FEUP

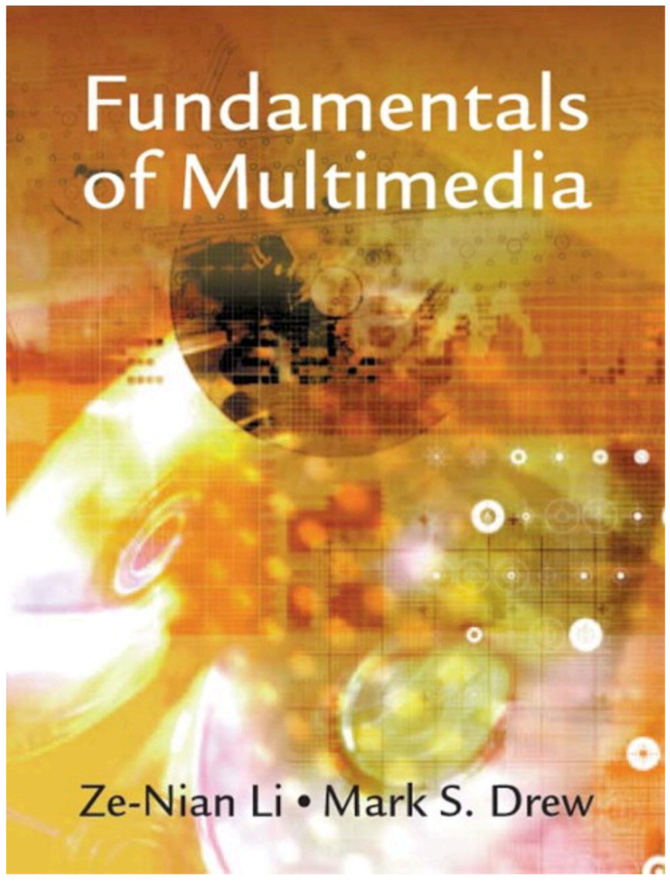
Departamento de Engenharia Electrotécnica e de Computadores

# Multimedia Systems - M.EEC057

## Master degree in Electrotechnical and Computing Engineering 2023-2024

- Introduction to Multimedia information, applications and systems
- The basics of MM systems
  - The media and the AVHS
  - Processing and compression

# Chapter for this lecture



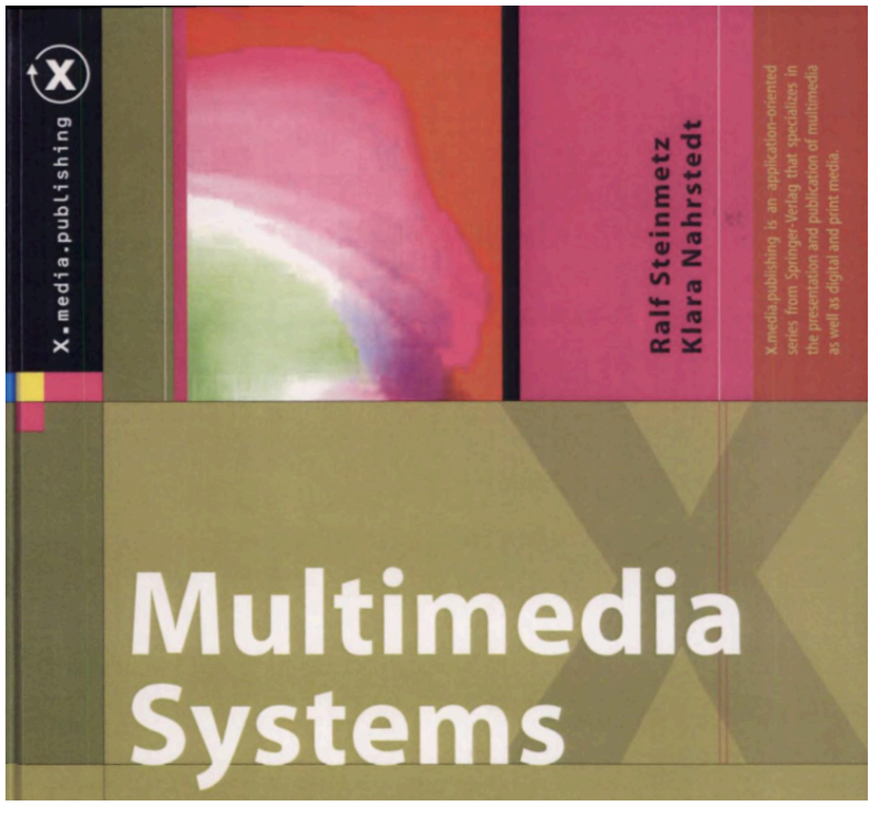

CHAPTER 1

## Introduction to Multimedia

### 1.1 WHAT IS MULTIMEDIA?

People who use the term "multimedia" often seem to have quite different, ev
viewpoints. A PC vendor would like us to think of multimedia as a PC th
capability, a DVD-ROM drive, and perhaps the superiority of multimedia-en





# What's in these slides

- Multimedia information and applications
  - definition and examples
- Multimedia systems
  - characteristics
  - challenges
  - main concepts
  - components

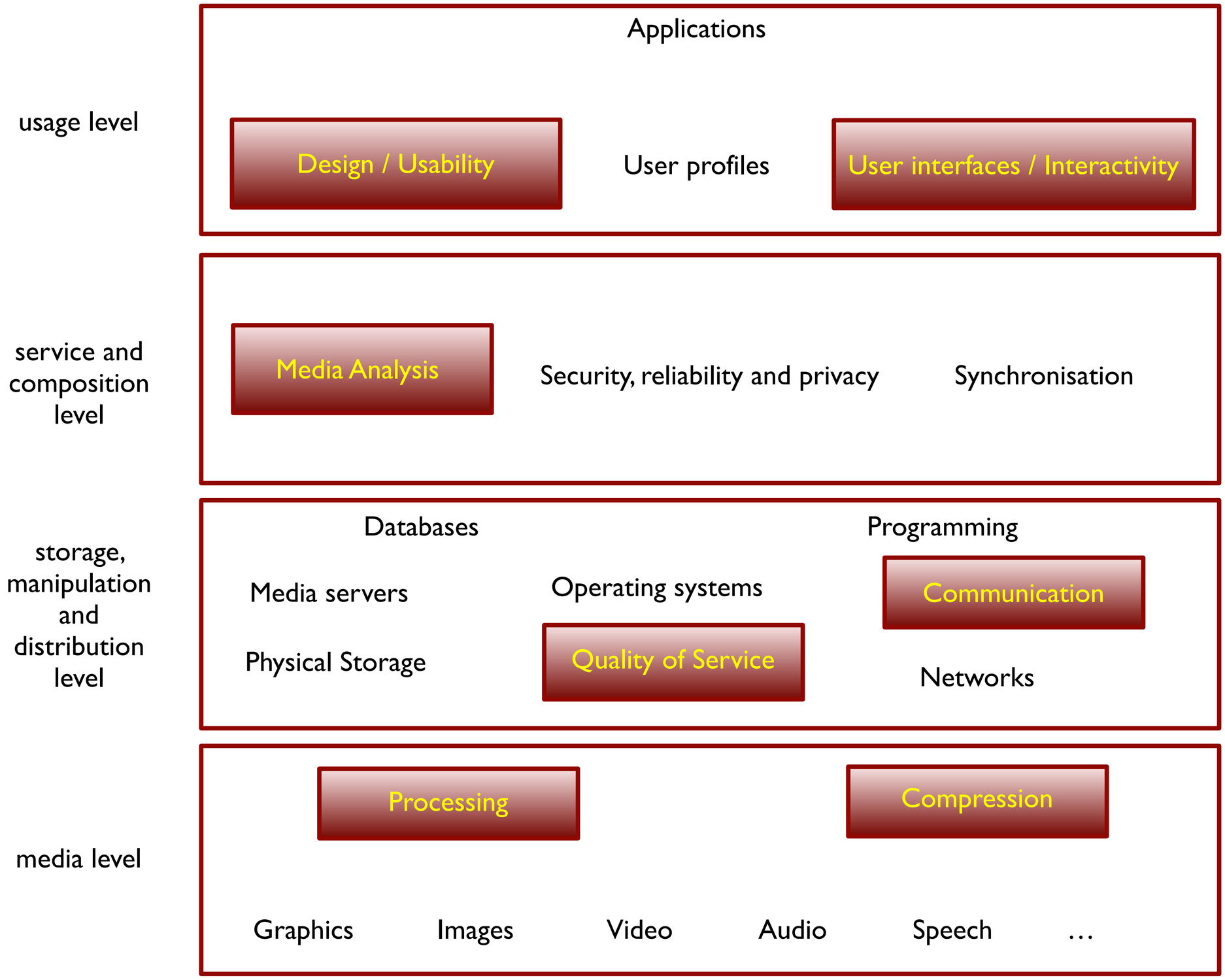
# What does Multimedia stand for?

- Multimedia
  - It is the field of study or the application area that addresses the integration of several media using a computer
  - All media data must be represented, stored, processed and transmitted in the digital format
- Multimedia Application
  - Application that uses multimedia information
  - Establishes some kind of relationship between those sources
- Multimedia System
  - One that can process multimedia data and applications

# What is multimedia information?

- It's digital!
- Several media (more than one …)
  - Sources of information such as, text, graphics, images, sound/audio, animation, video
  - Can be discrete or continuous
    - But at least one of them must be continuous
- Some kind of coordination/relationship must exist between them
  - It can be temporal or spatial
- There should be some interaction
  - The user should be able to control how the information is presented

# Areas relevant to multimedia systems



# Related terms

- Media
  - It is what distinguishes the different types of information
    - text, graphics, sound, speech, image, video
- Medium
  - It is what distinguishes the way how information is conveyed to/from the user
    - TV, Radio, Print, Web
- Multimodal / Modality
  - When the information has more than one form of representation (it comes in several media …)
    - an image and its textual description (two media for the same information, or the same information in two modes)
  - It is also related with the human senses used to perceive information
    - The prime minister speech in text (vision) and sound (audition)
- Hypermedia
  - media that contains links to other media

# Examples of multimedia applications

- World Wide Web
- Adobe Acrobat
- PowerPoint/Keynote
- Multimedia Authoring, e.g., Macromedia Director
- VoD, Video-on-demand
- interactive TV
- digital games
- Virtual Reality, Augmented Reality
- Digital video editing, production/post-production systems
- multimedia databases

# What is a Multimedia System?

- One that can process multimedia data and applications …
  - Characterised by its capacity to process, manage, store and present multimedia data
  - As such, it should exhibit the minimum of 4 basic characteristics:

1) Must be controlled by a computer/processor
2) It has to be an integrated system
3) It has to be able to process digital data
4) It offers an interactive graphical user interface

# Components of a Multimedia System

- hardware and software that support the previously identified requirements of multimedia applications
  - acquisition, processing, storage, transmission and presentation devices
- Acquisition devices
  - cameras; video recorders; microphones; keyboards and mouses; sensors; etc.
- Processing devices
  - computers, microprocessors, etc.

# Components of a Multimedia System (2)

- Storage devices
  - Hard disk, external drivers, CD-ROMs, DVD-ROM, cloud, etc.
- Communication networks
  - LANs, Intranets, Internet, high speed WAN, MAN, core networks
- Presentation devices
  - Loudspeakers; colour printers; UHD, HDTV e SDTV TV sets; high resolution displays; headphones; smart glasses; displays of handheld devices; etc.

# Important aspects to consider when developing MM apps

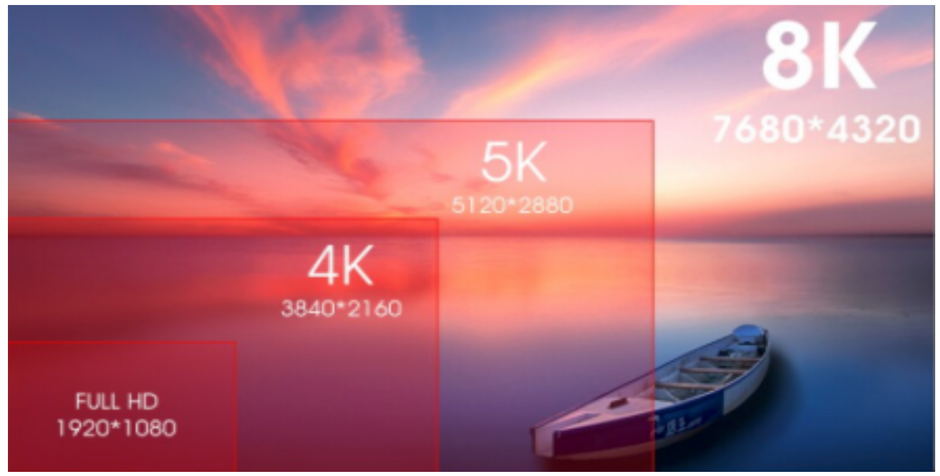
- How does the user perceive the information and the messages?
  - understand how the Human Audio Visual Systems (HAVS) work
  - apply user-centered approaches
- How to conceive and develop applications?
  - which representation formats?
  - is there the need to compress? Which compression algorithms to use?
  - is there the need to process? Which type of processing operations?
  - what is the desired quality (Quality of Service, QoS and Quality of Experience, QoE)
- Is it real-time? What are the admissible delays?
  - It may depend on the type of application in view
    - videoconference, VoD, VoIP, IPTV, …
    - streaming vs download

# Challenges to address

- In networked environments
  - Ensure the original relationships between the different media are preserved
    - Lip-sync
    - Temporal order
  - Network restrictions
    - limited/finite bandwidth (shared, best effort networks)
    - No guarantees of error-free or losses-free
    - delays, jitter

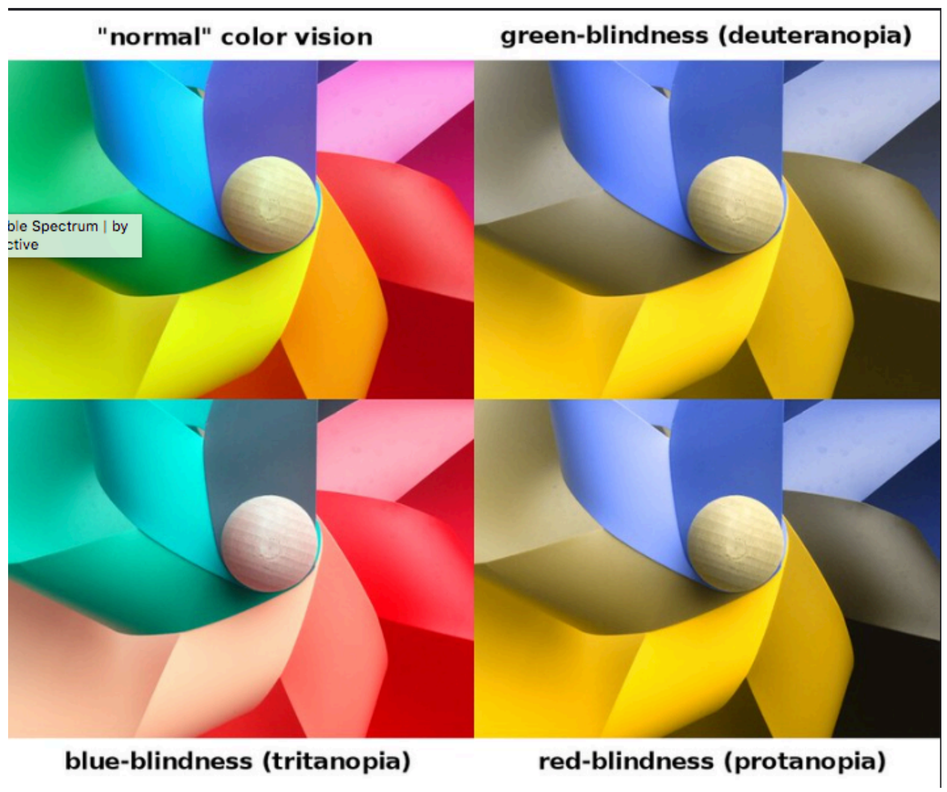
# Challenges to address (2)

- characteristics and restrictions of terminals/receivers
  - Laura's receiver may be different from that of John
    - Different screen sizes
    - Different software installed
    - Handheld with battery vs fixed / power-connected
    - Types of network access

# Challenges to address (3)

- Users' preferences, abilities and restrictions
  - People are inherently different from one another
    - Distinct preferences for colours, language, media type, etc.
    - Different ways of perceiving quality
  - Some may have physical limitations
    - "hard-to-ear", "colour-blind", etc



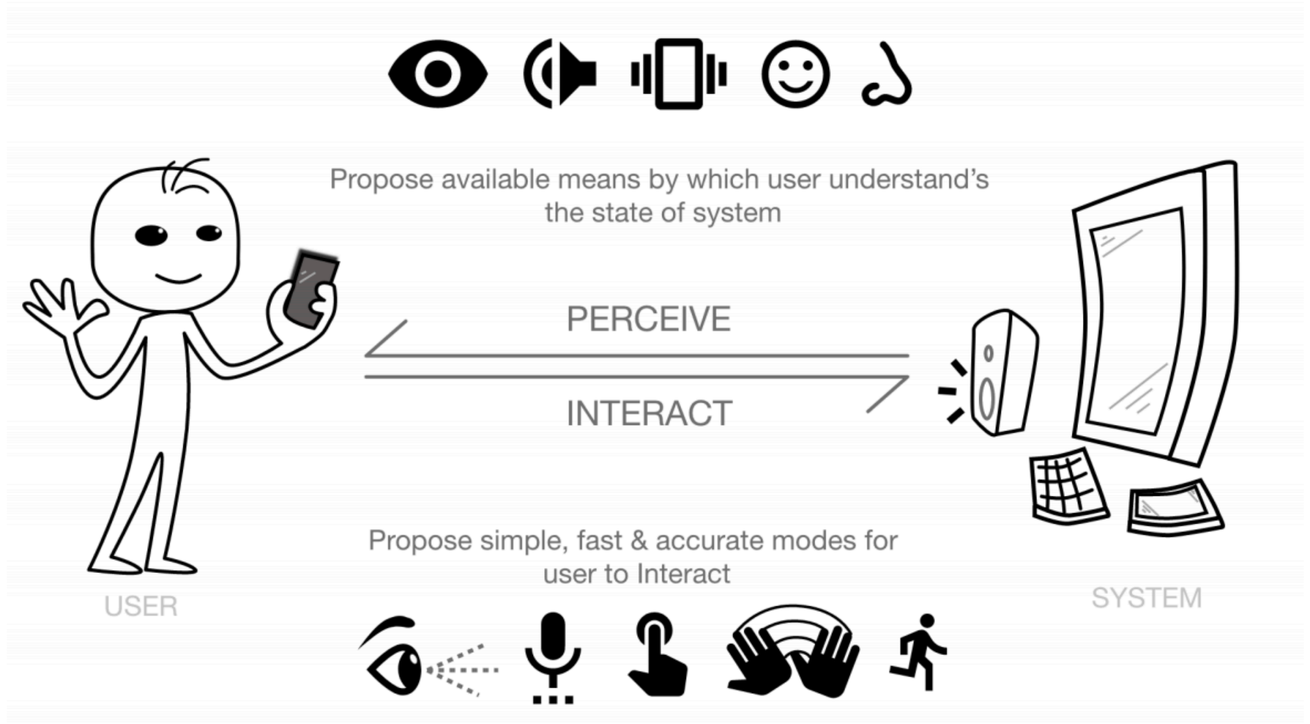
# Challenges to address (4)

- How to promote interactivity
  - targeting improved performance or usability
- it needs to be effective so that users can appropriately and efficiently interact with the system
  - the system will receive in due time the required input from the user
    - **performance** …
- but, it should be as as natural as possible
  - through the use of human-like communication methods such as speech or gesture
    - **usability** …
- and, ideally, interaction should adapt to individual users
  - taking into consideration physical limitations and/or preferences
    - **usability** …

# Challenges to address (5)

- How to promote interactivity
  - Explore different modalities
    - That make use of different human senses
      - Identify the one(s) that best suits the requirements
      - Decide modalities to use
      - Identify the need for media processing techniques
  - Explore the use of intelligent techniques
    - Directly at the interface
      - to analyse media and interpret users' actions
      - to understand users' intentions/needs/preferences and seamlessly adapt to individual users
    - On the backend
      - to anticipate users' needs/decisions and automatically perform actions on behalf of the users
  - Provide sufficient, pertinent and timely feedback on the system's state

# Challenges to address (6)




| INTERACT | | PERCEIVE | |
|---|---|---|---|
| Gaze | | | Vision |
| Speech | | | Audio |
| Direct Touch | | | Vibration |
| Gesture & Kinesics | | | Facial Expression |
| Proxemics | | | Smell |

Figures from https://www.uxness.in/2020/04/getting-closer-to-multimodal-interaction.html

# Proposed activity

- *Activity 1: Are there similarities or intersections between offering multimodal interaction (rooted in the normal operation of the application) and offering adaptable interfaces? Discuss strengths and weaknesses of each one from an engineering system point of view and quality of user experience*

# Next:

- Representation and characterisation of multimedia information
  - sound
  - visual signals
- The HAVS