CMPT 263: Human-Centered Computing

Summer 2026

Week 2: Computer – Interface Types

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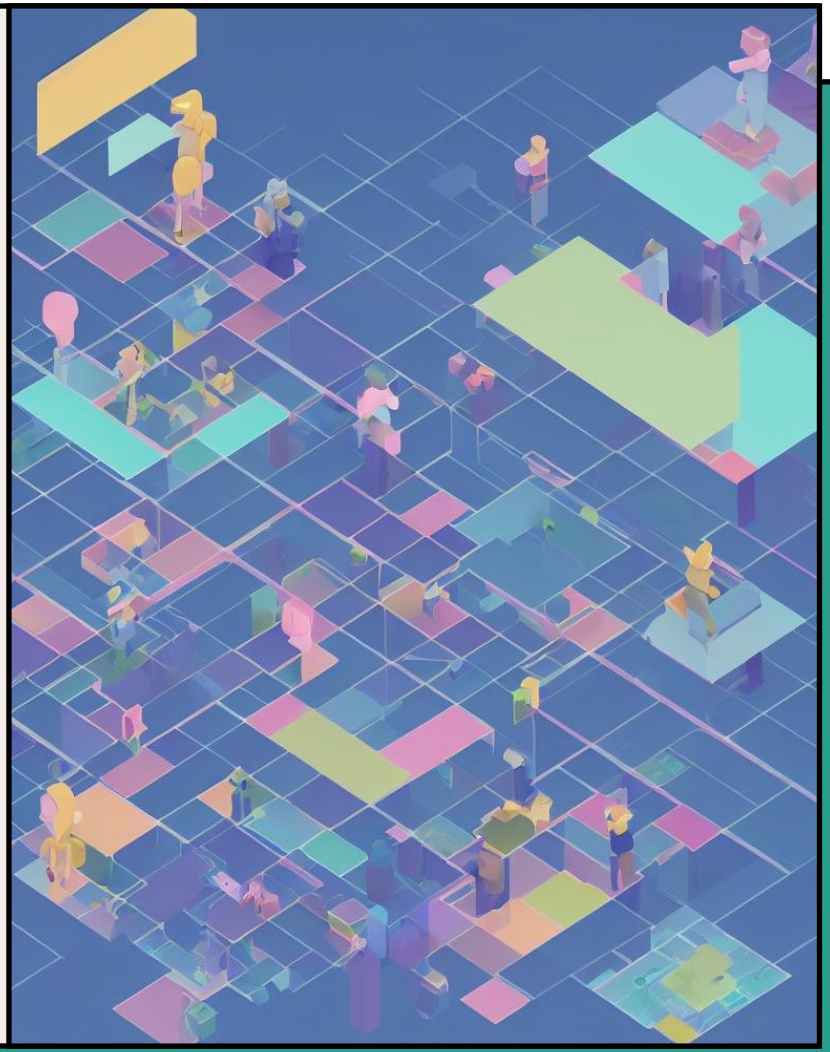


Image generated from deepai.org with prompt: human-centered computing

Recap from Last Lecture

- **Cognition** – understanding them help designing our interfaces to support human use
  - By amount of mental effort, by processes, by including external players & artifacts
  - Different design principles/guidelines to help mental processes
- **Mental Models** –human learn & make sense of things by forming mental models
  - To help them understand and make predictions
  - Related by metaphors, and good ones need to be established
- **Action Cycle** – human do things by moving between goals and world (the computer)
  - Two pathways (execution & evaluation)
  - Can further be broken down into steps where good designs can help (and bad designs can hinder)

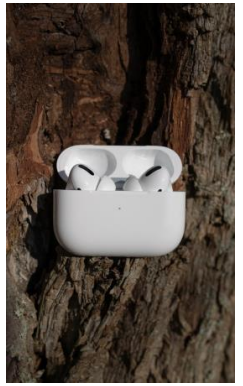
Today

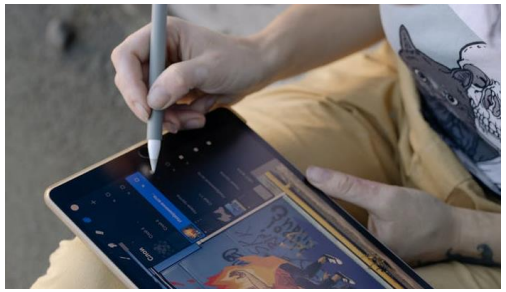
- Different (computer) user interface types
  - Brief history + survey
  - Characteristics, examples, benefits/drawbacks
- Future opportunities

(Computer) User Interfaces

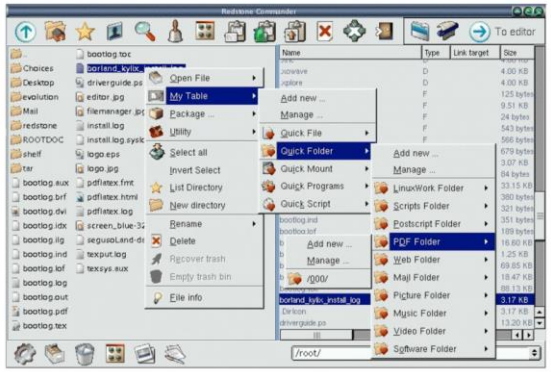
- They control the way data & instructions are entered (input) from the user into the computer, and how the computer presents information from itself to user (output)
  - Sometimes inputs are not user-initiated (e.g., continue sensing, background processes)
  - Sometimes outputs are unpromoted (e.g., notifications, ambient displays)



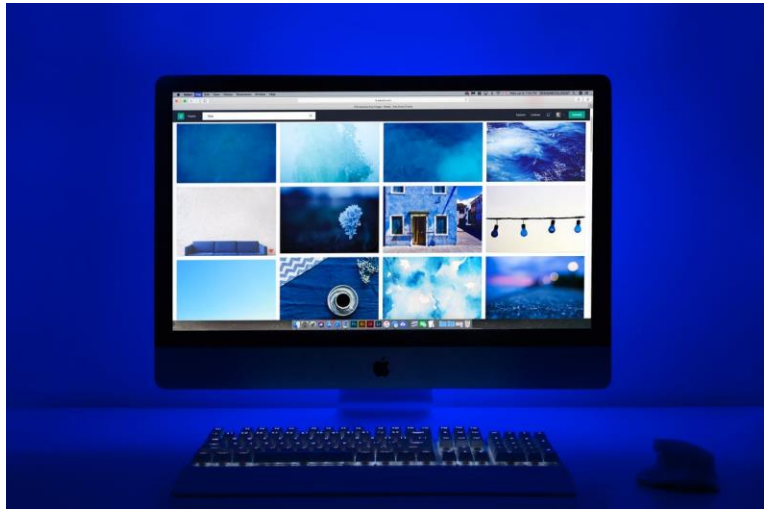





Most Common Ones Are Screen-Based



Beyond Desktop Computers



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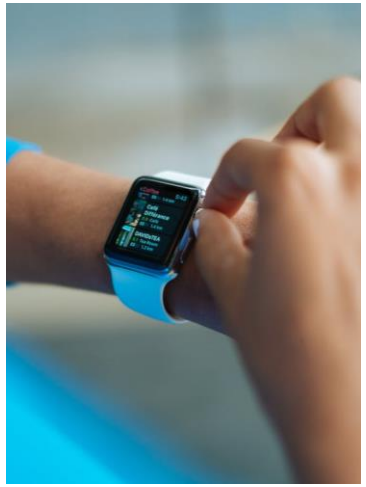
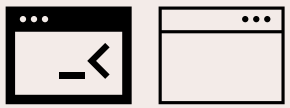


Interface Types by Decades

1980's

- Command line
- WIMP/GUI

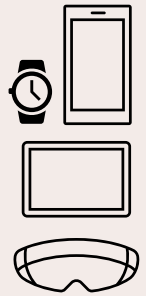


1990's

- GUI with advanced graphics (multimedia, VR, infoVis)
- Web
- Speech/voice
- Stylus, gesture, touch
- Embedded (appliances)

2000's

- Mobile
- Multimodal
- Shareable
- Tangible
- AR, VR, MR, XR
- Wearable
- Robotic
- Brain/Neural

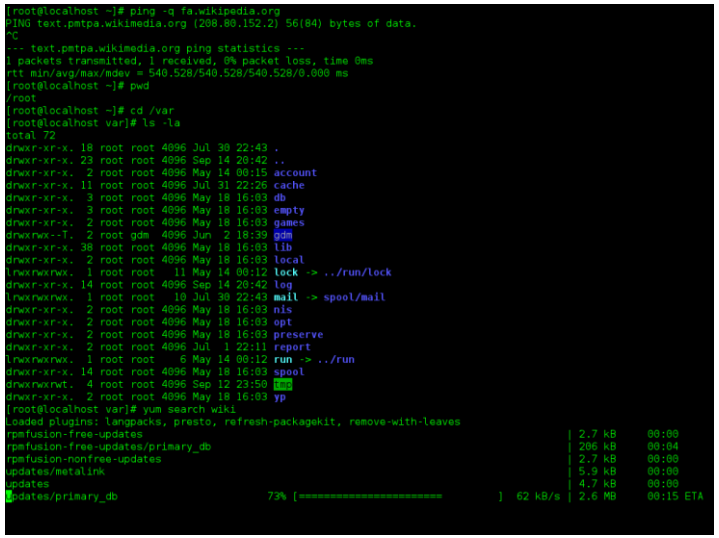


Adapted from slides by Stacey Scott and also from materials in ID-Book Ch 7.

Command Line Interfaces (CLIs)

- Text-based, available since 1960's, still in use these days (usually for admin/maintenance)
- Input: keyboard with commands (e.g., ls, dir, copy, move), shortcuts (e.g., Ctrl_Alt+Del), or function keys
- Output: screen display (usually with a small set of colours)

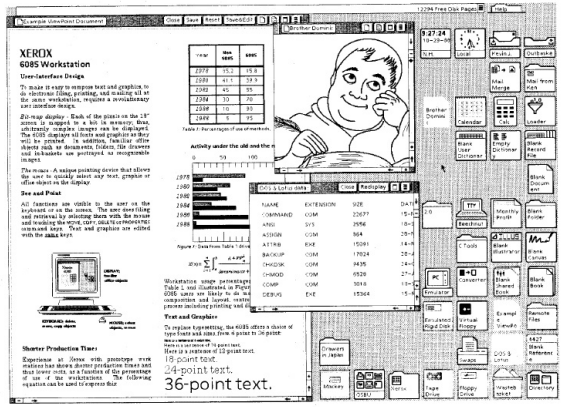
- Benefits: fast, precise, require less resources
  (case-in-point: MS-DOS uses 512KB Ram & 6 MB HDD)
- Drawbacks: hard to learn, hard to recall, look intimidating



By ZxxZxxZ - Own work, GPL, https://commons.wikimedia.org/w/index.php?curid=16485488

WIMP/GUIs

- Windows, Icons, Menus, Pointing Device, available in 1980's
  - Windows: hold content, can be scrolled, stretched, closed, move around, overlapped, and placed next to each other
  - Icons: graphical representations of applications, objects, commands, and tools
  - Menus: graphical representations of available options/commands
  - Pointing device: allows user to physically control a cursor as point of entry
- Input: the pointing device (in theory) and keyboard (in practice)
- Output: graphical displays using WIMs



- Benefits: easy to learn, easy to remember, metaphorical
- Drawbacks: slower, content occupies more space, require pointing precision

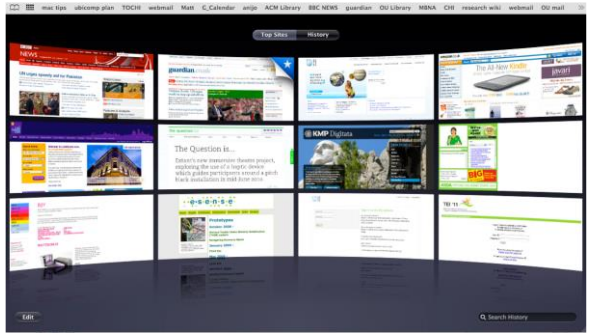
Modern GUIs

- Same basic building blocks as WIMPs
  - With more varieties to the components, including colour, sound, animation, contextual menus, …etc.
  - With new graphical elements, including toolbars, docks, rollovers, tooltips, …etc.
- Combined with touchscreens and other devices, allowing gestures (e.g., multi-touch, swipes, touch & hold, …etc.)

Source: https://support.microsoft.com/en-gb/help/17161/windows-10-find-all-your-apps-and-programs

Notes on Windows

- Windows in WIMPs were invented to **overcome physical constraints** of a computer display by enabling more information to be viewed and tasks to be performed, e.g.:
  - Scrollbars allow viewing of documents larger than the window viewport
  - Resizable windows accommodate content of different dimensions
  - Movable windows facilitate comparison between multiple content
- But having too many windows can make things difficult
  - Many UI designs include layout techniques to help with that



Top image: OSX's Exposé
Bottom image: panorama view in browser

Mobile

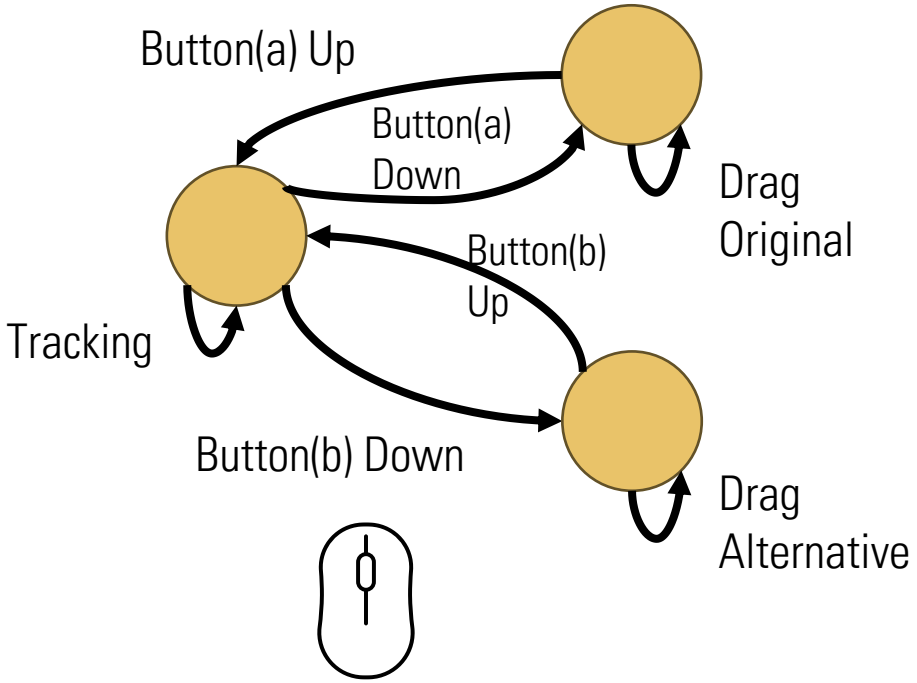
- Pervasive and come in many forms with multiple ways to interact
- Input: touch, movements, voice, proximity, gestures, …etc.
- Output: screen displays, audio, haptics, …etc.

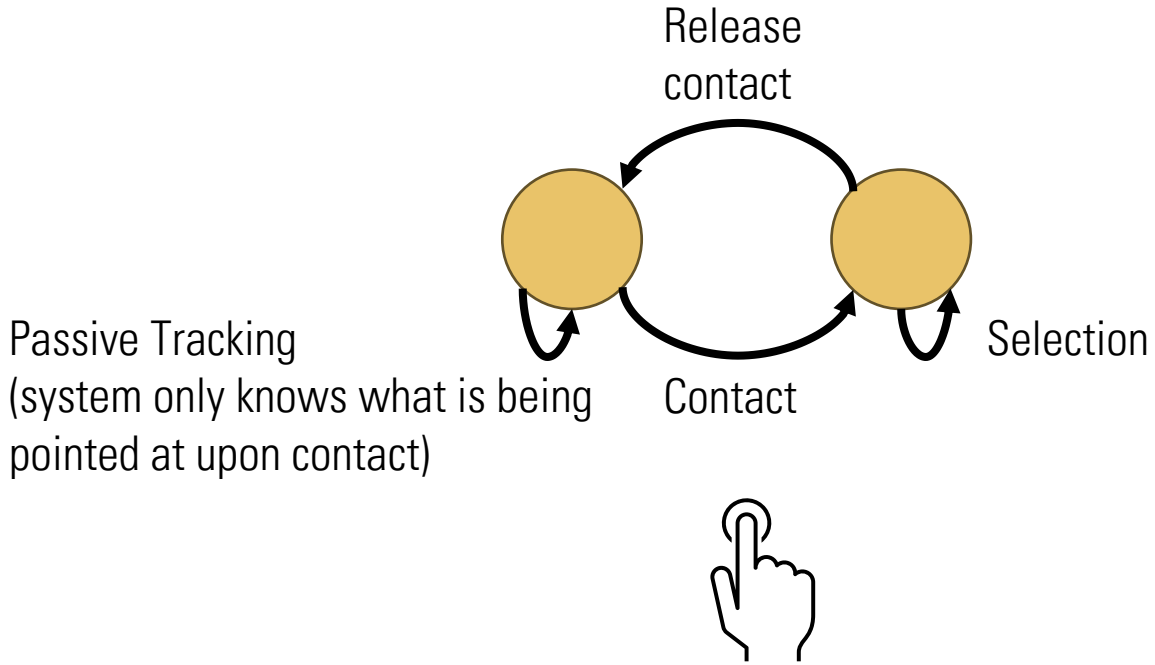
- Benefits: opportunities for direct and engaging interactions (e.g., tilting for driving gams)
- Drawbacks: typically small screens with limited control space (e.g., fat finger problem) or control issues (e.g., require fine motor skills)

- Fun read: Sensors in your smartphone https://gizmodo.com/all-the-sensors-in-your-smartphone-and-how-they-work-1797121002

Think about This

- Touchscreens do not have “hover” and “right-click”, how do we enable that?

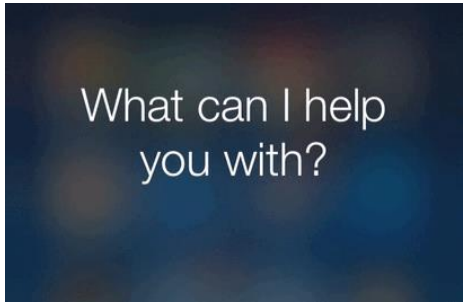




Ref: Buxton, W. (1990). A Three-State Model of Graphical Input. In D. Diaper et al. (Eds), Human-Computer Interaction - INTERACT '90. Amsterdam: Elsevier Science Publishers B.V. (North-Holland), 449-456.

Speech/Voice

- Started with single-word simple commands (e.g., in game consoles), now speech-to-text and conversation-based (e.g., AI assistants)
- Input: voice (with a "trigger phrase")
- Output: voice and sometimes visuals



- Benefits: hands-free, better accessibility, can be more natural
- Drawbacks: susceptible to ambient noise & tone variation, privacy concerns (others can hear what you say, most voice assistances collect voice data to train language models and improve accuracy)

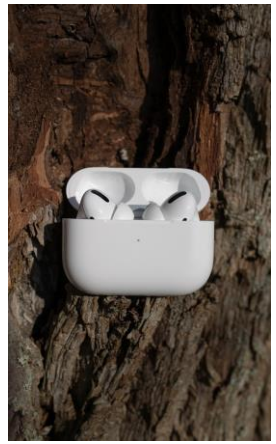
Google Assistant

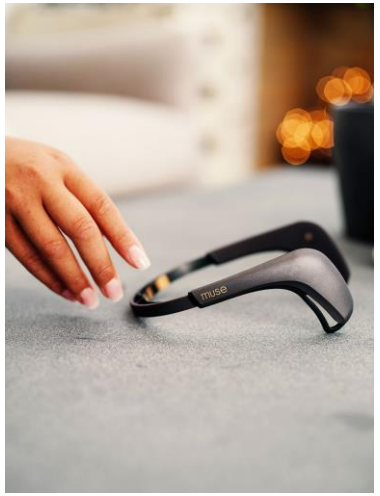
Left: https://www.cultofmac.com/296755/set-up-iphone-6/
Bottom: https://medium.com/orbismobile/my-experience-with-google-assistant-codelabs-and-why-you-should-also-take-them-right-now-8e7a77719d2c

Wearable

- On-body, often screen-less (or with tiny screens)
- Input: motion, biometric sensing, touch/tap, …etc.
- Output: audio, haptics, screen displays (if available), …etc.

- Benefits: always-on/available (particularly useful for continuity)
- Drawbacks: limited interactivity (due to size, output availability, power), privacy concerns





https://choosemuse.com/muse-2/

The Story of Google Glass

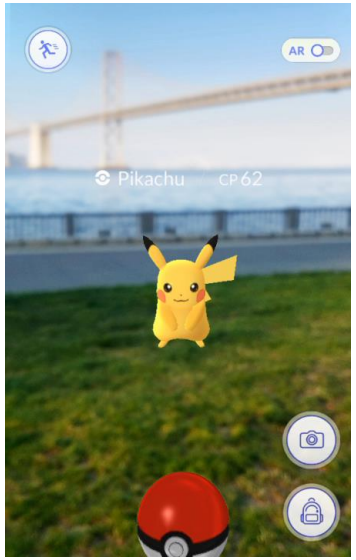
- Released in 2013, discounted in 2015
  - Pivoted to "Enterprise Edition" in 2017, discounted again in 2023
  - Making way to XR smart glasses
- Many reasons for its failure in gaining mainstream popularity
  - Market misalignment (targeted as fashionable & luxury item)
  - Hard to get, lack support, limited in functionality & applications
  - Safety, privacy, and social concerns ("glassholes")
- Lesson: wearables are particularly tricky because of both hardware challenges and societal acceptance

Top: By Dan Leveille (danlev on Wikimedia) - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=33220901
Bottom: https://www.pcmag.com/news/google-glass-everything-you-need-to-know

AR & VR

- An overlay that either augments (AR) or replace (VR) the view of the world
  - Mostly for educational/instructional and entertainment purposes
- Input: movements/gestures, hand-held controllers
- Output: screen (for viewing), sound, haptics (more recent)

- Benefits: immersive experience
- Drawbacks: prone to out of sync issues, VR motion sickness



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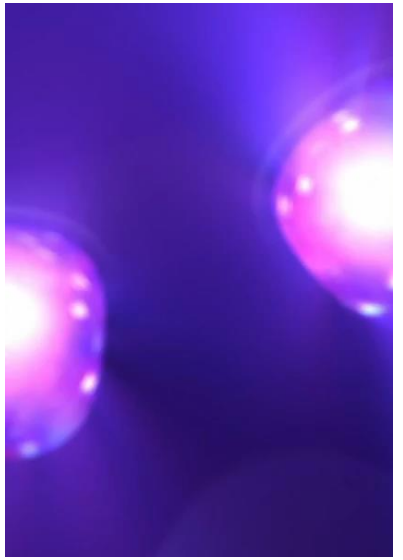


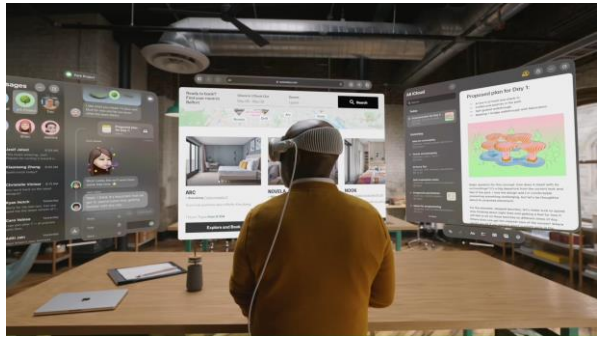
https://www.oculus.com/

MR & XR

- Mixed Reality (MR) enables interactive experiences with both virtual objects and physical environments

https://www.youtube.com/watch?v=_xpl0JosYUk

Microsoft Hololens



Apple Vision Pro

- Extended Reality (XR) is an umbrella term for AR, VR, and MR

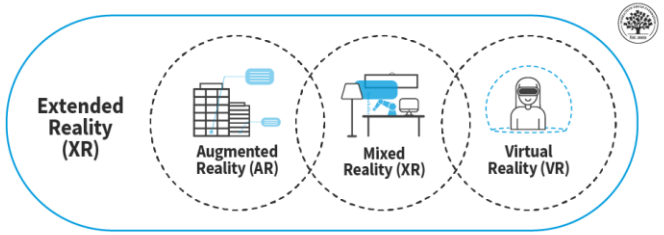
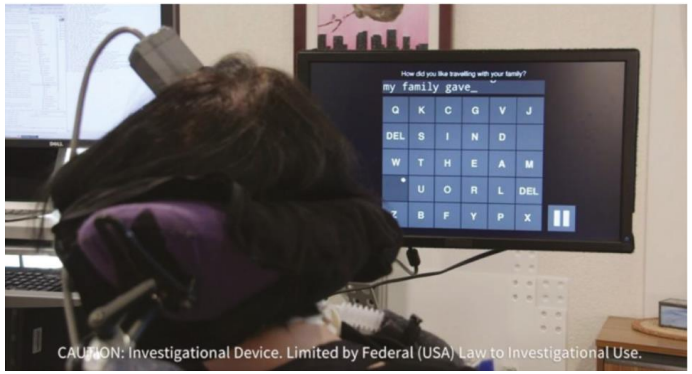


Image from https://www.interaction-design.org/literature/article/beyond-ar-vs-vr-what-is-the-difference-between-ar-vs-mr-vs-vr-vs-xr

What's in The Future?

- AI-assisted interfaces
- Interfaces on organic materials (e.g., bendable, fabric)
- More pervasive (e.g., embedded)
- Directly with brains (BUI)

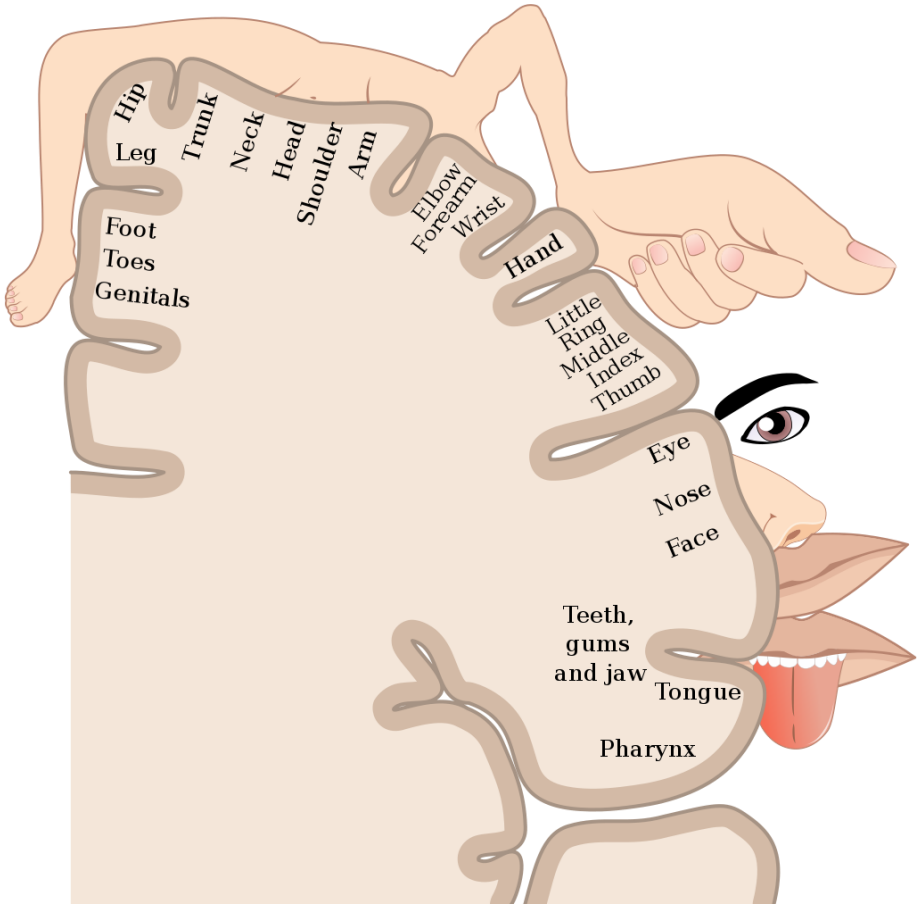


From ID-Book p251. Original source: Brown University

https://www.motorola.ca/smartphones-razr/p

The Cortical Homunculus

- A distorted representation of the human body based on a neurological "map" of the areas and proportions of the human brain dedicated to processing motor functions, or sensory functions, for different parts of the body – Wikipedia
- Shows opportunities on how we can design interfaces that best cater the capability of different parts of our body



Post-Lecture Activities

- Read the materials listed on CourSys for Week 2
  - Chapter 7 of ID-Book
  - Chapter 13: Fat Fingers in Brave NUI World book by Daniel Wigdor & Dennis Wixon
    https://sfu-primo.hosted.exlibrisgroup.com/permalink/f/15tu09f/01SFUL_ALMA51189009040003611

- Do the **Self-Test** of the week (when available)

- Look at your mobile devices and think about this:
  - What kind of input/output do they have? Which of them do you use the most?
  - What's the most fun/frustrating use of use of those input/output?
    Can you relate those with the cognitive process we discussed previously?