[CLASS 01]

Introduction to HCI

HCI Elements

There are three parts of HCI. Those are Human, Computer, and Interaction. Let's see the details one by one.

HCI Elements: (1) Human

Human is one of the most important parts in HCI.

Why? Simply, that's because computers are developed to provide services to humans for convenience and satisfaction.

Among the series of Prof. Lee's courses, the "Human" part is covered in the "Human Factors and Ergonomics" (SIT22008). Here in the HCI course, I don't give details about H.

physical, cognitive, emotional being

Human Factors and Ergonomics (HF/E)

To get knowledge about human, please refer to Prof. Lee's HF/E course materials provided through Google Drive and https://handonghci.github.io/Courses/ sites.

Human Factors and Ergonomics (SIT22008)

- Syllabus
- 1. Introduction to HF/E
- 2-1. Physical Ergonomics I: Biomechanics
- 2-2. Physical Ergonomics II: Anthropometry, ergonomics at workplace, virtual ergonomics
- 3-1. Cognitive Ergonomics I: Information Processing Model
- 3-2. Cognitive Ergonomics II: Fight or flight response, human error, cognitive training
- 4-1. Emotional Ergonomics I: Emotional Design
- 4-2. Emotional Ergonomics II: Emotional Engineering, Measurement of Human Emotion
- 5-1. Usability Engineering I: User-Centered Design Principles
- 5-2. Usability Engineering II: Usability Evaluation, Build-Measure-Learn
- Assignments

Review of HF/E

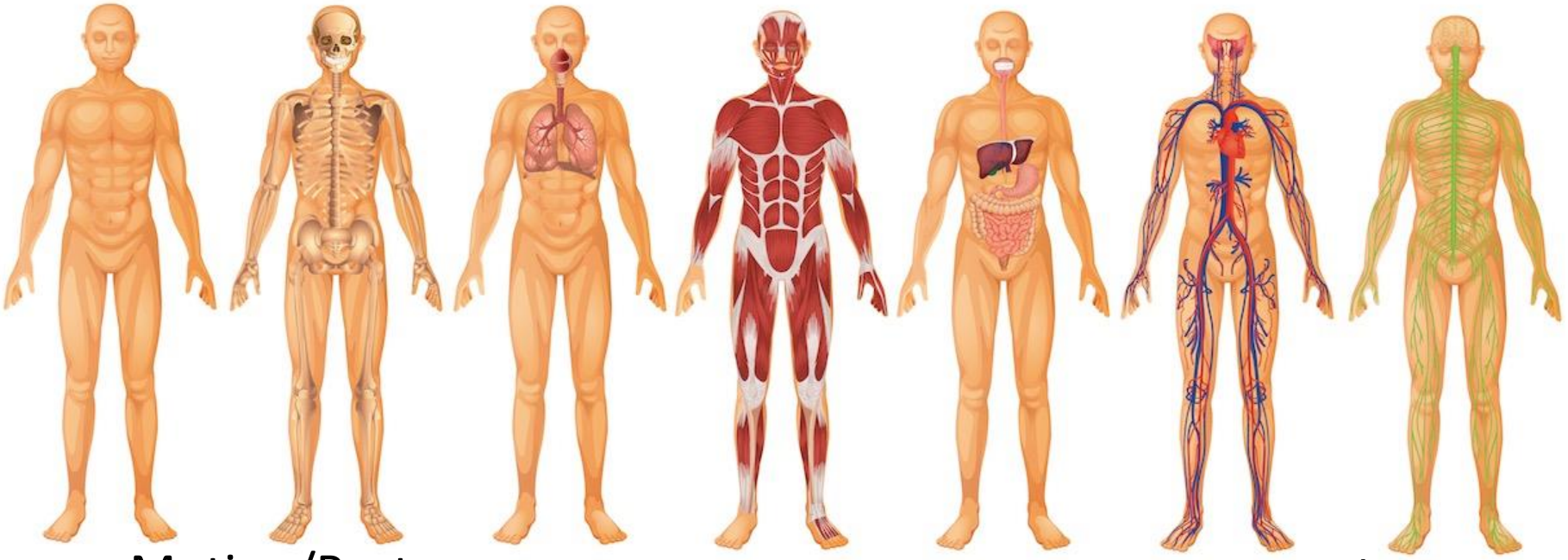
Let's quickly review about which data from HUMAN can be used in HCI, in terms of the following three areas.

1. Human **Physical** Data
2. Human **Cognitive** Data
3. Human **Emotional** Data

Human Physical Data

Anthropometric Size

Eye movement



Motion/Posture

Body Shape

Muscle signals

Respiration

Heart signal

Bio Rhythm

Blood pressure

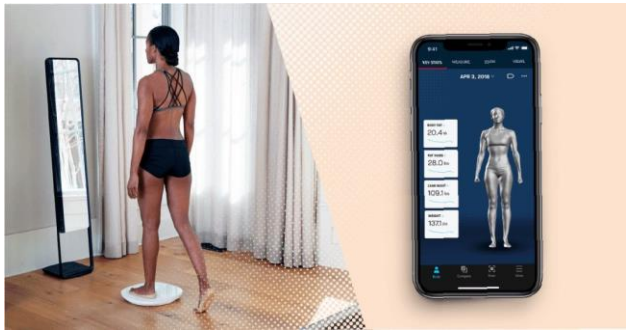
Body temperature

Human Physical Data

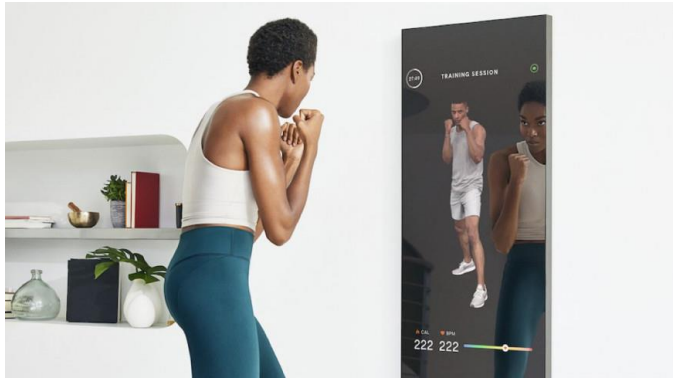
- Generated lots of information/data daily
- Human data is captured and used through computer technologies
- To provide services to users
- Example: A smartwatch on the wrist
  - Captures user's location, heart signal, and physical activities, …
  - In case of less movement,
    it gives alarm to make the user walk

Human Physical Data & HCI Examples

- body size and shape

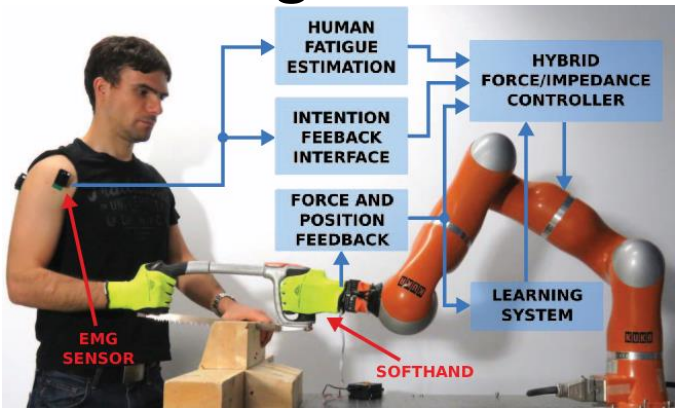


- motion

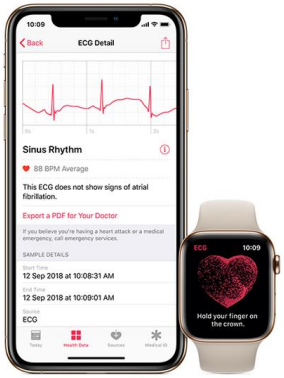


Human Physical Data & HCI Examples

- muscle signals

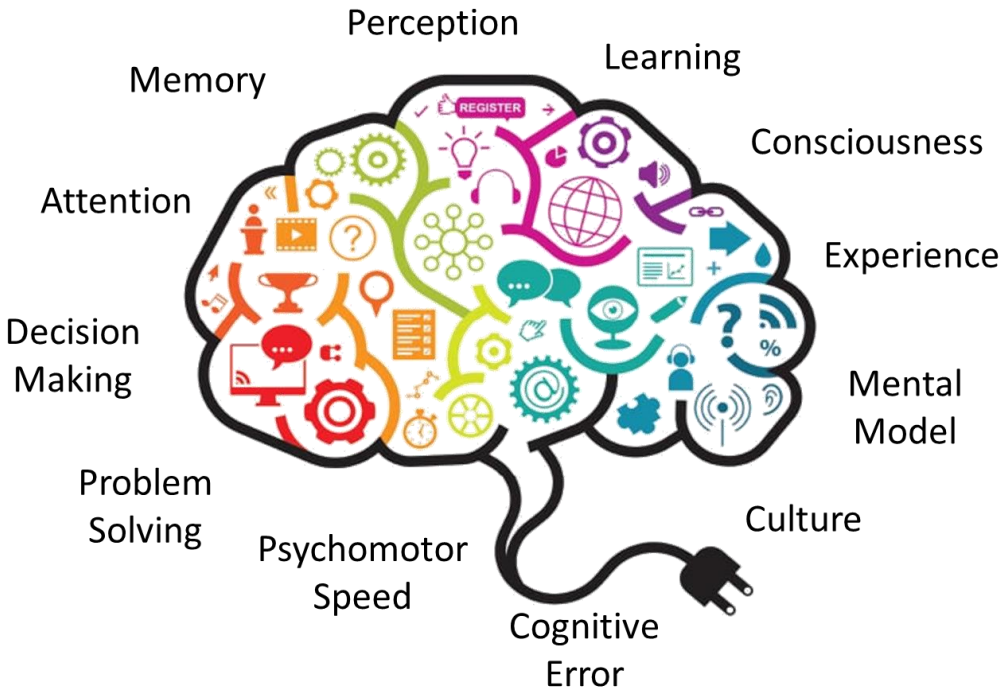


- heart signals



Human Cognitive Data

- Cognitive performance can be interpreted through analysis of human behavior
- Example
  - understandability
  - memorability
  - problem solving
  - decision making
  - …



Human Cognitive Data

- Human cognition is related to **user-centered design or usability** issues
- Good UI → easy to understand, easy to conduct tasks, easy to memorize, …
- Bad UI → error, mistake, annoying, …

Category	Question	Score	Remarks
Discoverability	배치된 정보가 눈에 잘 띄는가?	Y/N/해당없음	
	글자가 눈에 잘 들어오는가?		
	인터페이스가 조절 가능한 요소로서 인식되는가?		
	한번에 적절한 양의 정보를 제공하는가?		
	중요한 정보들이 숨겨지 있지 않고 화면상에 드러나 있는가?		
	인터페이스 사용에 대한 적절한 가이드를 제공하고 있는가?		
	기타 discoverability를 저해하는 요소가 모두 해결되었는가?		
Simplicity	불필요한 요소들은 제거되었는가? 또는 필요할 때만 볼 수 있도록 숨겨져 있는가?		
	색상, 글꼴 등과 같은 디자인 요소의 variation(다양성)이 적절한가?		
	화면의 layout(배치)이 깔끔한가?		
	유사한 정보가 중복되어 있지 않은가?		
	정보의 흐름이 단순한가?		
	기타 simplicity를 저해하는 요소가 모두 해결되었는가?		
Flexibility	사용자가 화면, 인터페이스, 기능 등에 관한 설정을 customizing할 수 있는가?		
Affordance	버튼은 눌릴 수 있는 요소인 것처럼 설계되었는가?		
	눌릴 수 없으면서도 버튼처럼 보이는 요소들은 모두 제거되었는가?		
Mapping	인터페이스와 디스플레이 간에 연관된 요소가 있다면, 연관된 요소 사이에 시각적으로 matching되는가?		
Consistency	Logic 및 정보 흐름에 일관성이 있는가?		
	Layout(배치)에 일관성이 있는가?		
	인터페이스의 순서 간에 일관성이 있는가?		
	디자인 요소 간에 일관성이 있는가?		

Usability checklist

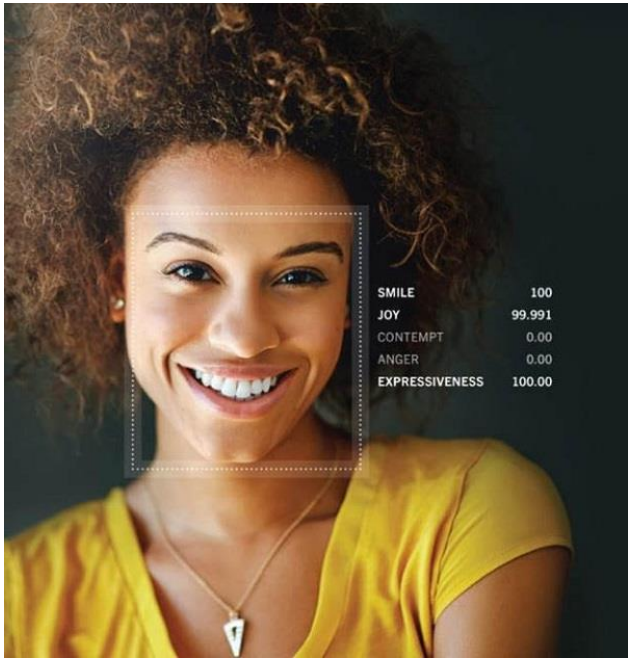
Human Emotional Data

- Related to how people feel
- Examples of feeling: happiness, sadness, joy, surprise, love, satisfaction, relaxation, …
- Positive design: providing positive emotions to users through products/apps

25 positive emotions

Human Emotional Data & HCI Examples

- Human emotions can be recognized by facial detection
- computer vision technology + machine learning



Human Motion & HCI

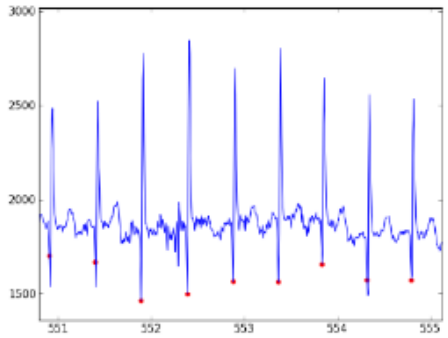
Human Motion & HCI: Media Art using Kinect + Scratch

https://www.youtube.com/watch?v=tAQJ2TnOeU8
https://github.com/HandongHCI/HandongHCI.github.io/tree/master/HCI2018S/MediaArt

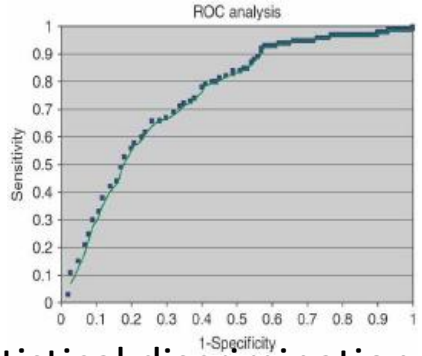
Face Motion & HCI using Depth Sensing

https://www.youtube.com/watch?v=OTpl0HFxbZE

Bio Signal & HCI: Blood Pressure Example



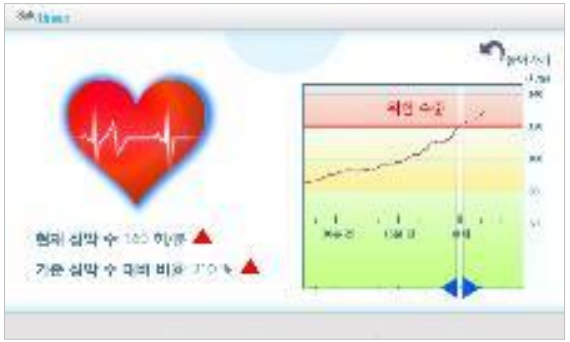
Acquiring heart rate by steering wheel everyday



$$\mathrm{SDNN} = \sqrt{\frac{\sum_{j=1}^{N}\left(\mathrm{RR_j} - \overline{\mathrm{RR}}\right)^2}{N-1}}$$

$$\mathrm{RMSE} = \sqrt{\frac{\sum_{j=1}^{N}\left(\mathrm{RR_j} - \overline{\mathrm{RR}}\right)^2}{N-2}}$$

Statistical discrimination of driver's mental workload



Providing realtime feedback to a driver

Bio Signal & HCI: Eye Movement Example

Tracking human eye movement in vehicle
→ Drowsiness detection, Accident prevention

Bio Signal & HCI: Muscle Signal & Bionic Leg

https://www.youtube.com/watch?v=5qtBQNqi9Pk
https://www.ossur.com/about-ossur/news-from-ossur/1396-ossur-introduces-first-mind-controlled-bionic-prosthetic-lower-limbs-for-amputees

Human Life Data & HCI: Smart Watch

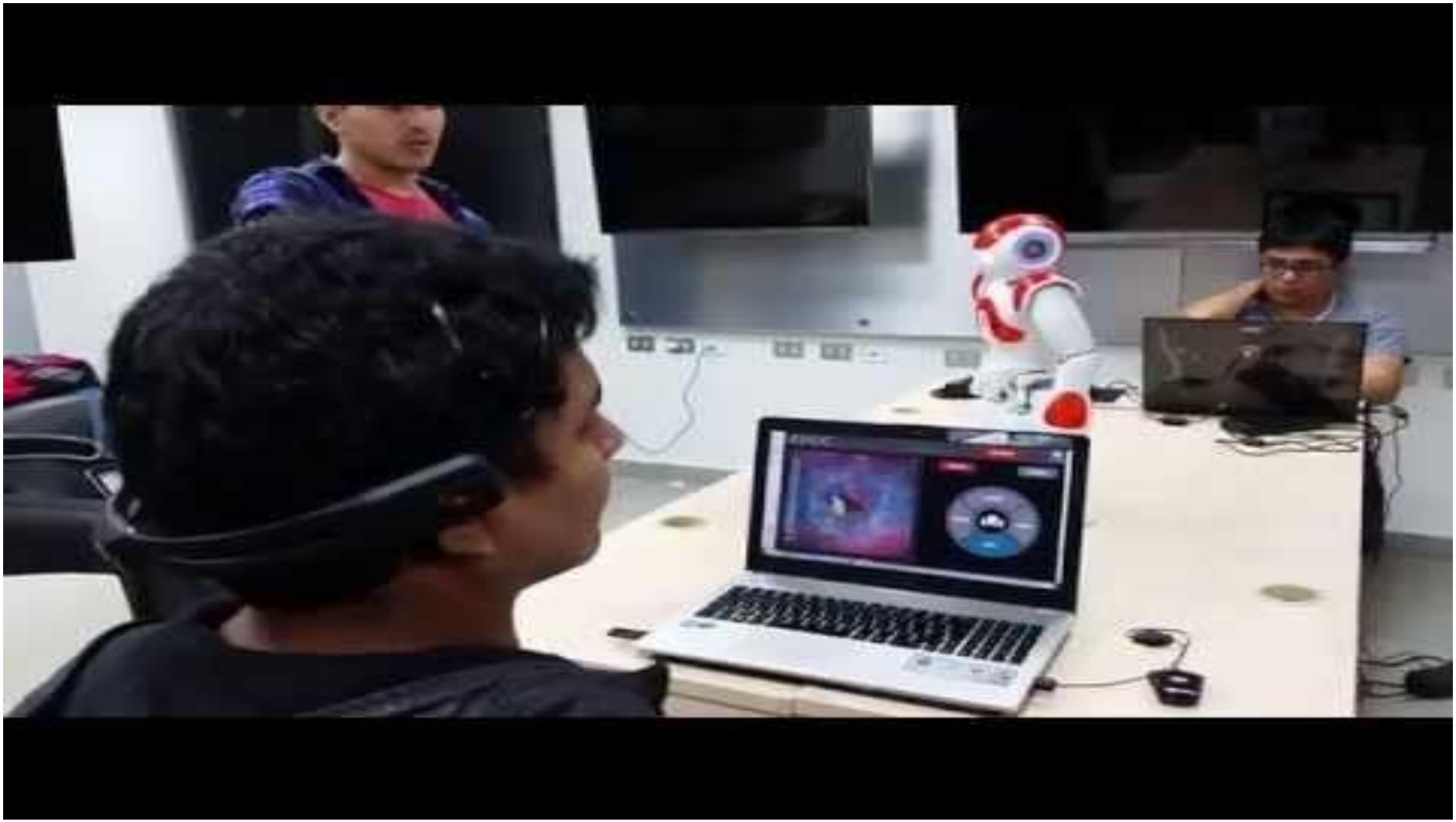
Life-time data collection

- Heart beat
- Walking distance
- Sleeping hours
- Exercise
- …

Provide healthcare services

- Body status prediction
- Sleep pattern analysis
- Exercise recommendation
- Sharing data to hospital

Human Thinking & HCI



https://www.youtube.com/watch?v=1JJKl9FSNhg

Human Feeling & HCI

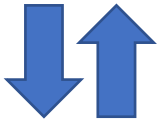
https://www.youtube.com/watch?v=xS9OMLR3Ojc

HCI Elements: (2) Computer Technology

- ‘Computer’ represents not only algorithms but also hardware
- Hardware consists of two main parts: INPUT & OUTPUT
- Human interacts with computers through various I/O techs

Change of I/O Technologies

Need Better Interacion

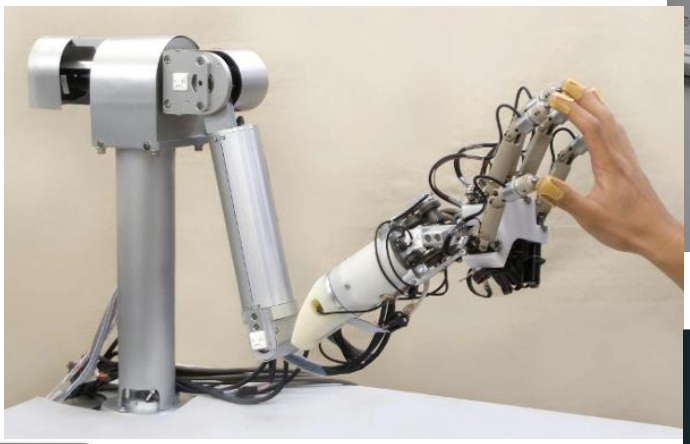


New Technology

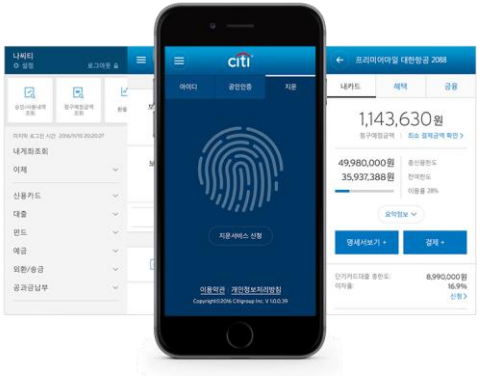
Input	Output
Keyboard	Command line interface
Keyboard/Mouse	Graphical interface
Touch screen	

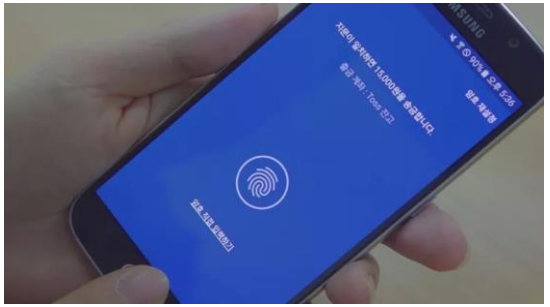
New I/O Technologies

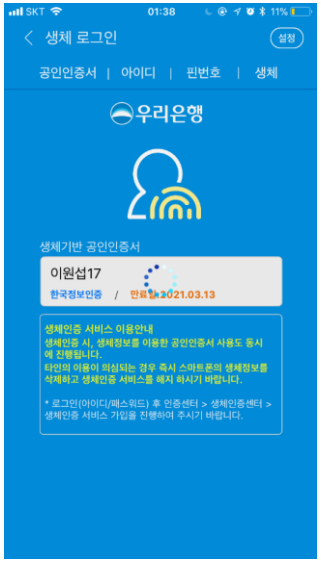
- Touch sensor
- Digital pen
- Voice interaction
- Motion sensor
- VR/AR
- Robotics
- … and a lot!

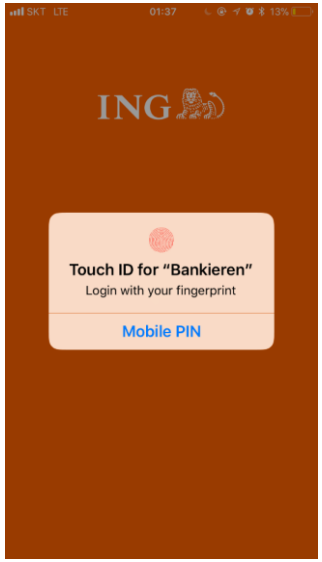


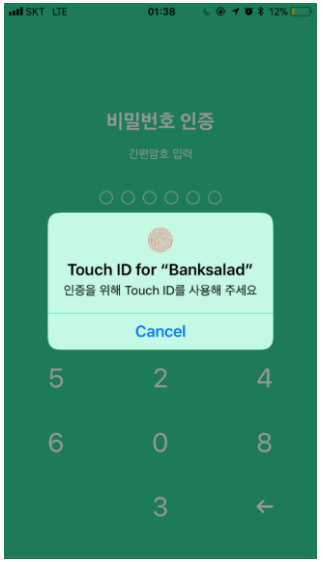
INPUT Technologies & HCI: Fingerprint Sensor



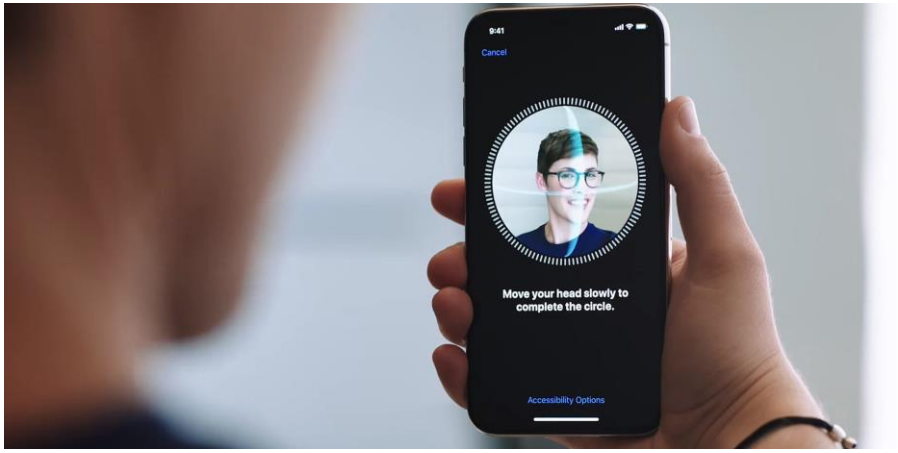


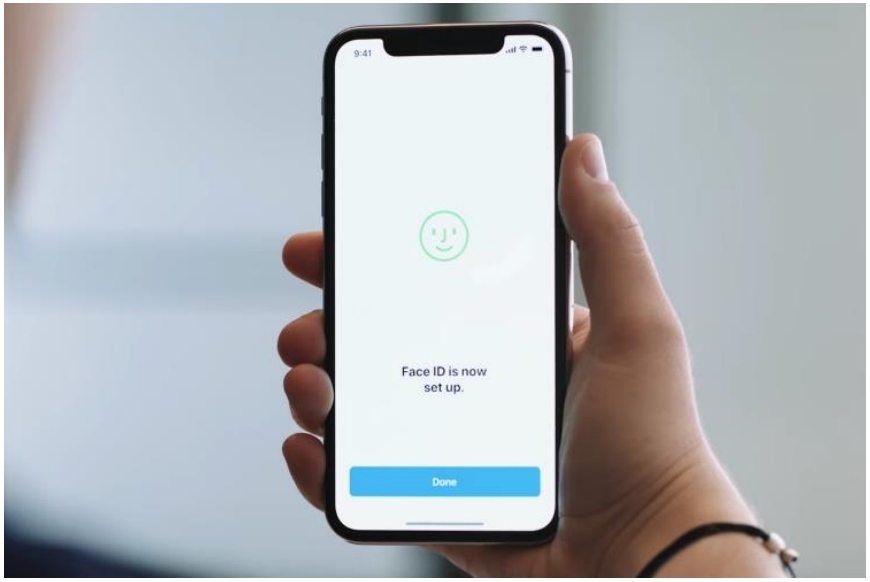




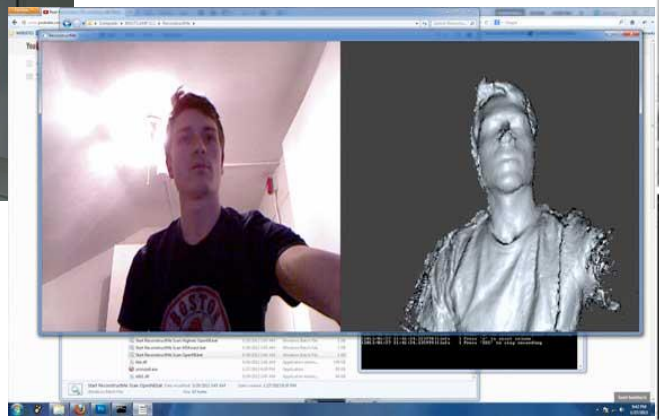


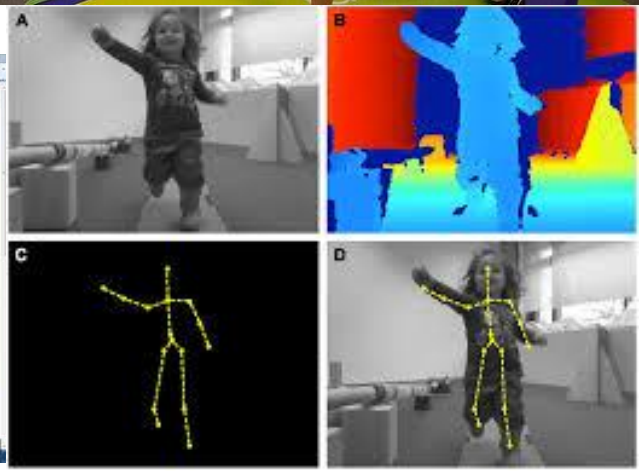
INPUT Technologies & HCI: Face Recognition Tech





INPUT Technologies & HCI: Depth Sensors and Applications



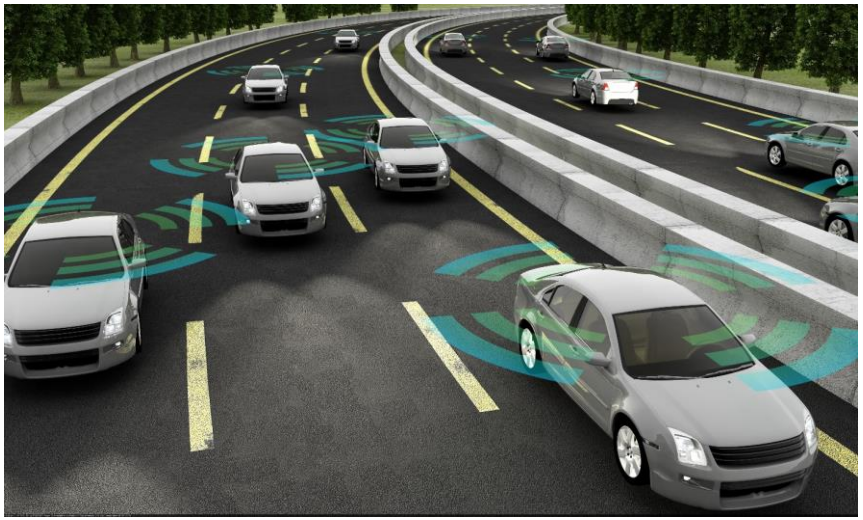


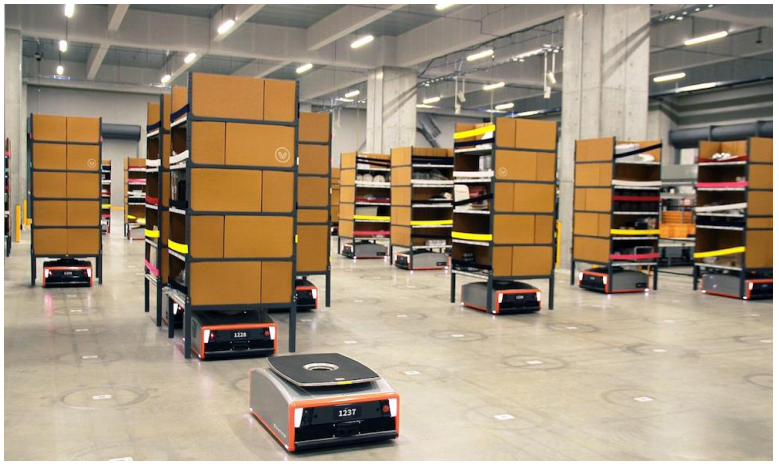
INPUT Technologies & HCI: Voice Interaction

OUTPUT Technologies & HCI: VR/AR

OUTPUT Technologies & HCI: Voice Interaction

OUTPUT Technologies & HCI: Autonomous Techs





HCI and Ethics

- New technologies and better HCIs are always GOOD?
- Not always high-techs are good
- **Low-techs are good enough to create values sometimes**
- High-techs can result negative effects sometimes

$100 laptop for education
in developing countries

$1000 smartphone (for what?)
in developed societies

HCI and Ethics

An engineer who contributes to the advance of ICT techs and HCI should have these questions.

- “What device or HCI can be created?”
- “What are its values for people?”
- “Which people?”
- “What could be positive as well as negative effects?”

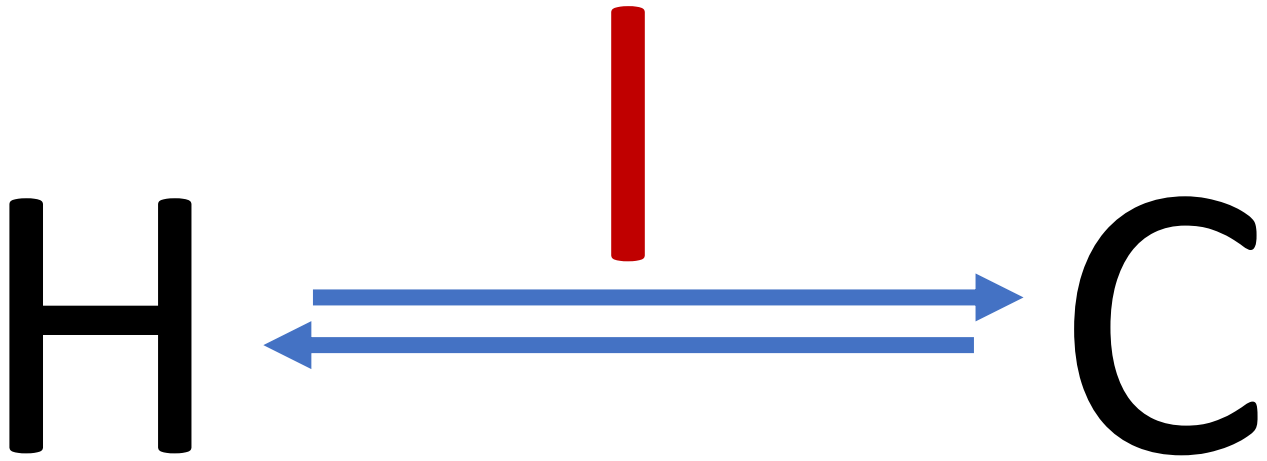
We will have time to discuss **humanity, sustainability, and ethics** about technologies and interactions

HCI Elements: (3) Interaction

Just a straightforward question.

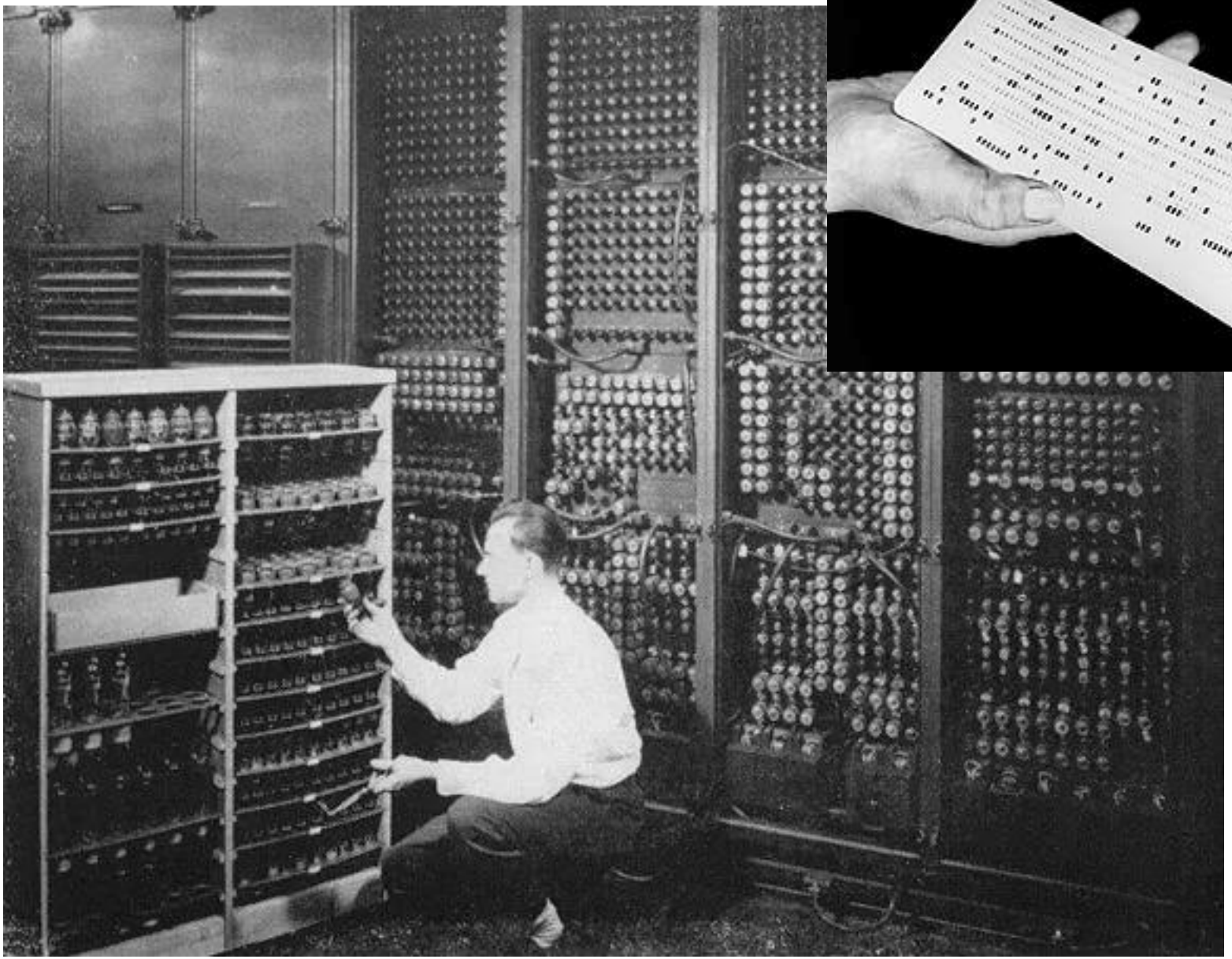
“What is interaction?”

Find the answer yourself.

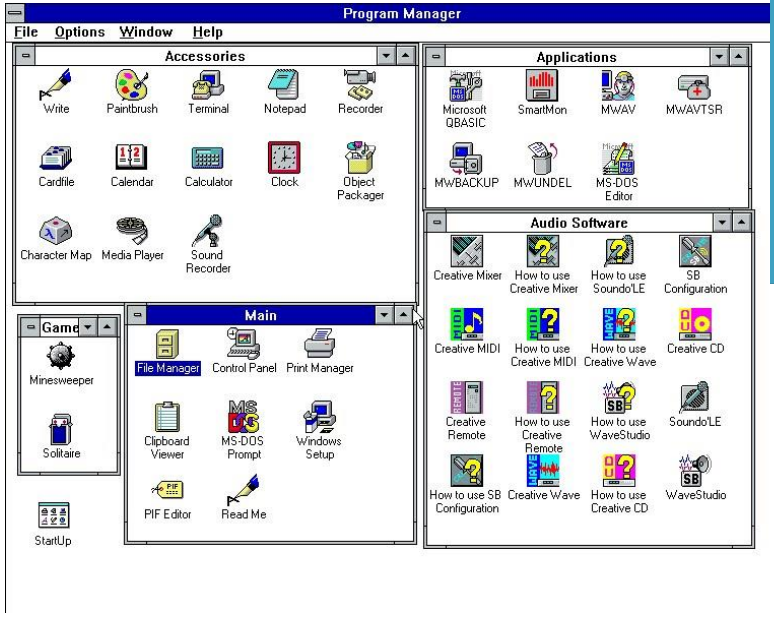


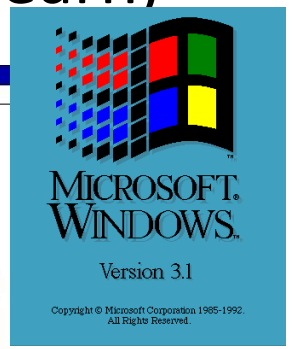
Natural Interactions

The First Human-Computer Interactions

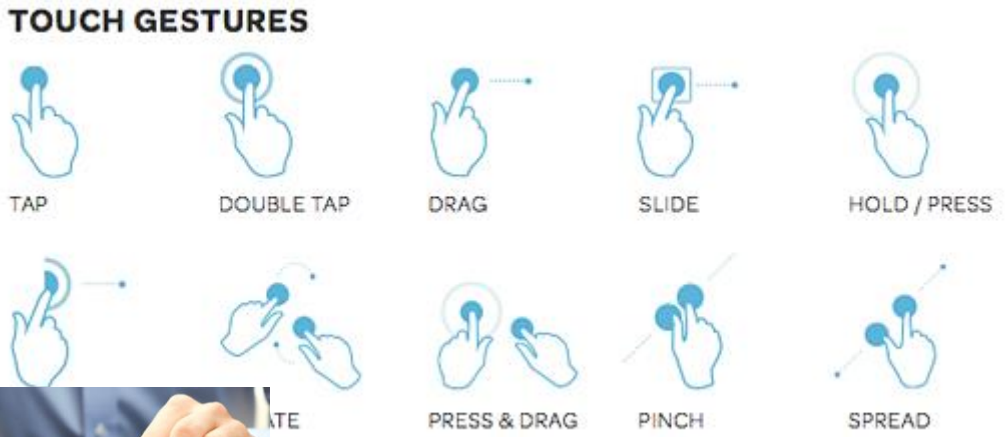


Human-Made Interactions are Unnatural (need to learn)



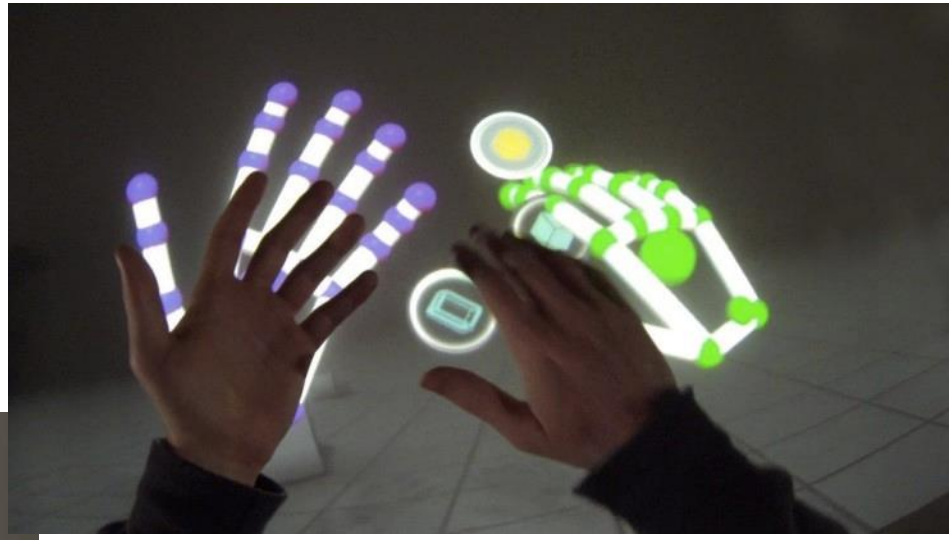


window
menu
icon
symbol
click
double click
drag-drop
…



smartphone is
easier than computer
(gesture is easier than mouse device)

New Interactions: Getting Back to Natural Interaction

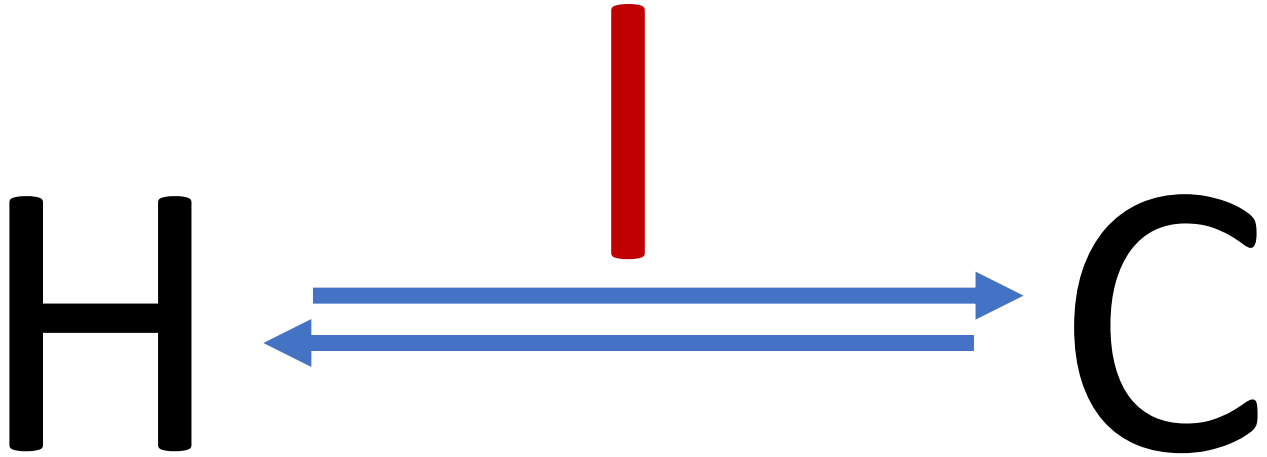


Where interaction is extinct,

there is the place of eternal death.

Summary

- Unnatural interaction
  → Natural interaction
- E.g., gesture, voice, brain signal, …



- Human data
- Physical data (movement, heart signal, …)
- Good UI & good interaction → good usability
- Positive emotions & positive design

- Hardware: input/output devices
- Software: algorithm