

# Human/Computer Interaction

## Unit 1

# Human and Computer I/O Capabilities

Dr. Mirjam Augstein



# About me

- Professor at University of Applied Sciences Upper Austria @KWM (degree program Communication and Knowledge Media)
- PhD @JKU (2011)
- Ongoing collaboration with JKU
- Coordination of all HCI topics @KWM
- Research focus on HCI since ~ a decade
- Main research areas: CSCW, Personalization, Interaction
- Head of research group PEEC (Personalized Environments and Collaborative Systems)



Dr. Mirjam Augstein

Human/Computer Interaction Unit 1



# Interaction Matters?

Human/Computer Interaction Unit 1

Winter Term 2022/2023

Mirjam Augstein



# Interaction Matters!

## Missing haptic feedback

### Haptische Rückmeldung fehlt

Doch auch das Interface-Design sei ein Faktor gewesen: „Das Design des „John S. McCain“-Steuerungs- und Kontrollsystems erhöhte die Wahrscheinlichkeit von Bedienungsfehlern, die letztlich zu der Kollision geführt hatten.“ Der Bericht verwies unter anderem darauf, dass Besatzungsmitglieder ein Schiff derzeit über verschiedene mit Touchscreen-Systemen ausgestattete Stationen der Kommandobrücke steuern können.

Wer die Kontrolle worüber verfügt, wird zwar auf dem Bildschirm angezeigt, ist aber nur schwer zu erkennen. Während es dem Bericht der US-Behörde zufolge bei Hebeln spürbar ist, ob die Steuerung auf Eingaben reagiert oder auch, ob Steuerungen der Schiffsschrauben separat arbeiten, fehlt dieses haptische sowie sofortige Feedback bei Touchscreens.



Der beschädigte Zerstörer „USS John S. McCain“ im Hafen von Singapur 2017

<https://orf.at/stories/3133433/>

## The untested monostable shifter

*„The problem with the monostable shifter was that it had minimal user feedback. With Fiat Chrysler Jeep, it is hard to tell whether someone has put the car into park or not. The difference between reverse and park is incredibly subtle. If a user makes a mistake and opens the door without the car in the park, there is no feedback to let the driver know the car isn't parked.“*

*„...operation of the Monostable shifter is not intuitive and provides poor tactile and visual feedback to the driver, increasing the potential for unintended gear selection.“*

<https://uxdesign.cc/the-usability-issue-that-caused-1-death-and-38-injuries-97911dfa5c7f>

Human/Computer Interaction Unit 1

Mirjam Augstein

Winter Term 2022/2023



# Interaction Matters!



<https://www.youtube.com/watch?v=TpgyxHwV8Fo>

Human/Computer Interaction Unit 1

Winter Term 2022/2023

Mirjam Augstein

# Human/Computer Relationship



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



- Studies show that a **human-computer relationship** can be **highly emotional**
- According to Brinks [1]
  - 62% of users have yelled at computers or insulted them
  - 31% of users have hit after the mouse
  - 15% of users have beaten the monitor
  - 1,5 % of users have dropped their monitor or PC
  - Just 24% of users have never become aggressive

# How do humans see computers?



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



Human/Computer Interaction Unit 1

Winter Term 2022/2023

Mirjam Augstein

# How do humans see computers?



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



Human/Computer Interaction Unit 1

Winter Term 2022/2023

Mirjam Augstein

# How do humans see computers?



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA

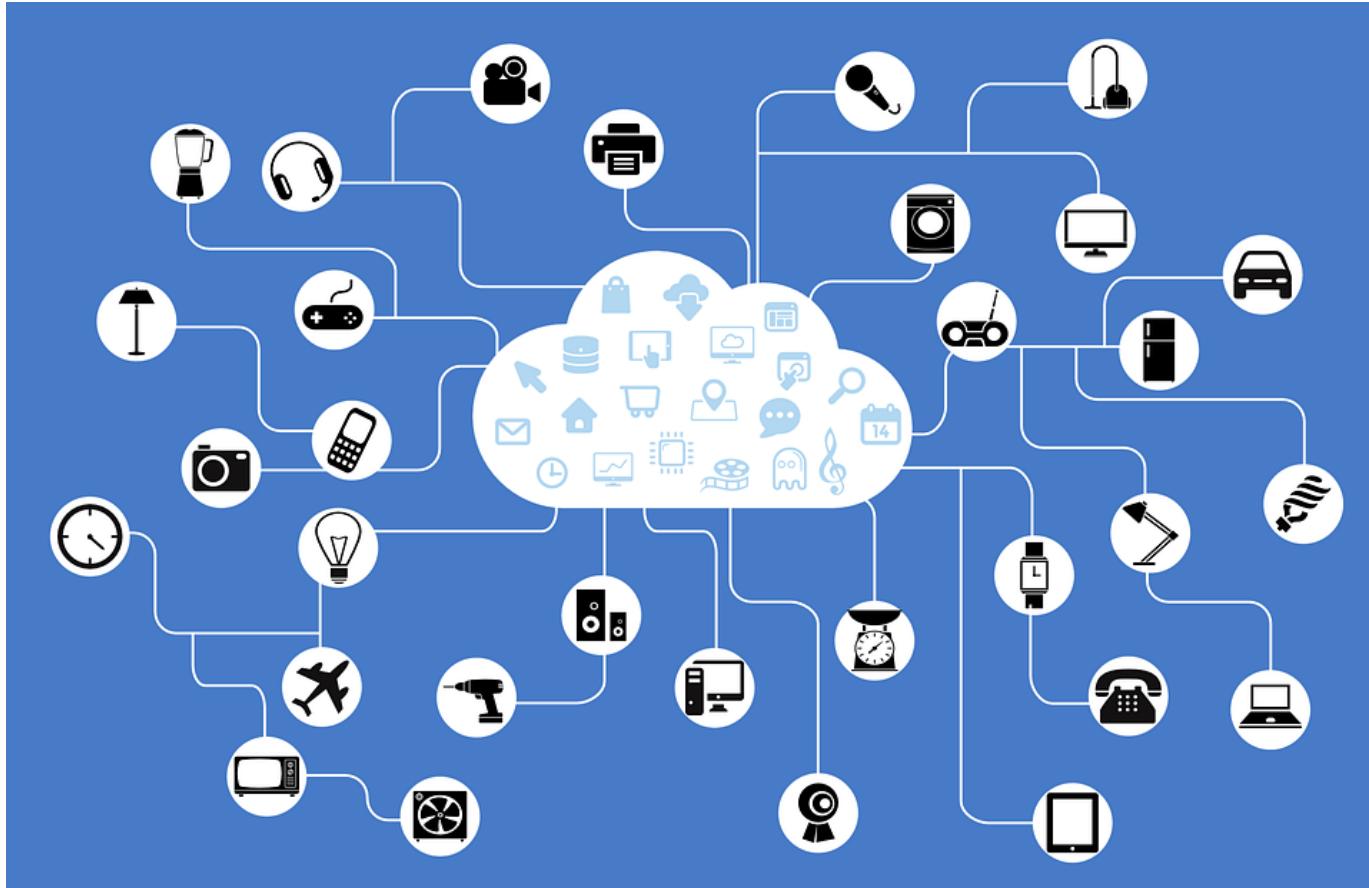


Human/Computer Interaction Unit 1

Winter Term 2022/2023

Mirjam Augstein

# How do humans see computers?



Human/Computer Interaction Unit 1

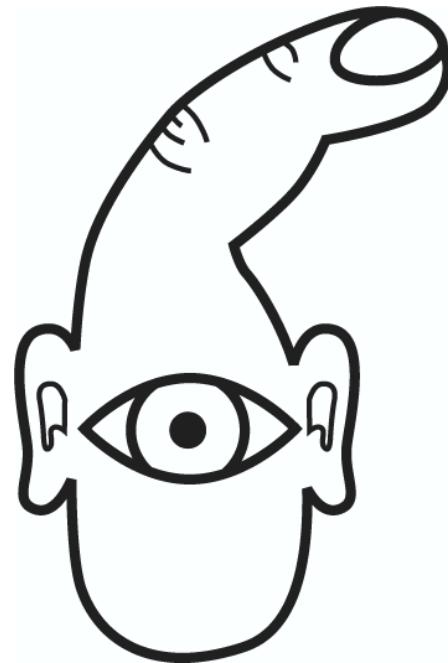
Winter Term 2022/2023

Mirjam Augstein

# How do computers see humans?



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



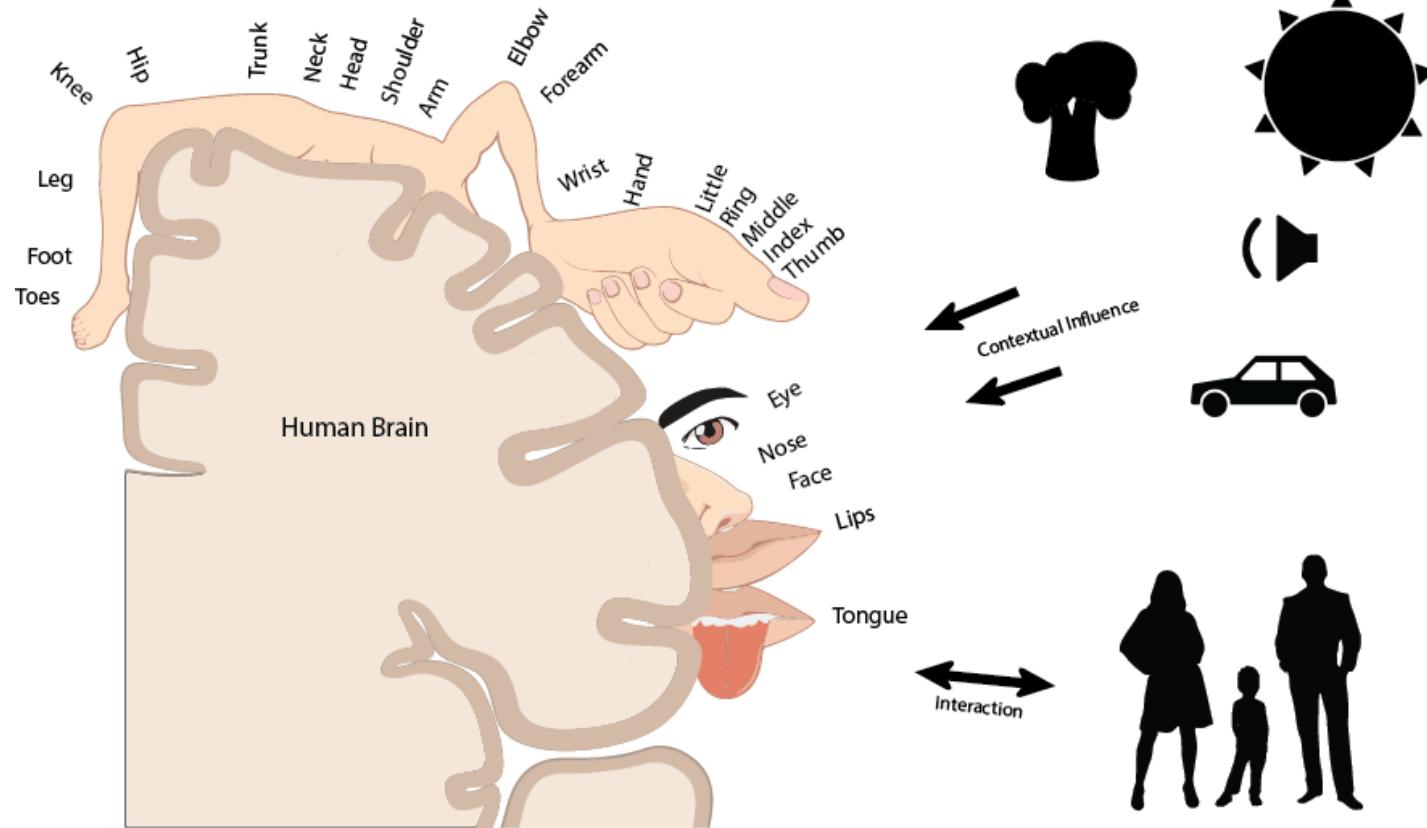
O'Sullivan & Igoe, 2004 [2]

Human/Computer Interaction Unit 1

Winter Term 2022/2023

Mirjam Augstein

# How do computers see humans?



Augstein & Neumayr, 2019 [3]

Human/Computer Interaction Unit 1



# Interaction: Input & Output

- *„Input and output are perhaps the most systematically neglected features of programming languages.“*  
*Shaw, 1986 [4]*
- Input: what the **computer** is able to **sense** as **information** processed **by the human**
- Output: **information** the **computer** processes **to the human**



# Interaction: Input & Output

- **Minimal interaction (input) [3]: controllable and reproducible** human action which
  - can be discrete or continuous
  - Is connected to at least one modality
  - Has at least two states
- Computer output requires human to be able to
  - **Sense**
  - **process** and
  - **interpret** it

# Interaction Methods:

# Categorization + Taxonomies



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



- **Technology-Based:**
  - Buxton, 1983 [5] **characterizes** of **input devices** (what is sensed vs. number of dimensions → touch screen is a positioning device sensing 2D)
- **Task-Based:**
  - Foley & Wallace, 1974 [6] introduce four **virtual devices** (pick, button, locator, valuator) that are used to **classify** all **available devices**
  - Foley et al., 1984 [7] provide **classification scheme** for **interaction tasks** distinguishing between: select, position, orient, path, quantify, text

# Interaction Methods:

# Categorization + Taxonomies



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



- **Modality-Based**

- Bernsen, 1994 [8] proposed a **generic taxonomy for output modalities (basic features)**: linguistic/non-linguistic, analogue/non-analogue, static/dynamic, **media of expression**: graphics, sound, touch)
  - Bernsen, 2008 [9] proposed a **taxonomy for input and output modalities** focusing on **graphics, acoustics and haptics**

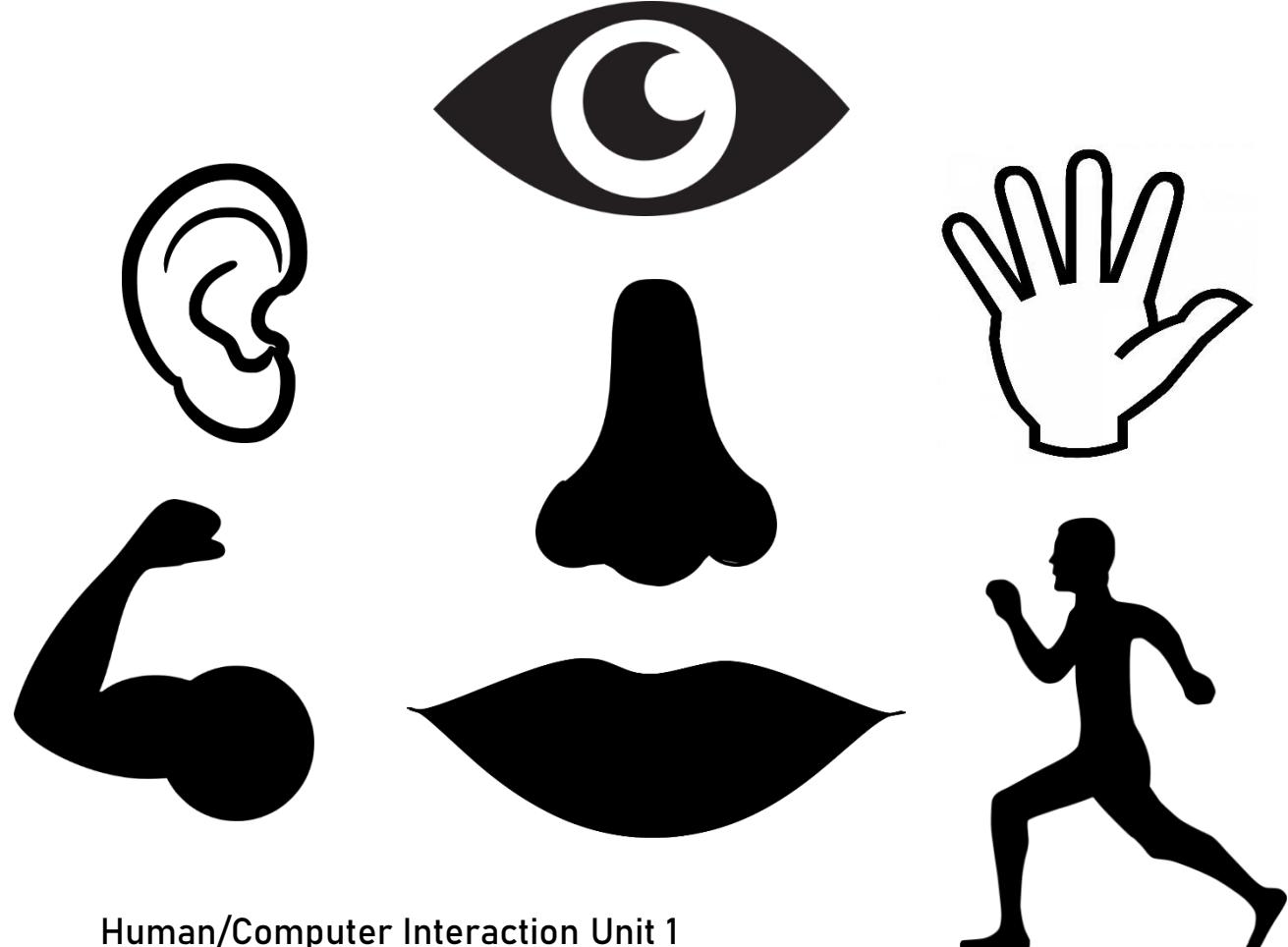
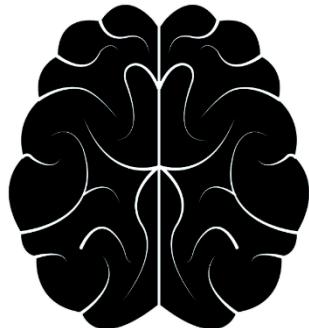
- **Human-Centered?**

- Jaimes & Sebe [10] list **human senses** (vision, audio, haptic, smell, taste) and **computer input devices** (pointing, keyboard, others)



# Human Perception

- Vision
- Audition
- Kinesthetics
- Touch
- Olfaction
- Gustation



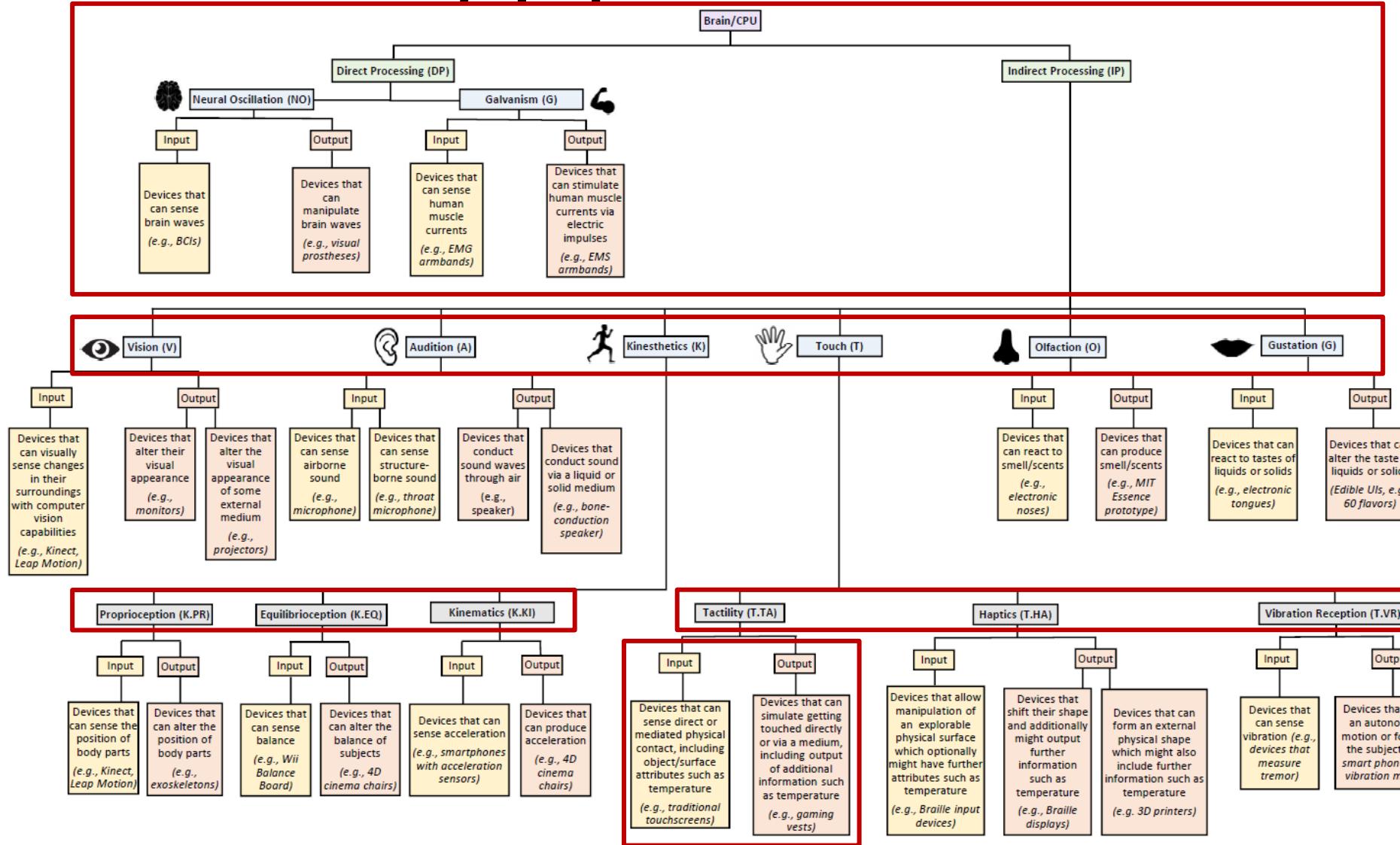
Human/Computer Interaction Unit 1

Mirjam Augstein

Winter Term 2022/2023

# Sensors & Senses

## Taxonomy [3]



# Direct and Indirect Processing



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



- **Distinction** necessary, some modalities / technologies are inherently different → **direct processing**
  - Brain-computer interfaces (BCI)
  - Electromyography (EMG)
  - Electrical muscle stimulation (EMS)
- **Indirect processing**  
stimulus → sensing → processing + cognition → reaction



Human/Computer Interaction Unit 1



# Vision

- Input
  - Devices that can **visually sense changes** in their surroundings with Computer Vision capabilities
  - **Human action:** e.g., gestures, poses
- Output
  - Devices that can **alter** their visual appearance
  - Devices that can **alter** the **visual appearance of some external medium**
  - **Human action:** see, interpret



Human/Computer Interaction Unit 1

# Vision: Pay Attention to ...



- ... colors
    - Might not be perceivable by all in the same way
    - <https://www.toptal.com/designers/colorfilter>

<h1>Diese Woche: Willkommen an der JKU!</h1> <p>Sport, Spaß, Infos und ganz viel Party: Komm zur Welcome Week und entdecke deine Uni!</p> <p><a href="#">ALLE INFOS ZUM EVENT</a></p>	
<p><b>STUDIUM</b></p> <p><b>Platz für deine Studienwahl.</b></p> <p>Entdecke die Studiengänge an der JKU</p> <p><a href="#">ZUM STUDIENANGEBOT</a></p>	 <p><b>Dürfen wir dir zeigen, was dich am Campus alles erwartet?</b></p> <p>Blätte jetzt deine virtuelle Tour über den JKU Campus.</p> <p><a href="#">ZUR KAMPUSFÜHRUNG</a></p>
<p><b>SERVICE</b></p> <p><b>Wann? Wer? Wie? Wo? Was?</b></p> <p>Wichtige Fristen &amp; Termine</p> <p><a href="#">ZU DEN INFOS</a></p>	<p><b>PRÄSENZBETRIEB</b></p> <p><b>Aktueller Stand der Maßnahmen gegen die Pandemie an der JKU.</b></p> <p>Die derzeitigen Verhaltensrichtlinien im Kampf gegen die Pandemie.</p> <p><a href="#">ALLE INFOS</a></p>
<p><b>STUDIUM</b></p> <p><b>Anmeldung zum Studium</b></p> <p>Wichtige Infos zu deiner Anmeldung zum Studium an der JKU.</p> <p><a href="#">ALLE INFOS</a></p>	<p><b>STUDIENINTERESSIERTE</b></p> <p><b>Matura - was nun?</b></p> <p>Finde in 6 Schritten zu deinem Studium!</p> <p><a href="#">ALLE INFOS</a></p>

<h1>Diese Woche: Willkommen an der JKU!</h1> <p>Sport, Spaß, Infos und ganz viel Party: Komm zur Welcome Week und entdecke deine Uni!</p> <p><a href="#">ALLE INFOS ZUM EVENT</a></p>		<h2>PRÄSENTATIONEN</h2> <p><b>Aktueller Stand der Maßnahmen gegen Corona an der JKU.</b></p> <p>Die derzeitigen Verhaltensrichtlinien im Kampf gegen die Pandemie.</p> <p><a href="#">ALLE INFOS</a></p>
<h2>STUDIUM</h2> <p><b>Platz für deine Studienwahl.</b></p> <p>Entdecke die Studiengänge an der JKU</p> <p><a href="#">ZUM STUDIENGANG</a></p>	<h2>STUDIUM</h2> <p><b>Dürfen wir dir zeigen, was dich am Campus alles erwarten?</b></p> <p>Bringe jetzt Deine virtuelle Tour über den JKU Campus.</p> <p><a href="#">ZUR KAMPUSFÜHRUNG</a></p>	<h2>PRÄSENZBETRIEBS</h2> <p><b>Aktueller Stand der Maßnahmen gegen Corona an der JKU.</b></p> <p>Die derzeitigen Verhaltensrichtlinien im Kampf gegen die Pandemie.</p> <p><a href="#">ALLE INFOS</a></p>
<h2>SERVICE</h2> <p><b>Wann? Wer? Wie? Wo? Was? Wann?</b></p> <p>Wichtige Fristen &amp; Termine</p> <p><a href="#">ZU DEN INFOS</a></p>	<h2>STUDIUM</h2> <p><b>Anmeldung zum Studium</b></p> <p>Wichtige Infos zu deiner Anmeldung zum Studium an der JKU.</p> <p><a href="#">ALLE INFOS</a></p>	<h2>STUDIENERINTERESSIERTE</h2> <p><b>Matura - was nun?</b></p> <p>Finde in 6 Schritten zu deinem Studium!</p> <p><a href="#">ALLE INFOS</a></p>

<h1>Diese Woche: Willkommen an der JKU!</h1> <p>Sport, Spaß, Infos und ganz viel Party: Komm zur Welcome Week und entdecke deine Uni!</p> <p><a href="#">ALLE INFOS ZUM EVENT</a></p>		
<p><b>STUDIUM</b></p> <h2>Platz für deine Studienwahl.</h2> <p>Entdecke die Studiengänge an der JKU</p> <p><a href="#">ZUM STUDIENGÄNGERUND</a></p>	<p><b>STUDIUM</b></p> <p><b>Dürfen wir dir zeigen, was dich am Campus alles erwartet?</b></p> <p>Blätte jetzt deine virtuelle Tour durch den JKU Campus</p> <p><a href="#">KURZ CAMPUSBESUCH</a></p>	<p><b>PRÄSENZBETRIEB</b></p> <p><b>Aktueller Stand der Maßnahmen gegen Corona an der JKU.</b></p> <p>Die derzeitigen Verhaltensrichtlinien im Kampf gegen die Pandemie.</p> <p><a href="#">ALLE INFOS</a></p>
<p><b>SERVICE</b></p> <h2>Wann? Wer? Wie? Wo? Was? Was?</h2> <p>Wichtige Fristen &amp; Termine</p> <p><a href="#">ZU DEN INFOS</a></p>	<p><b>STUDIUM</b></p> <h2>Anmeldung zum Studium</h2> <p>Wichtige Infos zu deiner Anmeldung zum Studium an der JKU.</p> <p><a href="#">ALLE INFOS</a></p>	<p><b>STUDIENINTERESSIERTE</b></p> <h2>Matura - was nun?</h2> <p>Finde in 6 Schritten zu deinem Studium!</p> <p><a href="#">ALLE INFOS</a></p>

		<h1>Diese Woche: Willkommen an der JKU!</h1> <p>Sport, Spaß, Infos und ganz viel Party: Komm zur Welcome Week und entdecke deine Uni!</p> <p><a href="#">ALLE INFOS ZUM EVENT</a></p>
<p><b>STUDIUM</b></p> <p><b>Platz für deine Studienwahl</b></p> <p>Entdecke die Studiengänge an der JKU</p> <p><a href="#">ZUM STUDIENANGEBOT</a></p>	<p><b>STUDIUM</b></p> <p><b>Dürfen wir dir zeigen, was dich am Campus alles erwartet?</b></p> <p>Bringe jetzt deine virtuelle Tour durch den JKU Campus.</p> <p><a href="#">ZUR CAMPUSFÜHRUNG</a></p>	<p><b>PRÄSENZBETRIEB</b></p> <p><b>Aktueller Stand der Maßnahmen gegen Corona an der JKU.</b></p> <p>Die derzeitigen Verhaltensrichtlinien im Kampf gegen die Pandemie.</p> <p><a href="#">ALLE INFOS</a></p>
<p><b>SERVICE</b></p> <p><b>Wann? Wer? Wie? Wo? Was?</b></p> <p>Wichtige Fristen &amp; Termine</p> <p><a href="#">ZU DEN INFOS</a></p>	<p><b>STUDIUM</b></p> <p><b>Anmeldung zum Studium</b></p> <p>Wichtige Infos zu deiner Anmeldung zum Studium an der JKU</p> <p><a href="#">ALLE INFOS</a></p>	<p><b>STUDIENINTERESSIERTE</b></p> <p><b>Matura - was nun?</b></p> <p>Finde in 6 Schritten zu deinem Studium!</p> <p><a href="#">ALLE INFOS</a></p>

<h1>Diese Woche: Willkommen an der JKU!</h1> <p>Sport, Spaß, Infos und ganz viel Party: Komm zur Welcome Week und entdecke deine Uni!</p> <p><a href="#">ALLE INFOS ZUM EVENT</a></p>	
<p><b>STUDIUM</b></p> <p><b>Platz für deine Studienwahl!</b></p> <p>Entdecke die Studiengänge an der JKU</p> <p><a href="#">ZUM STUDIENANGEBOT</a></p>	<p><b>PRÄSENZBETRIEB</b></p> <p><b>Aktueller Stand der Maßnahmen gegen Corona an der JKU.</b></p> <p>Die derzeitigen Verhaltensrichtlinien im Kampf gegen die Pandemie.</p> <p><a href="#">ALLE INFOS</a></p>
<p><b>SERVICE</b></p> <p><b>Wann? Wer? Wie? Wo? Was?</b></p> <p>Wichtige Fristen &amp; Termine</p> <p><a href="#">ZU DEN INFOS</a></p>	<p><b>STUDIUM</b></p> <p><b>Anmeldung zum Studium</b></p> <p>Wichtige Infos zu deiner Anmeldung zum Studium an der JKU.</p> <p><a href="#">ALLE INFOS</a></p>
	<p><b>STUDIENINTERESSIERTE</b></p> <p><b>Matura - was nun?</b></p> <p>Finde es in den Schritten zu deinem Studium!</p> <p><a href="#">ALLE INFOS</a></p>



# Vision: Pay Attention to ...

- ... colors
  - Might transport information



Human/Computer Interaction Unit 1



# Vision: Pay Attention to ...

- ... **contrasts**
  - <https://accessibleweb.com/color-contrast-checker/>



Human/Computer Interaction Unit 1



# Vision: Pay Attention to ...

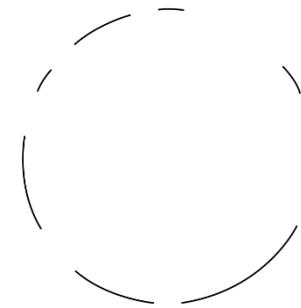
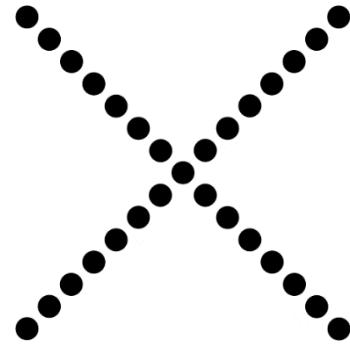
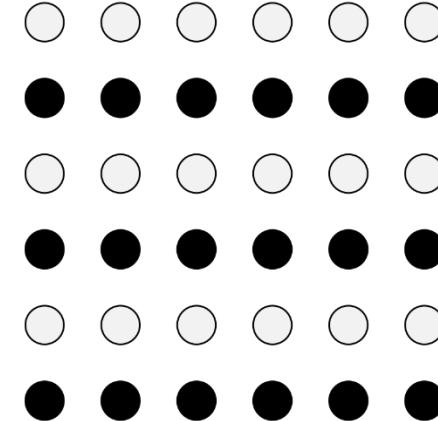
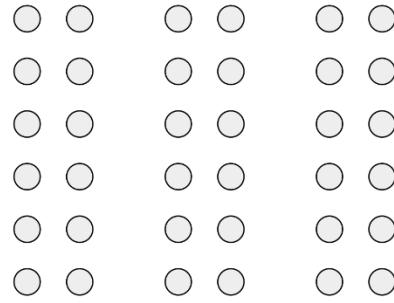
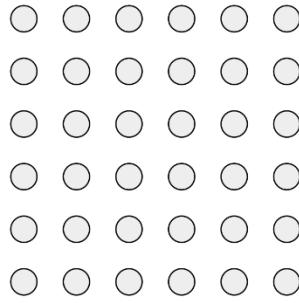
- ... shapes and arrangements
- Gestalt principles
  - Law of proximity
  - Law of similarity
  - Law of continuity
  - Law of closure
  - Law of common region
  - Law of symmetry
  - Law of figure / ground
  - Law of common fate

Human/Computer Interaction Unit 1

# Proximity, Similarity, Continuity, Closure



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA

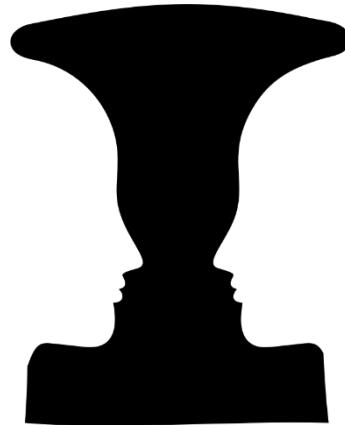
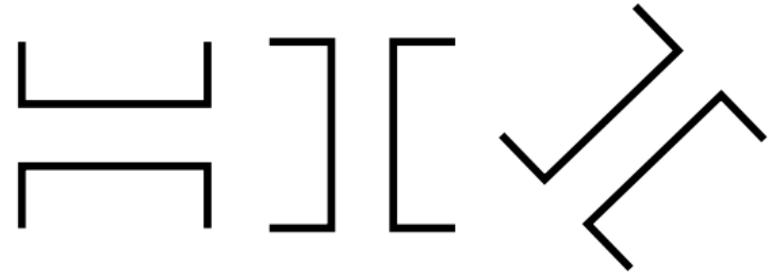
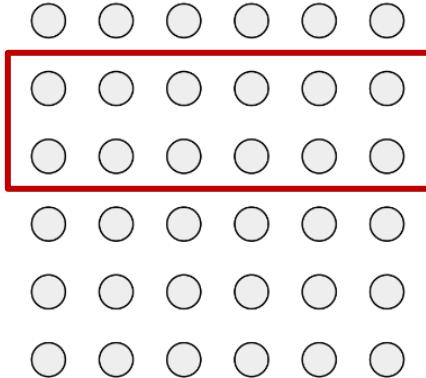


Human/Computer Interaction Unit 1

# Common Region, Symmetry, Figure/Ground, Common Fate



UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



Human/Computer Interaction Unit 1



# Audition

- Input
  - Devices that can **sense** airborne sound
  - Devices that can **sense** structure-borne sound
  - **Human action:** e.g., speak, sing
- Output
  - Devices that **conduct** sound waves **through** air
  - Devices that **conduct** sound via a **liquid or solid medium**
  - **Human action:** listen, interpret





# Audition: Pay Attention to ...

- ... noise, language/dialect/slang, overlapping frequencies

Check out [11] for more information

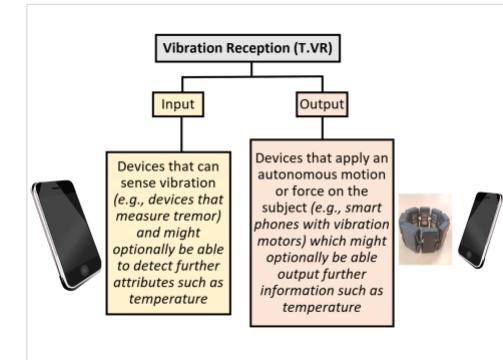
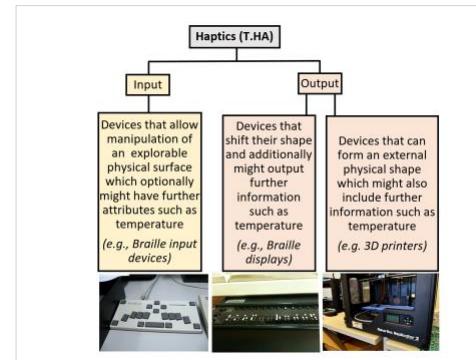
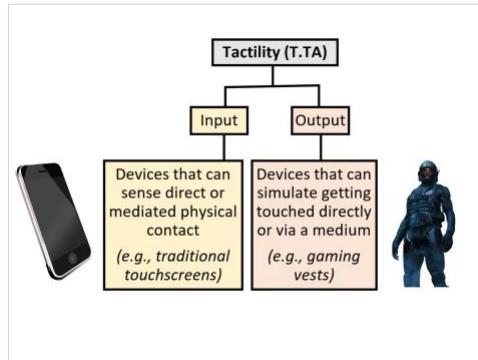
WeldVUI: Establishing Speech-Based Interfaces  
in Industrial Applications

Human/Computer Interaction Unit 1



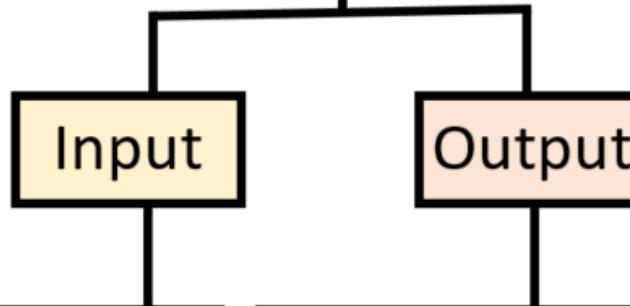
# Touch

- Distinguish between
  - **Tactility**: sensing **objects touching** the skin, perceiving object is rather **passive**
  - **Haptics**: **active exploration** through touch
  - **Vibration reception**



Human/Computer Interaction Unit 1

## Tactility (T.TA)



Devices that can sense direct or mediated physical contact  
*(e.g., traditional touchscreens)*

Devices that can simulate getting touched directly or via a medium  
*(e.g., gaming vests)*



## Haptics (T.HA)

### Input

Devices that allow manipulation of an explorable physical surface which optionally might have further attributes such as temperature  
*(e.g., Braille input devices)*

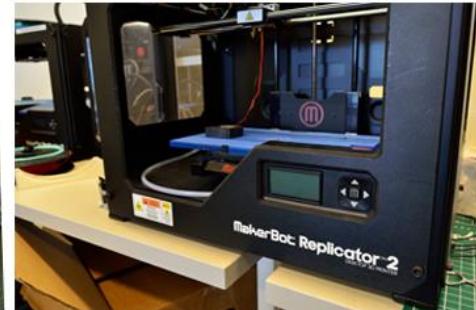


### Output

Devices that shift their shape and additionally might output further information such as temperature  
*(e.g., Braille displays)*



Devices that can form an external physical shape which might also include further information such as temperature  
*(e.g. 3D printers)*



## Vibration Reception (T.VR)

### Input

Devices that can sense vibration (e.g., devices that measure tremor) and might optionally be able to detect further attributes such as temperature



### Output

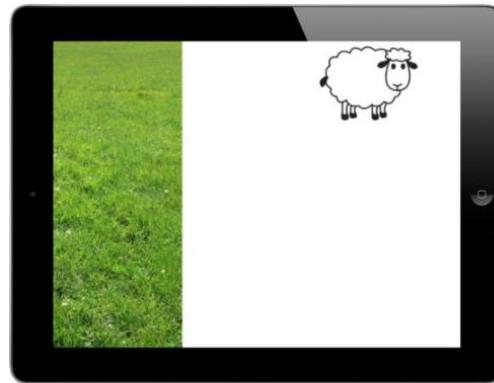
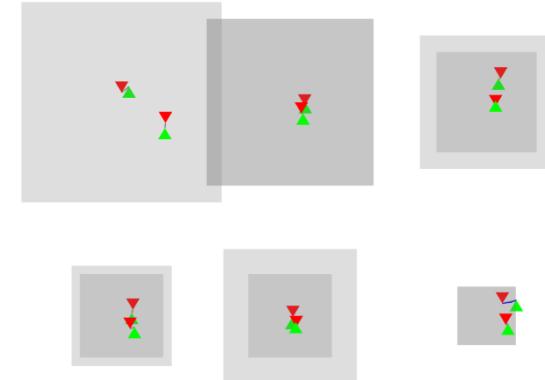
Devices that apply an autonomous motion or force on the subject (e.g., smart phones with vibration motors) which might optionally be able output further information such as temperature



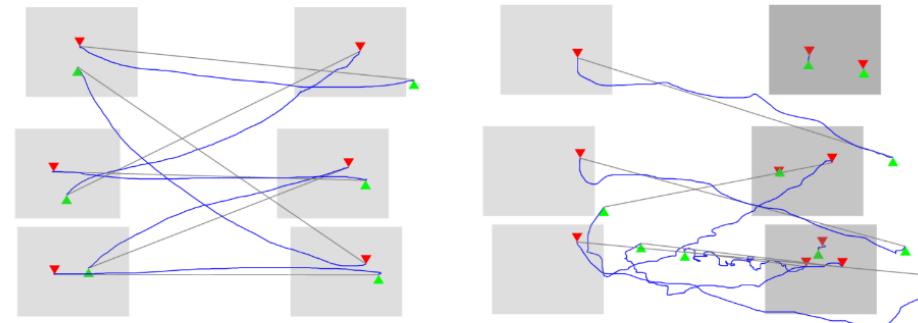


# Touch: Pay Attention to ...

- ... size
- ... positions
- ... distances
  - optimization: Fitts' Law



a ) Drag and Drop Test Screen



[12]

Human/Computer Interaction Unit 1



# Touch: Pay Attention to ...

- ... sensitivity
- ... pressure intensity



[13-14]

Human/Computer Interaction Unit 1

Winter Term 2022/2023

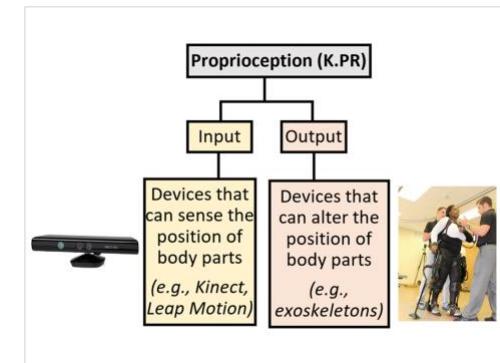
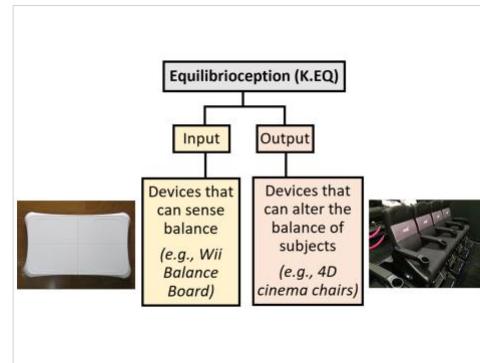
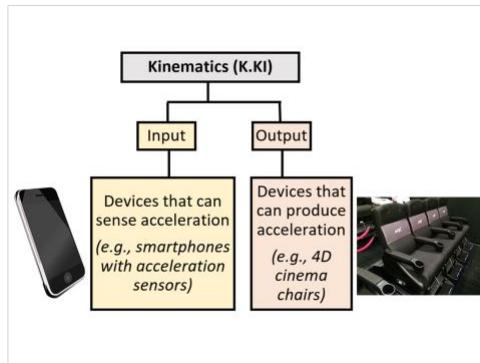
Mirjam Augstein

34



# Kinesthetics

- Feeling of **motion**
- Distinguish between
  - **Kinematics**: movement and acceleration
  - **Equilibrioception**: balance
  - **Proprioception**: position of body and limbs



Human/Computer Interaction Unit 1

## Kinematics (K.KI)

### Input

Devices that can sense acceleration  
*(e.g., smartphones with acceleration sensors)*

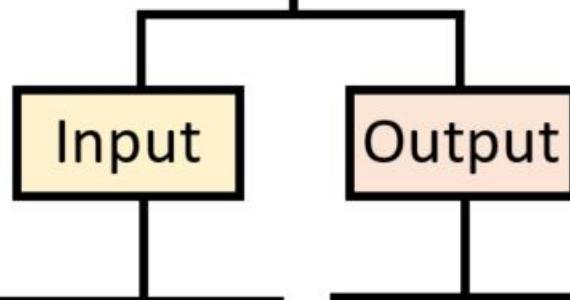


### Output

Devices that can produce acceleration  
*(e.g., 4D cinema chairs)*



## Equilibrioception (K.EQ)

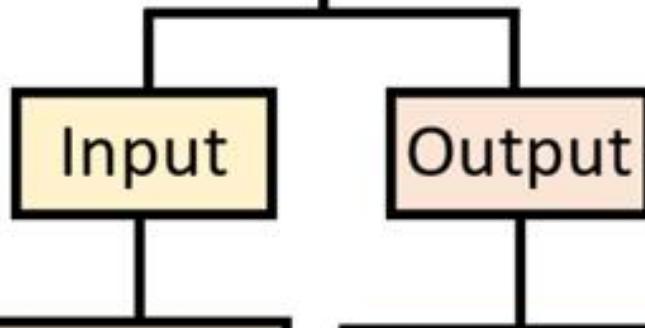


Devices that can sense balance  
(e.g., *Wii Balance Board*)

Devices that can alter the balance of subjects  
(e.g., *4D cinema chairs*)



# Proprioception (K.PR)



Devices that can sense the position of body parts  
*(e.g., Kinect, Leap Motion)*



Devices that can alter the position of body parts  
*(e.g., exoskeletons)*



# Kinesthetics: Pay Attention to...

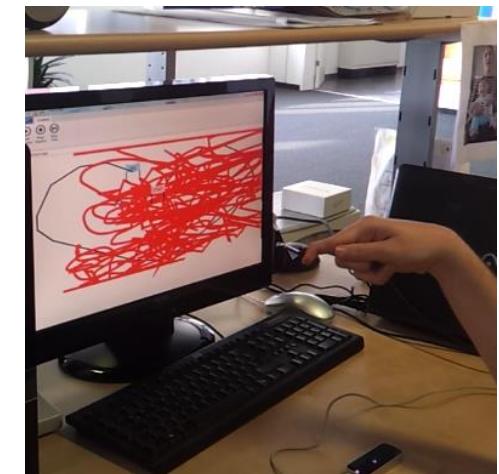
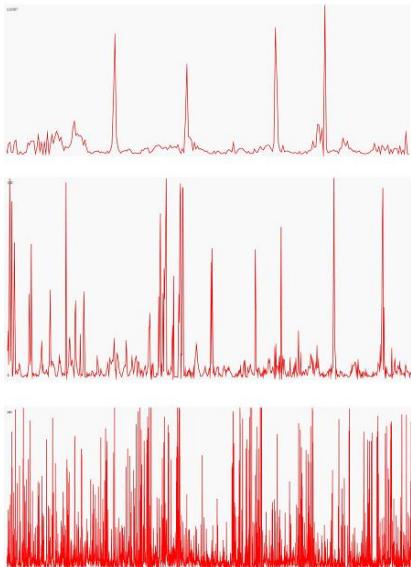


UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



- ... mobility, active area,  
(missing) feedback

[12]

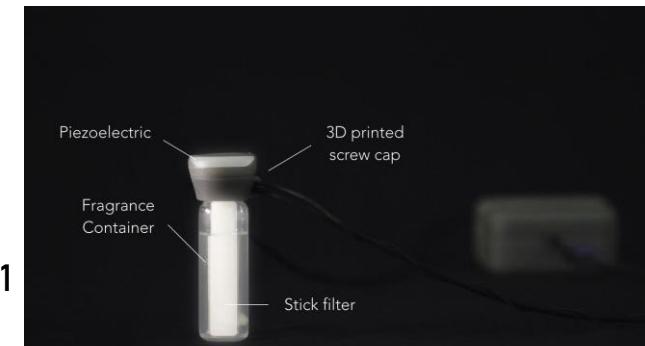


Human/Computer Interaction Unit 1



# Olfaction

- Input
  - Devices that can **react to smell / scents**
- Output
  - Devices that **produce smell / scents**
  - **Human action:** smell, interpret
- <https://www.media.mit.edu/projects/essence/overview/>



Human/Computer Interaction Unit 1

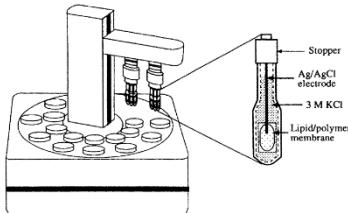
Mirjam Augstein

Winter Term 2022/2023

Credit: MIT MediaLab / Judith Amores

# Gustation

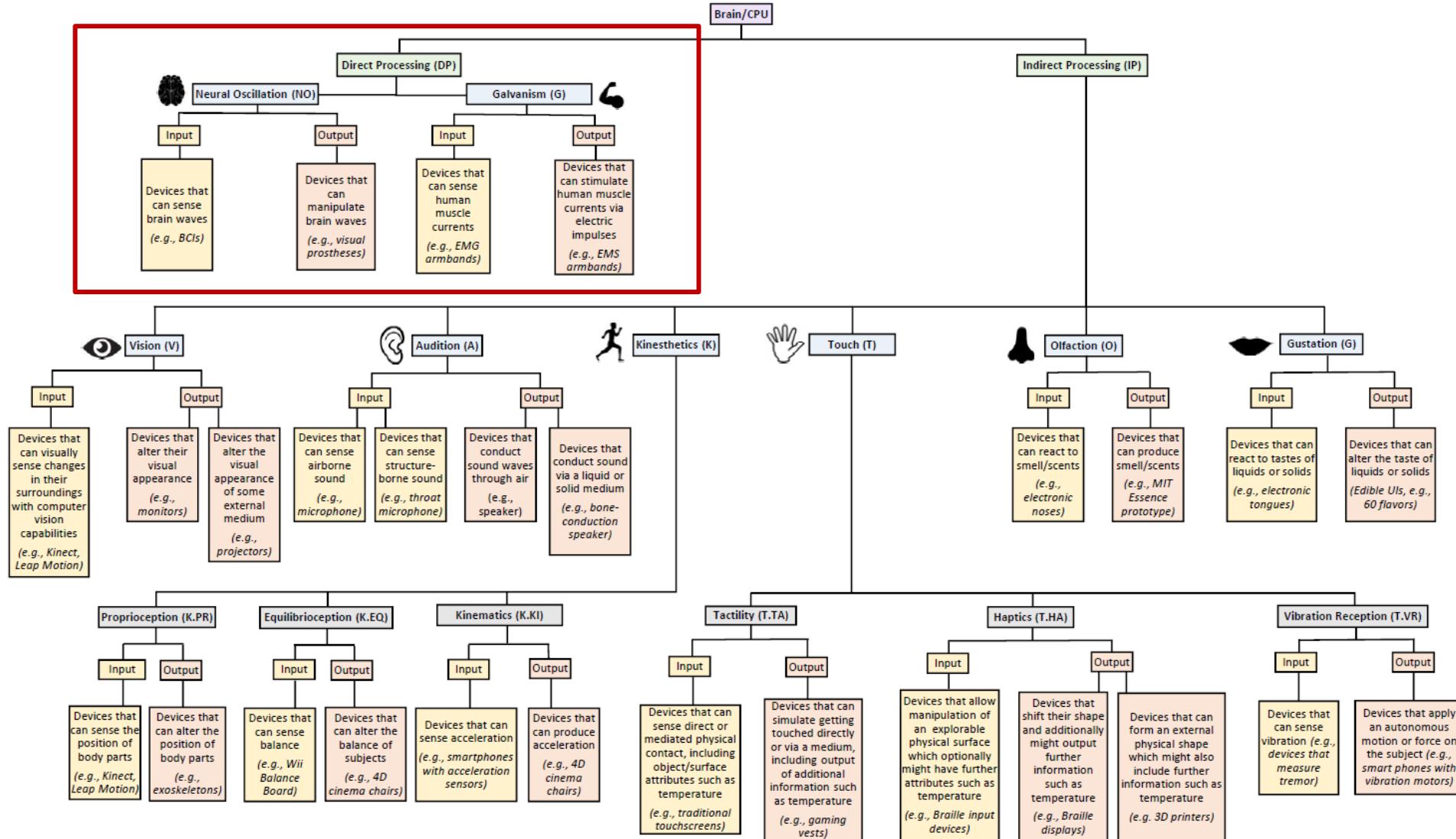
- Input
  - Devices that can **react to tastes of liquids or solids**
- Output
  - Devices that **alter the taste of liquids / solids**
  - **Human action:** taste, interpret
- <https://kunstuni-linz.at/60-flavors.11234+M52087573ab0.0.html>
- <http://www.printadrink.com/>



Human/Computer Interaction Unit 1

# Sensors & Senses

## Taxonomy [3]





# Neural Oscillation

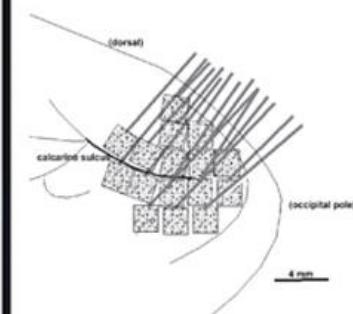
- Input
  - Devices that can **sense** to **brain waves**
  - **Human action:** think / focus / unconscious
- Output
  - Devices that **manipulate** **brain waves**
  - **Human action:** unconscious



Picture by  
Dan Wilton  
under the CC  
Attribution-  
Share Alike  
4.0  
International  
license



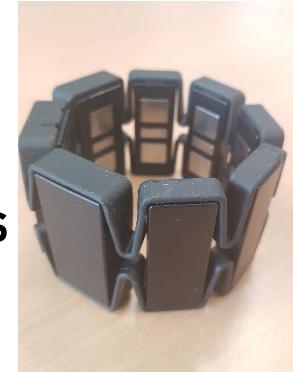
Human/Computer Interaction Unit 1





# Galvanism

- Input
  - Devices that can **sense** human **muscle currents**
  - **Human action:** tense / relax muscles / unconscious
  
- Output
  - Devices that **stimulate** human **muscle currents**
  - **Human action:** unconscious



Human/Computer Interaction Unit 1

# Sensors & Senses

## Taxonomy: Application



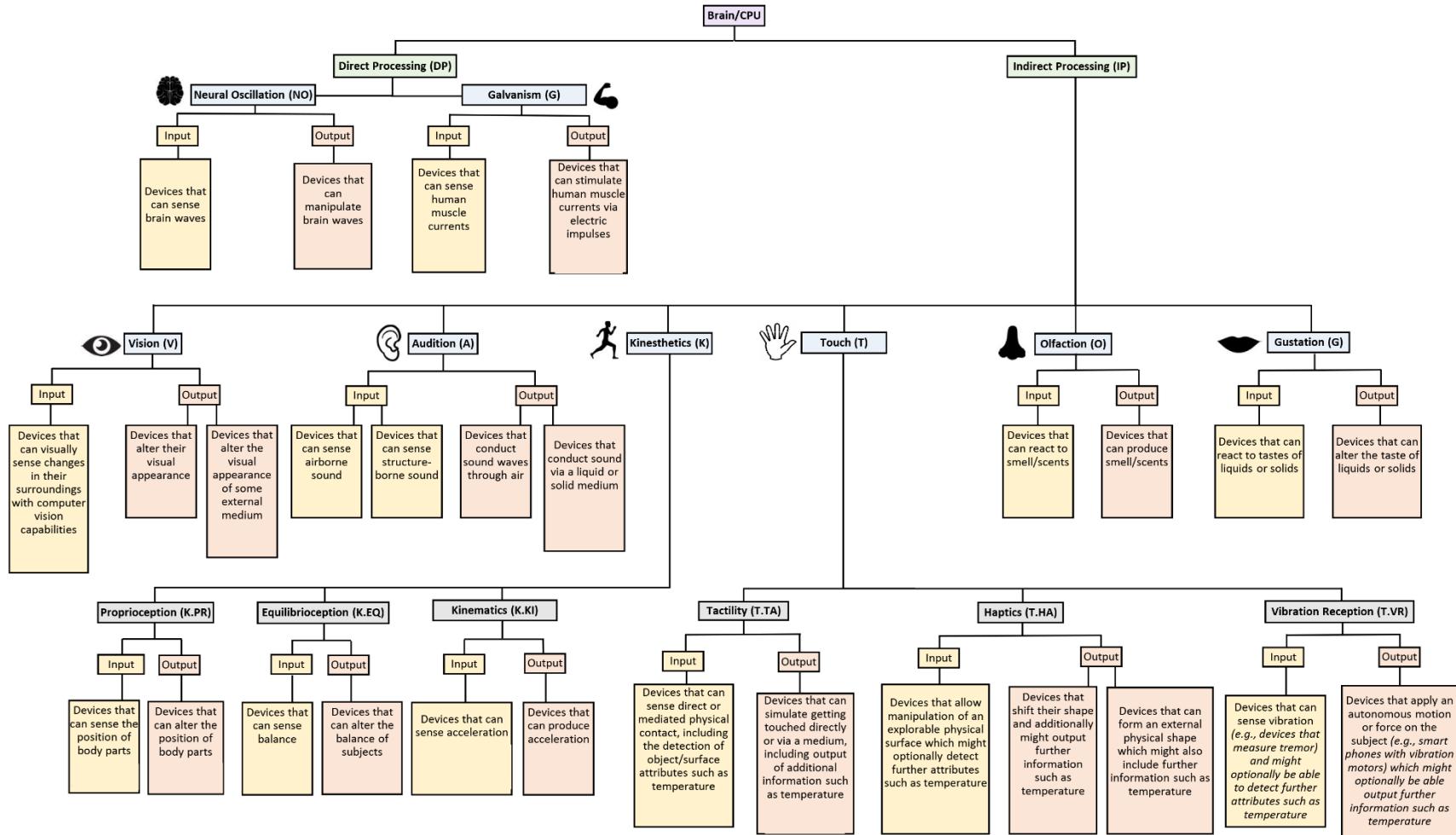
UNIVERSITY  
OF APPLIED SCIENCES  
UPPER AUSTRIA



- Gain a **systematic overview** of interaction **modalities**
- **Describe** existing interaction devices or methods
- **Decide** which modality and/or device to use for specific person or specific use case
- Example 1: **classify** a Braille display 
- Example 2: **describe** a standard **smart phone** 
- Example 3: **select** an **input** and **output method** for an industrial use case with the following parameters: loud environment, input should be precise and reliable, not safety-critical, seated position, leather gloves on

Human/Computer Interaction Unit 1

# Sensors & Senses Taxonomy



Human/Computer Interaction Unit 1

# Sensors & Senses Taxonomy

## Impact & Limitations



- **Systematic** and probably the **most exhaustive** taxonomy of interaction modalities and devices
- **Less prone** to be quickly **outdated** → more **durable**
- Applicable in a **wide range** of **domains**
- However:
  - a **simplification** and **not complete**
  - (Purposefully) reduced to **maximum overlap** (Bernsen) of **human** and **computer capabilities**
  - **only** contains measures generally **suitable** for **interaction**



# Scope & Limitations

- Excluded „senses“:
  - **Nociception:** sense of pain
  - **Chronoception:** sense of time
  - **Thermoception:** sense of temperature
- Further **asymmetries**, e.g. discrepancy between human and computer capabilities (e.g., meta information through pitch of voice or facial expression)
- **Borderline cases**, e.g.: human output of scent for interaction purposes

## P(A)INBALL: A pinball machine that hurts

Alina Hultgren

Mixed Reality and Visualization  
University of Applied Sciences  
Düsseldorf

Joseph-Göckeln-Str. 9

40474 Düsseldorf, Germany

alina.hultgren@fh-duesseldorf.de

Christian Geiger

Mixed Reality and Visualization  
University of Applied Sciences  
Düsseldorf

Joseph-Göckeln-Str. 9

40474 Düsseldorf, Germany

geiger@fh-duesseldorf.de

**Abstract**

In this paper, we describe the concept, implementation and evaluation of a mixed reality pinball game called Pinball, which directs discomfort on the users, as part of the game mechanism. We created a pinball machine consisting of an original pinball cabinet to be operated via a joystick and a trackball, combined with virtual and tangible devices that allow for carefully designed uncomfortable, sometimes physically painful, interactions. Users can decide how much pain to endure intended as a means to explore their own limits of enduring discomfort as tests of courage in social interactions mediated via technology.

**Author Keywords**

Uncomfortable interactions; tangible user interfaces.

**ACM Classification Keywords**

H.5.2. User Interfaces: Haptic I/O

**Introduction**

“A life without pain has no meaning”, German philosopher Schopenhauer once said, whose philosophy regarded the suffering of the body as evolving to the central locus of meaning of human existence [7].

Pain has not only been a topic for philosophers, see e.g. “Dukkha” (suffering, pain) in Buddhist tradition

Daniel Glomburg

Mixed Reality and Visualization  
University of Applied Sciences

Düsseldorf

Joseph-Göckeln-Str. 9

40474 Düsseldorf, Germany

daniel.glomburg@fh-duesseldorf.de

Copyright is held by the author/owner(s).

TET 2014, Feb 16 - 19, 2014, Munich, Germany.

Daniel Dröchner

Mixed Reality and Visualization  
University of Applied Sciences

Düsseldorf

Joseph-Göckeln-Str. 9

40474 Düsseldorf, Germany

daniel.drochner@fh-duesseldorf.de



# Conclusions

- Range of I/O mechanisms is broad
- Human sensory system is complex
- Human capabilities are broad and diverse (!)
- Use cases are diverse
- Regardless of domain and scope:
  - Conceptualize, design and implement around the human
  - Tailor to the use case
  - Don't expect use case to evolve around technology
  - Don't expect human to adapt to technology

Human/Computer Interaction Unit 1



# Questions

Human/Computer Interaction Unit 1

Winter Term 2022/2023

Mirjam Augstein

50



# Contact

- eMail: [mirjam.augstein@fh-hagenberg.at](mailto:mirjam.augstein@fh-hagenberg.at)
- Web:
  - PEEC: <https://peec.fh-hagenberg.at/>
  - PURE: <https://pure.fh-ooe.at/de/persons/mirjam-augstein>
- Projects:
  - Overview: <https://peec.fh-hagenberg.at/projects>
  - HYCOS: <http://hycos.fh-hagenberg.at/>
  - WIFI: <https://welding.fh-ooe.at/>
  - Fun.tast.tisch: <https://www.funtastisch.at/>



# References

- [1] Aggression gegen Computer. Eine wissenschaftliche Untersuchung eines alltäglichen Phänomens, M. Brinks, ibidem Press, 2012
- [2] Physical Computing: Sensing and Controlling the Physical World with Computers, D. O'Sullivan & Igoe, T., Course Technology Press, 2004
- [3] A Human-Centered Taxonomy of Interaction Modalities and Devices, M. Augstein & T. Neumayr, *Interacting with Computers* 31 (1), Oxford Academic, 2019
- [4] An Input-Output Model for Interactive Systems, M. Shaw, In Proceedings of Human Factors in Computing Systems CHI '86, Boston, Massachusetts, USA, 1986
- [5] Lexical and Pragmatic Consideration of Input Structures. B. Buxton, *Computer Graphics* 17, 31-37, 1983



# References

- [6] **The Art of Natural Graphic Machine Conversation**, J. Foley & V. Wallace, *Proceedings of IEEE* 62, 462-471, 1974
- [7] **The Human Factors of Computer Graphics Interaction Techniques**, J. Foley, V. Wallace & P. Chan, *IEEE Computer Graphics and Applications* 4, 13-48, 1984
- [8] **Foundations of Multimodal Representations. A Taxonomy of Representational Modalities**, N.O. Bernsen, *Interacting with Computers* 6, 347-371, 1994
- [9] **Multimodality Theory**, N.O. Bernsen, In D. Tzovaras (ed.) *Multimodal User Interfaces. From Signals to Interaction*, 5-29, 2008
- [10] **Multimodal Human-Computer Interaction: A Survey**, A. Jaimes & N. Sebe, *Computer Vision Image Understanding* 108, 116-134, 2007



# References

- [11] WeldVUI: Establishing Speech-Based Interfaces in Industrial Applications, in Proceedings of the 17<sup>th</sup> IFIP Conference on Human-Computer Interaction (INTERACT), Paphos, Cyprus, Greece, 2019
- [12] User Modeling for People with Special Needs, W. Kurschl, M. Augstein, T. Burger, C. Pointer, *International Journal of Pervasive Computing and Communications* 10 (3), 2014
- [13] Haptic and Touchless User Input Methods for Simple 3D Interaction Tasks: Interaction Performance and User Experience for People with and without Impairments, M. Augstein, T. Neumayr, T. Burger, J. Altmann, W. Kurschl & S. Vreker, In VISIGRAPP 2018. Communications in Computer and Information Science, vol. 997, Springer, 2018
- [14] Collaboration around an Interactive Tabletop in Rehabilitation Settings, M. Augstein, T. Neumayr, R. Ruckser-Scherb, S. Dielacher, In C. Anslow, P. Campos, J. Jorge (eds.) Collaboration Meets Interactive Spaces, Springer, 2016