Brain Computer Interfaces / Human Computer Interaction

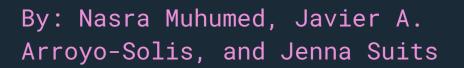


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- Human-Computer Interaction(HCI) is the study of the interaction between people(users) and computers
- HCI tries to provide us with an understanding of the computer and the person using it, to make the interaction between them more effective and enjoyable

HCI tackles questions like

- How can computers be made more accessible to everybody?
- To what level can computer interaction be standardized?
- Are computers "user-friendly"?



Key Components of HCI

Fundamentally, HCI is made up of four key components

1. The user

The user component refers to the person or group that are using the computer.

2. The goal oriented task

A user operates a computer system with an objective or goal in mind. The computer provides a digital representation of objects to accomplish this goal.

3. The interface

The interface is a crucial HCI component that can enhance the overall **user interaction experience**. Various interface-related aspects must be considered, such as interaction type (touch, click, gesture, or voice), screen resolution, display size, or even color contrast.

4. The context

HCI is not only about providing better communication between users and computers but also about factoring in the context and environment in which the system is accessed.

Why HCI?

Enable Frequent Users to Use Shortcuts

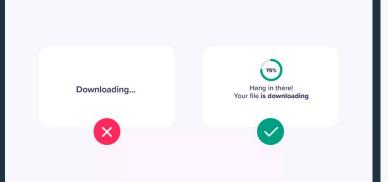
Shortcuts

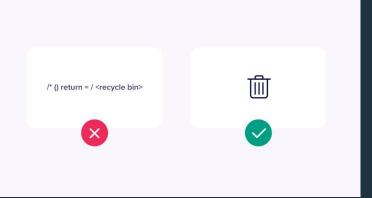
Offer informative feedback

Design Dialog to Yield Closure

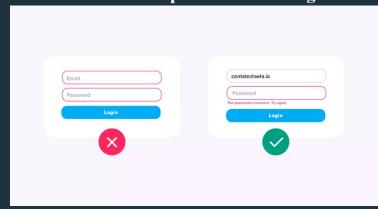
Gmail Keyboard Shortcuts

Shift + U Mark current messages as unread
C Write new mail
F Forward mail
R Reply
A Reply to all
/ Search messages

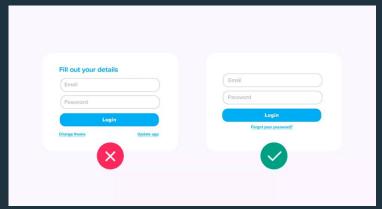




Offer simple error handling



Control focus





HCI Emergence (1980s):

As a means of examining how and why computers might be made more user-friendly, HCI emerged in the early 1980s.

HCI has expanded rapidly and steadily for three decades, creating 3 different waves

1980, the first wave: GUI and Mental Models

• In 1981, IBM launched its first personal computer, the IBM PC.

• In 1983, Apple revolutionized the market by releasing The Lisa, the first commercial computer with a graphical user interface (GUI)

• One year later, apple releases Macintosh





IMB PC



Macintosh

1990, the second wave: internet and communication

- In this decade, emails became popular, turning computers into communication tools.
- In the 1990s, another major milestone occurred with the founding of Google in 1998 by Larry Page and Sergey Brin. This company, initially small, would revolutionize content creation and access forever.
- Larry and Sergey, who studied at Stanford University, did research that led to the search algorithm. Their academic articles, like "The Anatomy of the Large-Scale Hypertextual Web Search Engine," were crucial for improving search technology.

2000, the third wave: devices and social impact

- The third wave brings the continuing diversification of computing devices.
- During this wave, the field of Human-Computer Interaction increasingly draws on philosophy and ethics to provide rhetoric about the consequences of technology on habit formation.
- A more holistic approach to design also appears, emphasizing complex interactions between people, spaces, and technologies.

3 HCl's Subfields

HCI is a broad field which overlaps with areas such as user-centered design (UCD), user interface (UI) design and many more.

HCI's Subfields

User-Centered Design (UCD)

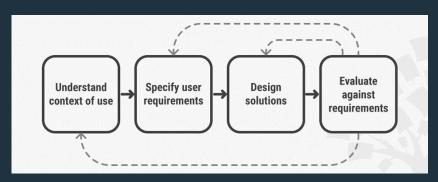
An iterative design process in which designers focus on the users and their needs in each phase of the design process.

User Interface (UI) Design

The process designers use to build interfaces in software or computerized devices, focusing on looks or style.

User Experience (UX) Design

The process of creating products or services that provide meaningful experiences for users.

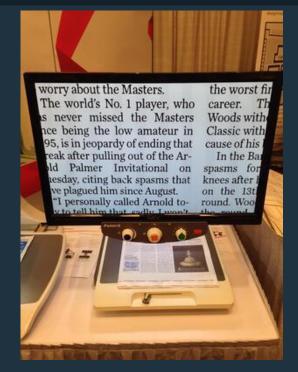




More HCI's Subfields

Accessibility and Assistive Technology

Tools or technology that are made to help individuals with disabilities to perform everyday task. Examples include screen readers, speech input software, and motion tracking or eye tracking



Human Factors and Ergonomics

The scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance



All of these subfields involve two constants, the user who communicates data/inputs and the computer system or device that takes it and translates it into something that the same user can interact with.

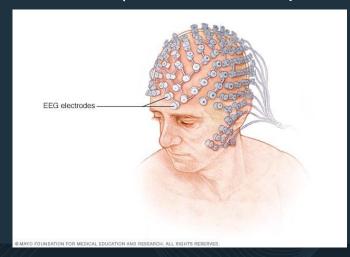
Brain-Computer Interfaces and Ethical Concerns

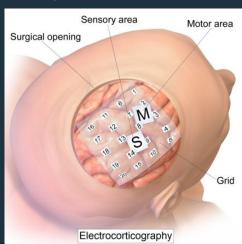
What is Brain-Computer Interfaces (BCI)

Brain-Computer Interfaces or BCI are computer-based systems that acquire brain signals, analyze them, and translate them into commands that are relayed to an output device to carry out a desired action.

Non-Invasive (Electroencephalogram)

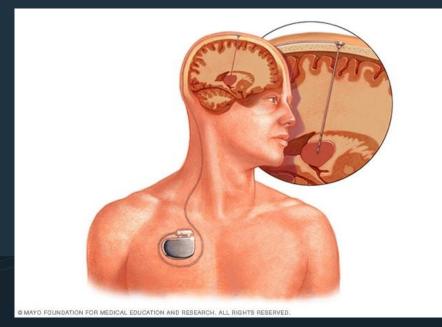
Invasive (Electrocorticography)





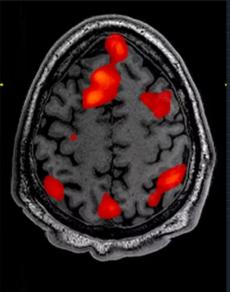
Write-In and Read-Out BCI

Write-In BCI: BCI that send signals to stimulate or inhibit specific brain activity. Example of this is Deep Brain Stimulation (DBS).



Read-In BCI: BCI that receive and record brain signals to assess and analyze it. Example of this is Functional Magnetic Resonance Imaging (fMRI).





Ethical Concerns



Some Ethical Concerns include:

- Safety/Surgical Complications
- Security/Protection
- Identity
- Responsibility
- Autonomy and agency

5 Technologies Derived From Brain Computer Interface (HCI)

HCI Technologies



- Detects where the eye is and where user is looking
- Gaze point
- Able to scroll just by rolling their eyes

Speech Recognition

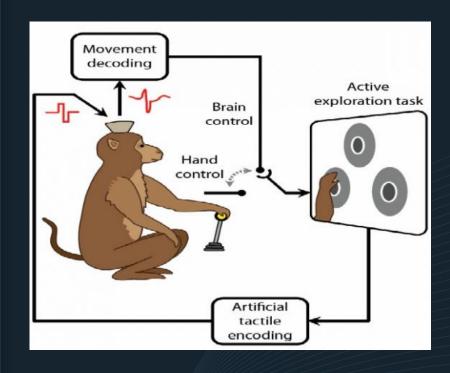
- Interprets the language
- Finds the meaning
- Performs the task for the user
- Siri / Alexa / Cortana

AR/VR

- Immersive
 technologies
 allowing users
 to interact
 with a digital
 world
- Future AR/VR are looking to use BCI

Brain Computer Interfaces Technology: 1970-80

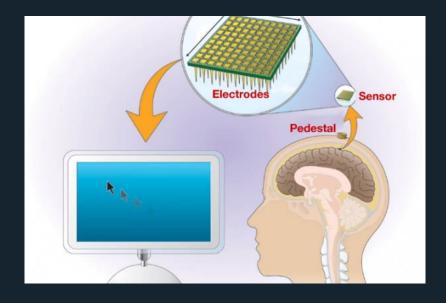
- BCI came from neurophysiologists studying motor systems in the 1970's
- Fet's tested on monkeys to discover how neurons are fired in the brain and how we can read them to understand what the user wants.
- Georgopoulos in 1980's developed population vector method which predicted arm movement direction from neurons firing in the motor cortex



Now able to not just read brain signals but are able to send them as well

Brain Computer Interfaces Technology: BrainGate

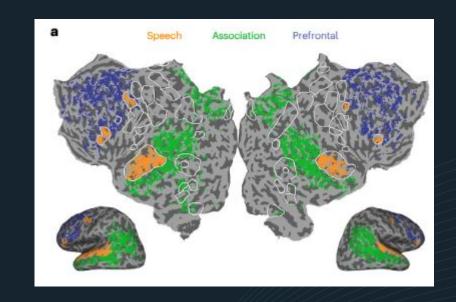
- BrainGate is a BCI that allows the restoration of communication to loss of mobility of limbs.
- 2008 patients were able to control a cursor on a computer
- Uses array of micro-electrodes implanted into the brain (which reads neuron signals that are trying to move a limb), and is decoded by a computer in real time to operate an external device.
- The latest 2021 allows brain to text, where a patient who is paralysed attempts to write and the BCI attempts to decode the attempted handwriting by the patient.



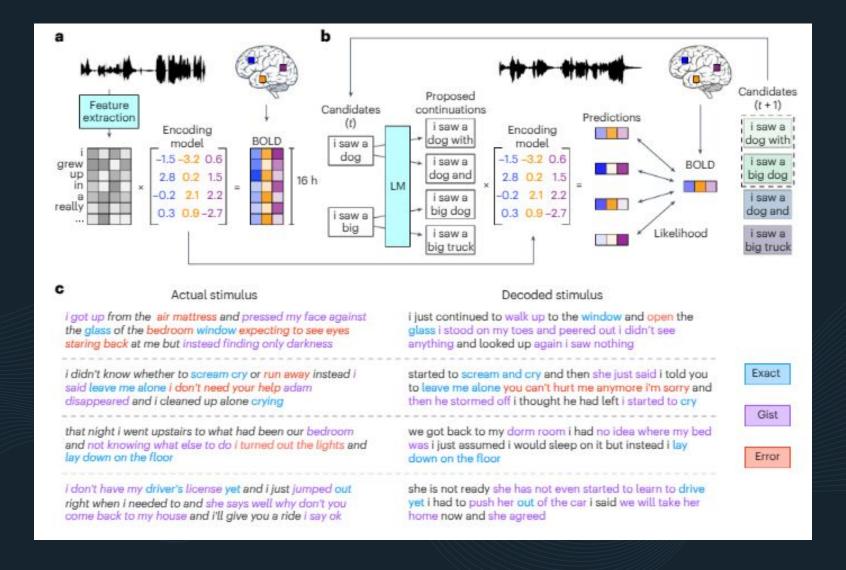


Brain Computer Interfaces Technology: fMRI

- Non-Invasive BCI that decodes language from the patient using recordings from a fMRI.
- The decoder reconstructs the language from the fMRI readings. The decoder generates intelligible word sequences that give the perceived sentence wanted by the patient.
- Can read imagined speech and even silent videos.



fMRI



Brain Computer Interfaces Technology: Neuralink

- January: Elon Musk implanted its BCI named "Telepathy"
- Uses brain signals to move limbs
- Elon Musk says his goal is "a full brain-machine interface where we can achieve a sort of symbiosis with AI"
- First year of 6 and is where most experiments have stopped. Patient is able to move cursor and click with just his mind. The patient is able to play chess.







6 Conclusion

Conclusion



HCI

- Human-Computer Interaction(HCI) is the study of the interaction between people(users) and computers
- AR/VR, Speech recognition, eye tracking

BCI

- Brain-Computer Interfaces or BCI are computer-based systems that acquires brain signals, analyzes them, and translates them into commands that are relayed to an output device to carry out a desired action.
- BrainGate, fMRI, Neuralink

Where we are headed

- Elon Musk wants symbiosis with AI
- VR and BCI are going to be working together.
- Possible instant translations of different languages in real time

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Questions?