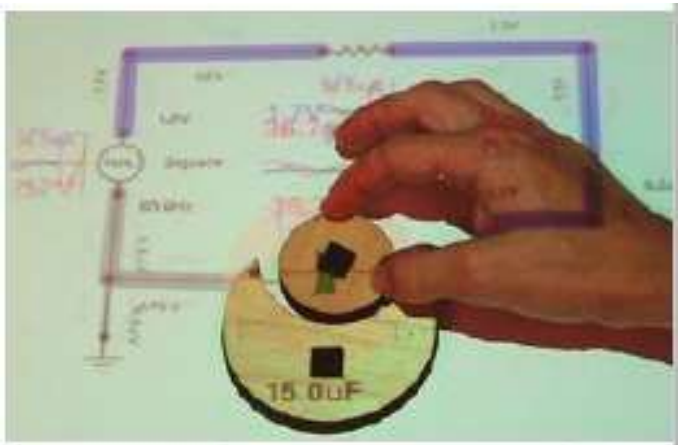
Diminished reality (Reduced reality)

- Deleting an element on a “real” image in real time

Tangible interfaces

- Association of real and digital objects
  - action directly on objects
  - simpler and more intuitive interaction





Wearable computing _

- Embedded computing
  - in clothes
  - in accessories









Mobile computing, nomadic

- Mobile devices
  - small, powerful, connected

- Compatibility problem between different devices
  - platform
  - Technical constraints
    - bandwidth
    - memory
    - storage space
    - **screen size** → plasticity of interfaces

Smart objects, web of things

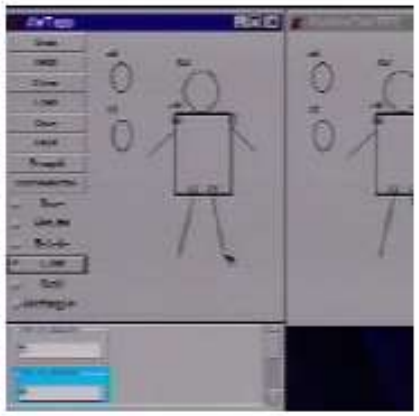
- Computing in everyday objects
  - distance between IT and non-IT

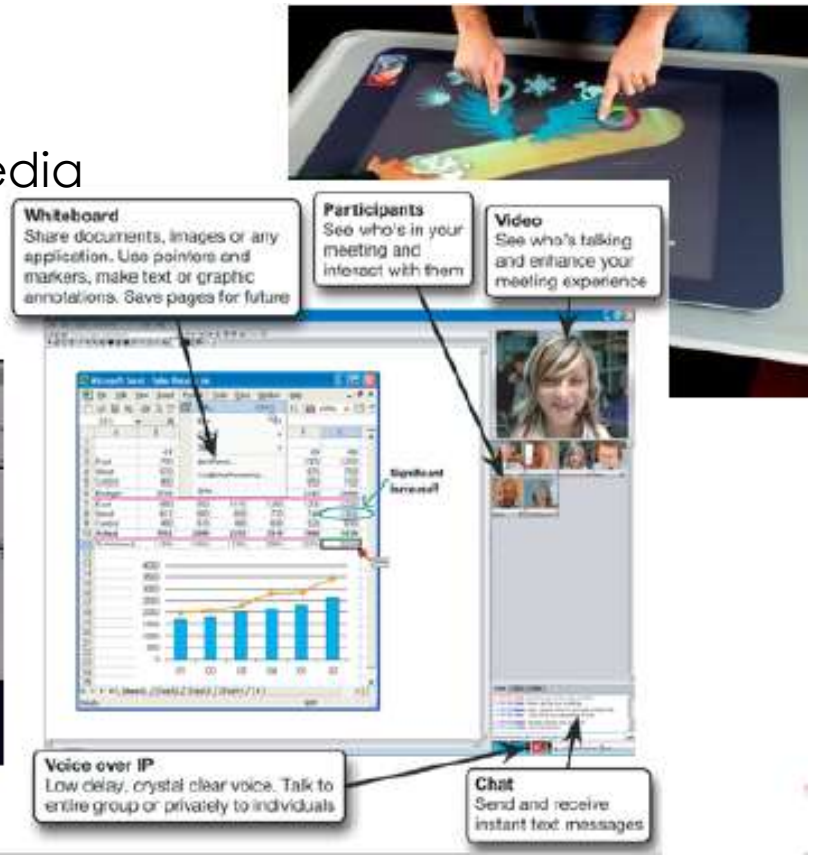
Pervasive , ubiquitous environments

- Pervasive computing
  - communicating objects (computers, smartphones , objects)
    - recognize each other
    - locate themselves
    - interact with each other (information transfer, data synchronization)
    - without user action
    - at any time

Collective

- **Collaborative** interactive system
  - together in the same place
    - table, board
  - from a distance
    - shared editors
    - integrating communication media





Back to reality…

- Screen, keyboard, mouse…

26/04/2013

A propos de l'interaction homme-machine

Nicolas Roussel - © *Inria*

Le clavier et la souris ont encore de l'avenir ! Tel est l'avis de Nicolas Roussel, chercheur en interaction homme-machine et membre de l'équipe-projet Mint (commune avec le CNRS et l'Université Lille1*). Pourquoi ? Il nous l'explique dans cet épisode du podcast audio.

Smartphones, tablettes tactiles, consoles de jeux... les objets numériques ont bel et bien envahi notre quotidien. Présents dans nos vies personnelles et professionnelles, ils bouleversent nos habitudes et parfois même, en créent des nouvelles. Ces interactions entre l'humain et les systèmes informatiques sont au cœur de l'interaction homme-machine (ou IHM). Car comme le précise Nicolas Roussel, l'interaction homme-machine n'est pas la science des interfaces, mais bien celle des interactions !

Pourtant, selon le chercheur, on est trop souvent dans le fantasme, dans une projection dans le futur, alors que la réalité est plus complexe dans ce domaine. Avec le numérique, beaucoup de promesses ont été faites — « avec ce nouveau dispositif, vous pourrez interagir plus facilement, plus rapidement, de manière plus naturelle ou plus intuitive, etc. » — mais sont-elles tenues ? Ces dispositifs numériques répondent-ils vraiment aux besoins, aux envies et aux attentes de leurs utilisateurs ? Quels sont les défis auxquels l'IHM devra faire face demain ? Nicolas Roussel nous donne un point de vue éclairé sur ces questions.

* au sein de l'UMR 8022 CNRS-Lille1-Lille 3-Inria, LIFL et de l'EA 2697 L2EP

Mots-clés : Nicolas Roussel - Centre de recherche Inria Lille - Nord Europe - Interaction homme-machine