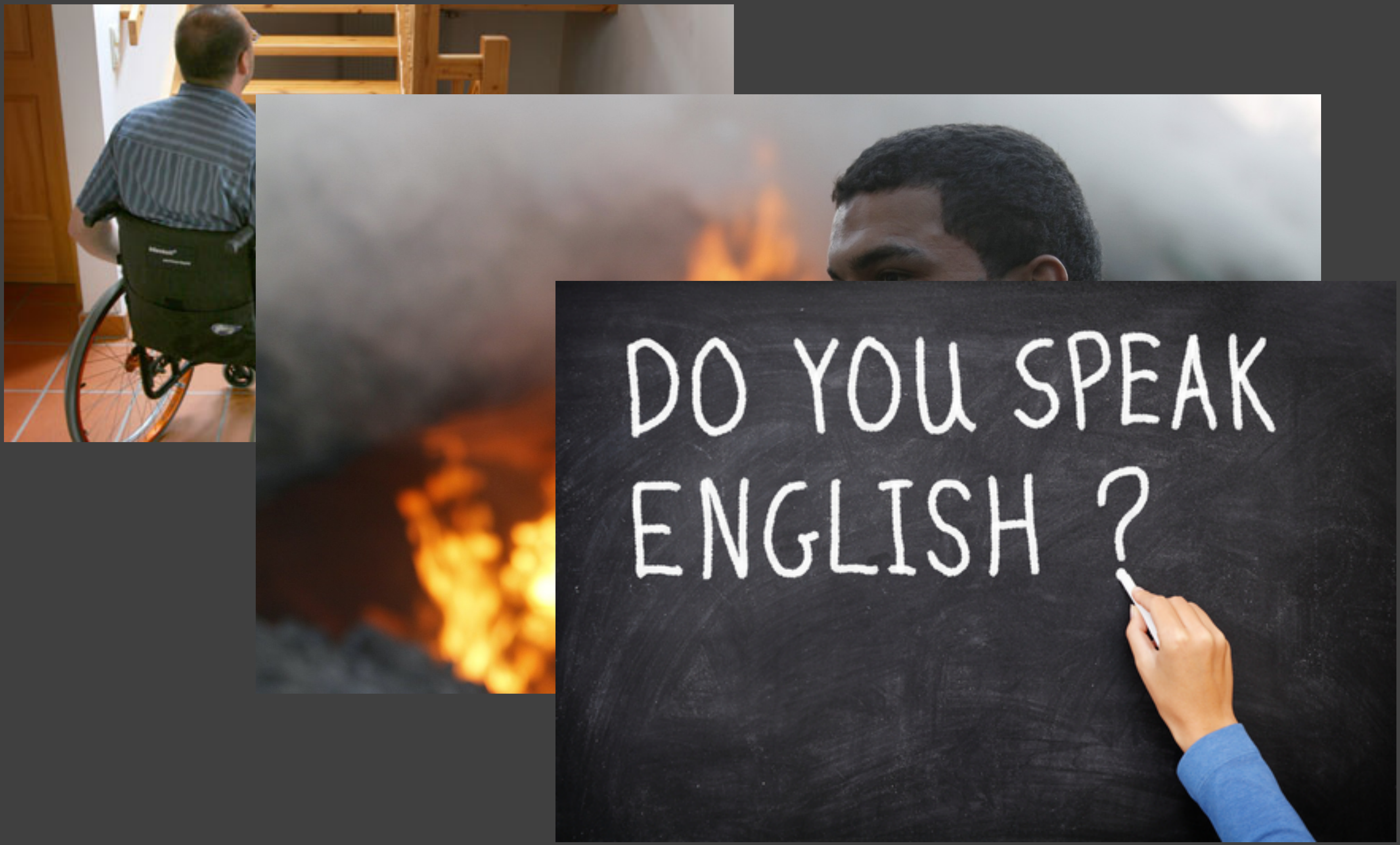
DESIGN 4 ALL

USER INTERFACE

COURSE 2020/2021

LABORATORIO DEI – DEPARTAMENTO DE INFORMÁTICA


DO YOU SPEAK
ENGLISH ?

Problem

- Interactive products aim at satisfying people with different characteristics, needs and requirements
  - Able-bodied and disabled people, people of all ages, people with different skills and levels of expertise, people from all over the world with different languages, cultures, education, etc.
- Interactive products can be used in different contexts
  - Communication, work and collaboration, health and well being, home control and automation, public services, learning and education, culture, travel, tourism and leisure, and many others.
- The UCD methodologies we have seen until now do not specify how designers can cope with these aspects (e.g. vulnerable groups)

How can we design systems for every user and for every context?

Adaptive Technology

Assistive or Adaptive Technology are products, devices or equipment that are used to maintain, increase or improve the functional capabilities of individuals with disabilities

- Screen readers, Braille displays for blind users, screen magnifiers for users with low vision, alternative input and output devices for motor impaired users

Adapted Keyboard

Footmouse

Universal Design

- Design products and environments that can be used by everyone, to the greatest extent possible, without the need of adaptation or specialized design.
- Improve the life of everyone by designing systems, products, communication channels and environments as close as possible to the needs of all user profiles with limited costs
  - Benefits people of all ages and abilities.

(Mace et al., 1991)

Accessible Home

Accessible Traffic Light

Seven Principles

1. Equitable use: The design is useful and marketable to people with diverse abilities
2. Flexibility in use: The design accommodates a wide range of individual preferences and abilities
3. Simple and intuitive: Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level
4. Perceptible information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities

www.ncsu.edu/ncsu/design/cud/about_ud/udprinciples.htm

Seven Principles

5. Tolerance for error: The design minimizes hazards and the adverse consequences of accidental or unintended actions
6. Low physical effort: The design can be used efficiently and comfortably and with a minimum of fatigue
7. Size and space for approach and use: Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility

www.ncsu.edu/ncsu/design/cud/about_ud/udprinciples.htm

Design 4 All in HCI

- Includes accessible design, inclusive design, barrier-free design, universal design, each highlighting different aspects of the same concept
- Applies principles and methods, and employ appropriate tools
- Develops IT&T products and services accessible and usable by all citizens
- Avoids the need for a posteriori adaptations, or specialized design
- Builds access features into a product starting from its conception, throughout the entire development life-cycle

(Stephanidis et al., 1998)

Design Qualities

Accessibility

- The interactive product has to take into account specific functional limitations and abilities, as well as other relevant contextual factors

Usability

- The interactive product has to fit individual users' needs and requirements in the particular context and situation of use

Accessibility is a fundamental prerequisite of usability

(Savidis & Stephanidis, 2004)

Dimensions of Diversity

User Diversity

Technological Diversity

User Diversity: Disability

Identification and study of target user groups as well as their requirements for interaction, appropriate modalities, interactive devices and techniques to address their needs

- Perception as visual and auditory impairments
- Motion as physical impairments
- Cognition as the ability of the human mind to process information, think, remember, reason, and make decisions

User Diversity: Age

A person perceives and processes information depending on the age

- Children
- Older users

Knowing the age of the target population of a technology product can provide clues about how to present information, feedback, video, audio, etc.

User Diversity: Expertise

The level of comfort and the ease of use of technology vary significantly depending on the skill levels of users

- Mix of users with a different technology skill level.
  - E.g. users unfamiliar with technology, like older users and those with minimal or no education, but required to use computing tools
- Accessible interface features
  - Help options, explanations to be expanded and viewed in more detail, use of labels and icons that are consistent and easy to understand

User Diversity: Culture

- Including details related to user culture makes the user experience with the system more inclusive and tolerant
- Language barriers
  - E.g. Applications in English could be difficult to use for people who do not speak or write the language.
- Customized systems depending on the markets in which they are sold
  - Language translations, changes to graphics, icons, content, etc.
- Differences in culture include interpretations of symbols, colors, gestures, etc.
  - E.g. there are differences in the use of colors (green is a sacred color in Islam, yellow in Buddhism)

User Diversity: Social

- Poverty, social status and limited educational opportunities create barriers to technology access
  - E.g. in many parts of the world, only certain segments of society have the opportunity to use technology and benefit from it.
- Studies have revealed that a certain level of technical education is required to receive optimal productivity from the use of technology
- Designing for technological literacy is a priority

Technological Diversity

- Situationally-induced impairments when using a system due to the context
  - E.g. a working environment, noise and visual distractions can interfere with the use of computer-based applications
  - Access to the World Wide Web could be limited by limitations of visual, motor, language, or cognitive abilities
  - The usage of mobile devices could be limited by the context
    - E.g. mobile phones are prohibited in some environments or there may not be network coverage.
- The user could be temporally disabled.
  - E.g. in dark or bright environments it may be hard to see the display or in a crowded place it may be difficult to carry on a voice conversation

Web Accessibility

- Ensure that people with disabilities can access, understand, navigate and interact with content available on the internet
- Ensure that people with disabilities can contribute by posting new content on the internet
- Not only people with disabilities, but also other vulnerable group as older people with changing abilities due to aging.

http://www.w3.org/WAI/intro/accessibility.php

Web Accessibility Guidelines

- Web Content Accessibility Guidelines (WCAG)
- Make Web content accessible
  - Text, images, forms, sounds, etc.
  - Web pages or Web applications
- General principles of accessible design with one or more checkpoints for their applications
- 3 levels of compliance as A, AA and AAA
  - Depending on applied guidelines and versions of HTML
- Drawn on extensive experience of domain experts and community feedback

http://www.w3.org/WAI/intro/wcag.php

Web Accessibility Guidelines

- WAI-ARIA Accessible Rich Internet Applications Suite
- Make dynamic content and advanced user interface controls accessible
  - E.g. Ajax, HTML, JavaScript, and related technologies
- Advanced web elements could affect the accessibility
  - E.g. a div element plus a background image provided by CSS and JS is used as a button - it can not be accessed by a keyboard

Example of application: http://hanshillen.github.io/jqtest/

http://www.w3.org/WAI/intro/aria

Web Accessibility Guidelines

Limitations arise in the application of guidelines

- Extensive training
- Time consuming

Semi-automatic tools for checking HTML documents

- TAW (Test Accessibility Web) http://tawdis.net/
- W3C HTML & CSS Validator http://validator.w3.org/

Web Accessibility in Mind

Web Accessibility in Mind (WEBAIM) http://webaim.org/

- http://webaim.org/intro/#experiences

Accessibility services for developing and evaluating accessible web pages

Design 4 All

- From “knowing the user” to “knowing the diversity of users”
- Which methods and techniques can be employed
    - E.g. the communication abilities is fundamental between users and stakeholders
- How such techniques could be revised to address diversity in design

Practical and organizational aspects of the involvement process play an important and critical role

	Disability				Age	
	Motion	Vision	Hearing	Cognitive / Communication	Children	Elderly
Direct observation	✓	✓	✓	✓	✓	✓
Survey and questionnaires	■	■	■	☒	■	■
Interviews	✓	✓	■	☒	■	■
Activity diaries and cultural probes	■	■	✓	■	■	✓
Group discussions	✓	✓	■	☒	■	■
Empathic modeling	✓	✓	✓	☒	☒	☒
Scenarios, storyboards and personas	✓	✓	✓	✓	✓	✓
Prototyping	✓	✓	✓	✓	✓	✓
User trials	■	■	■	■	■	■
Cooperative and participatory design	✓	✓	✓	■	■	■

✓ Appropriate ■ Needs modifications and adjustments ☒ Not recommended

Interaction Techniques

Speech

Haptics

Scanning-based interaction

Eye tracking

Gestures & head tracking

Brain Interfaces

Sign language

Multimodal interfaces

Speech

When user's hands are busy with another task and the traditional keyboard and mouse are inaccessible

- Children, elderly, visual and motor impaired

Speech output systems

- Speech is used for output and other modalities for input.
- E.g. screen access software

Speech recognition systems

- Speech is used for input and other modalities for output
- E.g. dictation systems

Spoken dialogue systems

- Speech is used for both input and output
- E.g. telephony systems

Speech

Example of speech-based interactions with a GUI for navigating, manipulating window and other command-based interactions

Limitations

- Recognition of errors
- Recovery process

Haptics

Cooperation between sensors in the skin and sensors in the muscles.

Functioning hands for exploration to collect information through active touch (haptics)

- Visual, hearing and motor impaired

Remote touching

- The experience of a distant object via some medium
- E.g. long cane, remote sensing

Reading texts

- Tactile equivalence of visual letters and other symbols
- E.g. braille displays

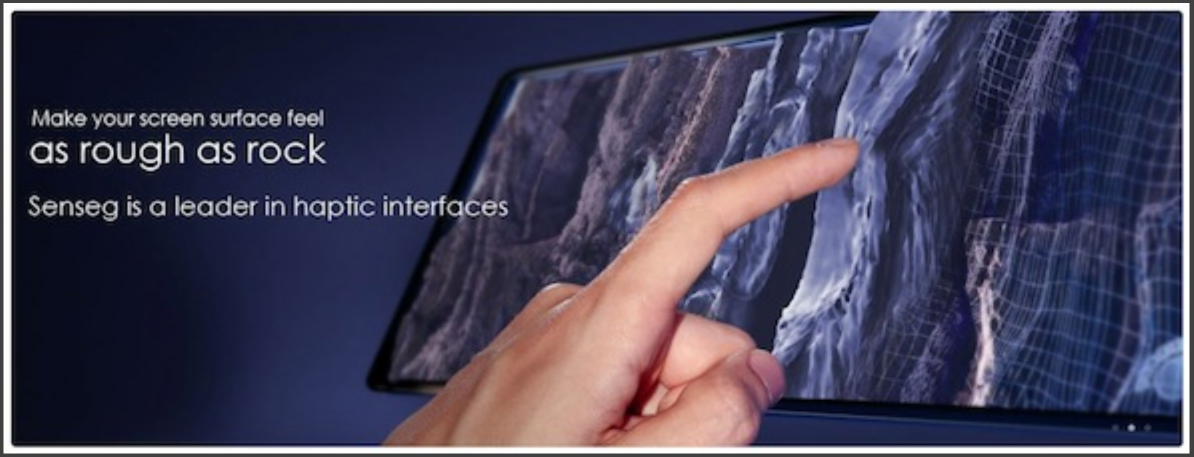
Haptic manipulation of virtual objects and scenes via a computer

- E.g. haptic displays

Haptics

Example of haptic display for making the screen surface feel as the visualized object

The vibration is the most common feedback that actual devices offer



Scanning Interaction

Interaction through switches

The focus marker scans the interface to highlight interactive objects sequentially

Switches can be activated by different modalities

- Hand, finger, foot, tongue, head, breath, eye, keyboard, mouse

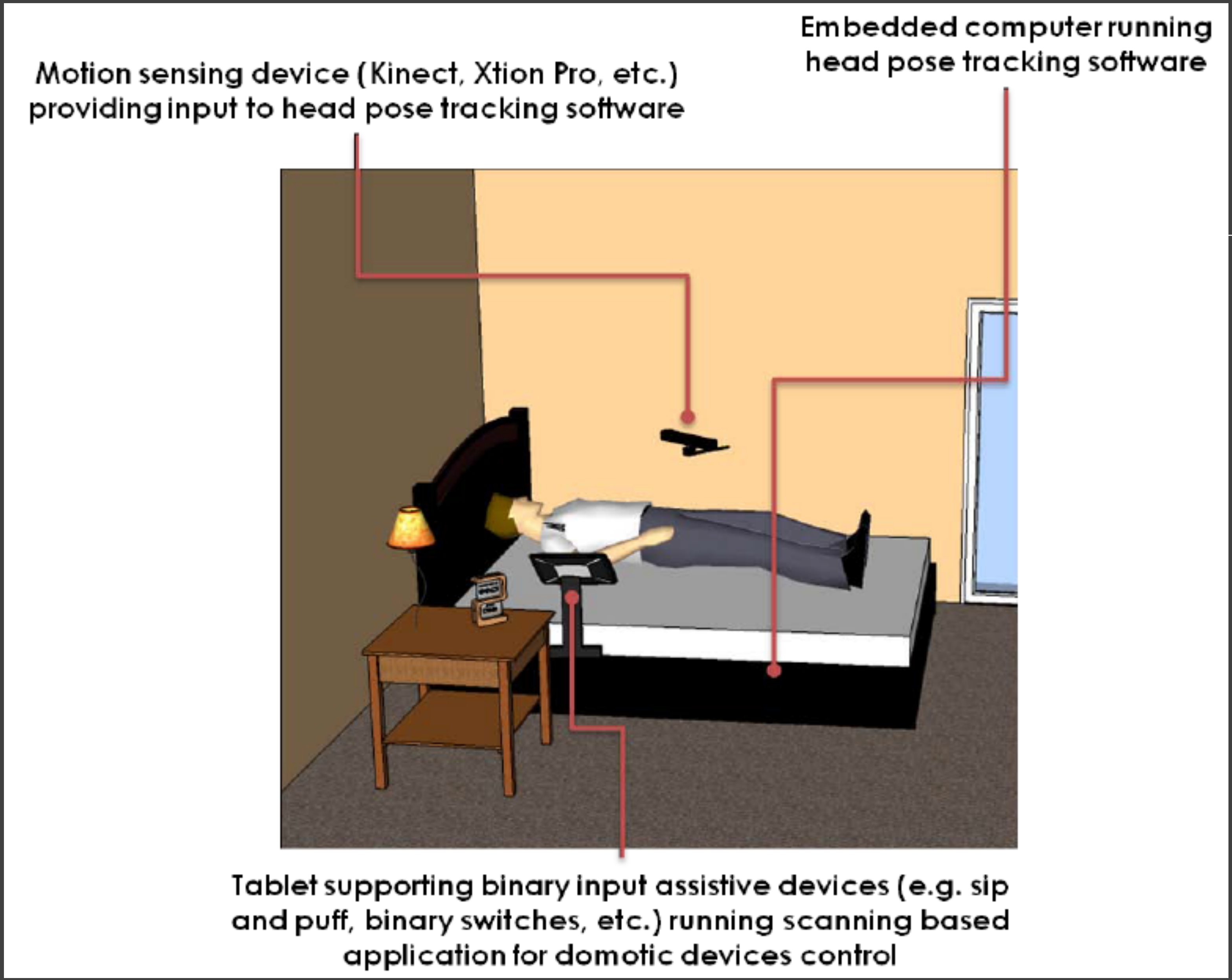
User with difficulties in using classical input devices, even temporarily

- Motor, speech and cognitive impaired

Applications with embedded scanning

Scanning tools for everyday computing tasks

- E.g. keyboard and mouse emulation


Motion sensing device (Kinect, Xtion Pro, etc.) providing input to head pose tracking software
Embedded computer running head pose tracking software
Tablet supporting binary input assistive devices (e.g. sip and puff, binary switches, etc.) running scanning based application for domotic devices control

Eye-tracking

Using gaze for communication

When the eye gaze is the only communication option available

- Motor Impaired

In gaze communication systems, users select items (e.g. letters) by looking at them

Problems related to involuntary or too fast eye movements

Using eye gaze to emulate the mouse and access to GUI

Other eye-controlled applications

- E.g. eye drawing, eye music, internet browsing, email, and games

Eye-tracking

- Using eye gaze for typing texts
- The user can not review what he is typing at the same time he is typing
- About 10 words per minute
- Performance and accuracy could be improved by appropriate feedback

Gesture & Head Tracking

Gestures as powerful feature of human expressions

Various approaches to gesture recognition

- Wearable devices, accelerometer-based tools, computer vision algorithms, gaming devices such as Microsoft Kinect.

User that can interact through gestures, even with limitations

- Motor, visual, hear and speech impaired, children, elderly
- E.g. home automation for impaired people

Not only hand, but also head and body gestures

- E.g. target selection applications and head-controlled switches

Gesture & Head Tracking

Head tracking using a stereo camera and a head-mounted tracking device

Used for emulating the mouse, controlling the cursor and selecting the task to execute both in desktop and interactive room environments

Brain Interfaces

Real-time communication system to send messages using bio-signals from the brain

User with parts of his brain active but without any other means of communication

- Motor and speech impaired

Two types

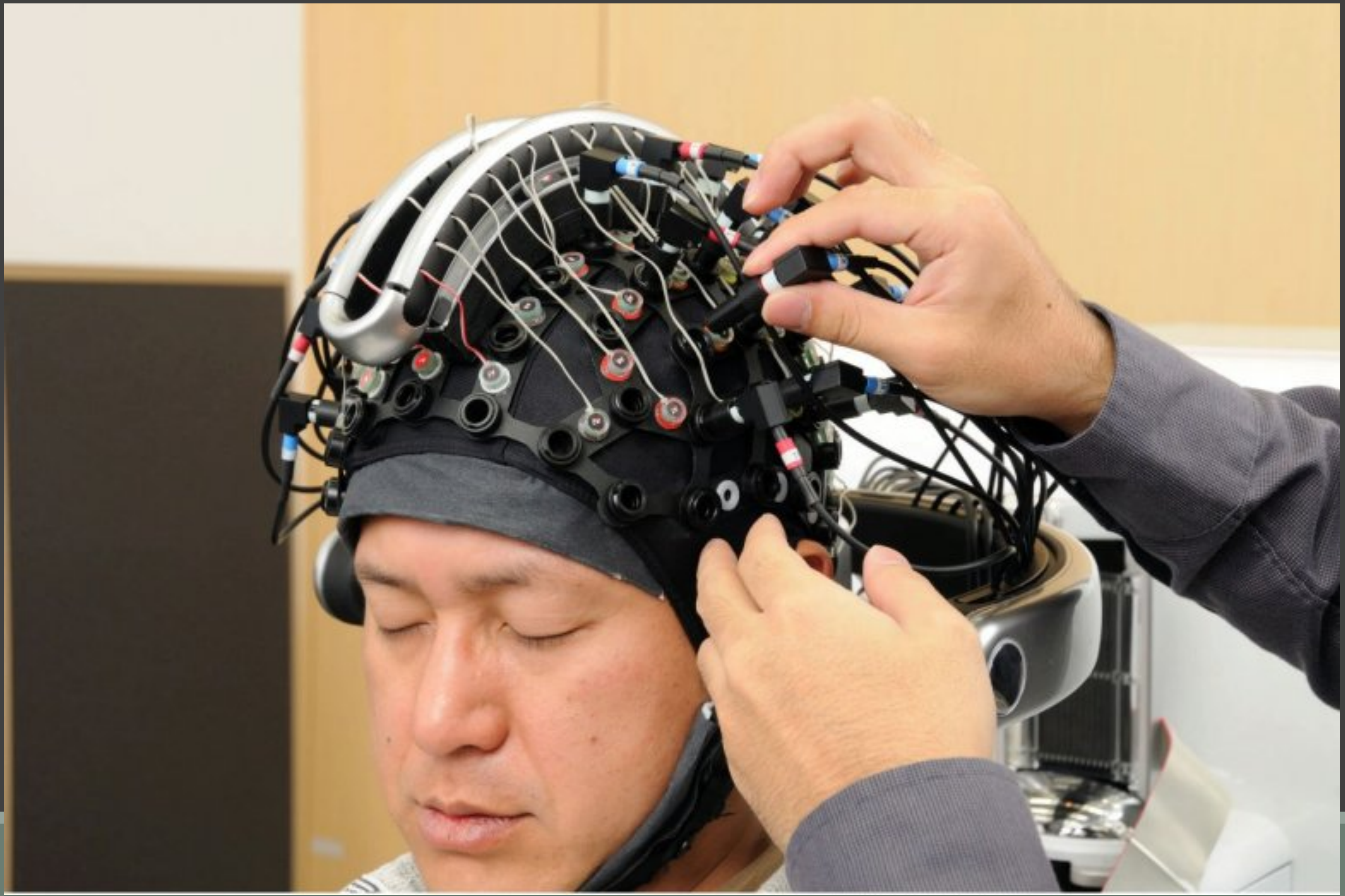
- Invasive: probes are inserted inside the brain
- Non-invasive: electrodes are placed externally on part of the body

Bio potentials are electrical signals obtained from the body

Each bio-potential has its own unique characteristics

- Amplitude, frequency, method of extraction, and time of occurrence

Brain Interfaces



Sign Language

User that for certain circumstances uses a sign language for communicating

- Hearing impaired

Machine translation system from English text into ASL (American Sign Language) animations instead of presenting written text

Input commands to a computing system using ASL and consequently output feedback into English text, speech or even ASL

- Today, recognition systems are in early stages of development.

Applications for displaying videos of humans performing sign language

- For making audio and speech materials accessible to signers
- For teaching reading and writing

Sign Language

Animations of a 3D human-like character that moves to perform a sign language message

Put together individual signs and a smooth-looking sign language into a sentence

Build a human model which is articulated and responsive enough to perform sign languages

Users successfully interpret the movements of the avatar to understand its meaning.

Multimodal Interfaces

Process of two or more input modes

- E.g. speech, pen, touch, manual gestures, gaze, head and body movement

Multi-sensory – multiple sensory modalities

Multi-channel – multiple channels on the same or different modalities

Multi-tasking – several tasks at the same time

Multi-form – same tasks in alternative ways

Covering limitations of other techniques, addressing different channels or presenting information in different contexts

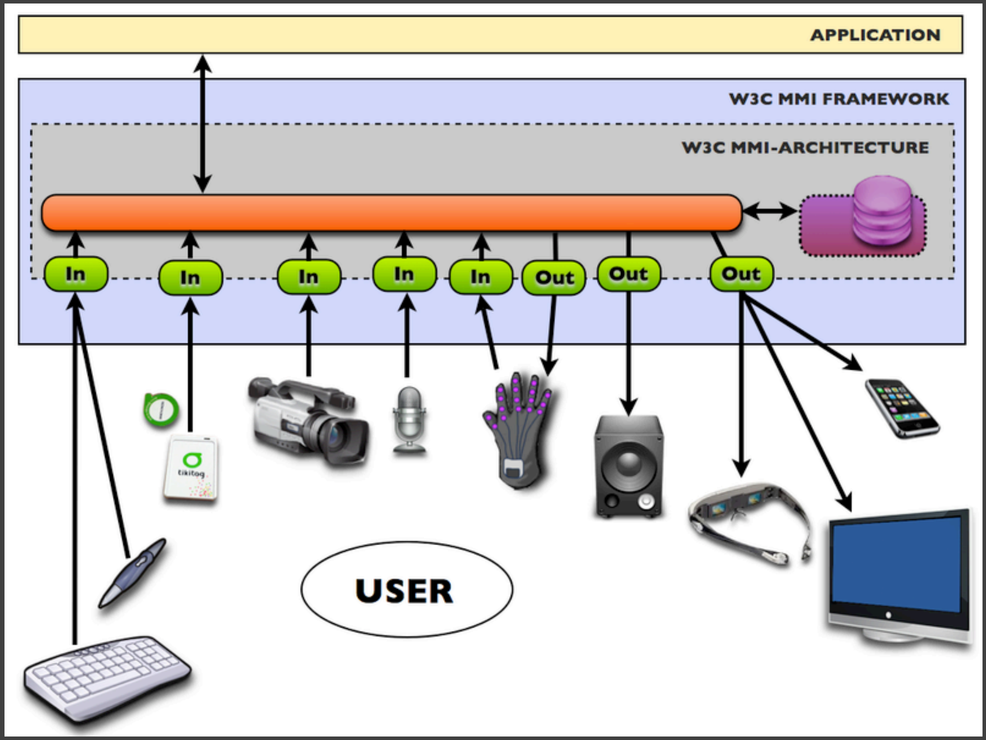
Multimodal Interfaces

Multimodal Architecture and Interfaces Recommendation

Includes a structure and a communication protocol

Facilitates integration and interaction among different multimodal input and output

Defined as an open standard by the World Wide Web Consortium in 2005



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