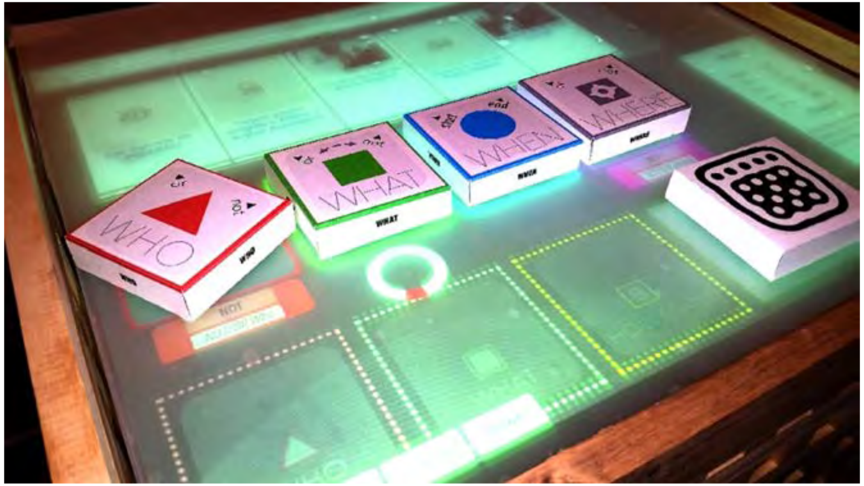
Tangible User Interface (TUI) – Introduction

TUI refers to a user interface in which a person interacts with digital information through the physical environment. It makes human computer interaction to be more involved with human body, which make interactive input more intuitive.



Amy Yanhong Li (Email: yanhong.li@ifi.lmu.de)

Tangibles for Classroom Learning

Technologies, such as interactive whiteboard and iPad, have been used to support learning for many years. However, TUI brought a new potential for learning for its embodied, playful and engaged physical design.

RQ: How to design TUIs to support classroom learning? What are the limitations of current TUIs for classroom learning?

Shelley, T., Lyons, L., Zellner, M., & Minor, E. (2011). Evaluating the embodiment benefits of a paper-based tui for educational simulations. In *CHI'11 Extended Abstracts on Human Factors in Computing Systems* (pp. 1375-1380).

Antle, A. N., Wise, A. F., & Nielsen, K. (2011, June). Towards utopia: designing tangibles for learning. In *Proceedings of the 10th International Conference on Interaction Design and Children* (pp. 11-20).

Playful Interactions with TUI

TUIs have physical objects could make people more engaged with HCI. One of the biggest advantages is playful interaction experience.

RQ: What are elements for playful interactions? Does playful interaction actually make people learn better?

Chang, Y. C., Lo, J. L., Huang, C. J., Hsu, N. Y., Chu, H. H., Wang, H. Y., ... & Hsieh, Y. L. (2008, April). Playful toothbrush: ubicomp technology for teaching tooth brushing to kindergarten children. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 363-372).

Feltham, F., Vetere, F., & Wensveen, S. (2007, August). Designing tangible artefacts for playful interactions and dialogues. In *Proceedings of the 2007 conference on Designing pleasurable products and interfaces* (pp. 61-75).

Amy Yanhong Li (Email: yanhong.li@ifi.lmu.de)

Aesthetics Design of TUI

TUIs change our traditional ways to interact with ‘computers’, which make people can use their natural body gestures. Therefore, its interface designs have more aesthetics requirement to either make human interaction more nature or change our user experience.

RQ: How TUIs design could change human interaction? When interacting using human body, what aesthetics do we need for TUI design?

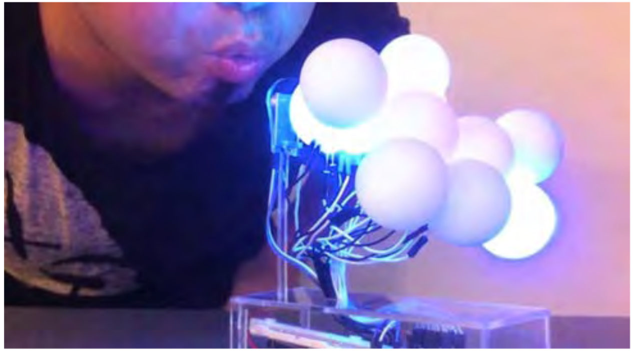
Neumann, L., Sbert, M., Gooch, B., & Purgathofer, W. (2005). Defining computational aesthetics. *Computational aesthetics in graphics, visualization and imaging*, 13-18.

Mõttus, M., & Lamas, D. (2015). Aesthetics of interaction design: A literature review. *Proceedings of the Mulitimedia, Interaction, Design and Innnovation*, 1-10.

Amy Yanhong Li (Email: yanhong.li@ifi.lmu.de)

Abstract Representation of Tangible Interaction

Tangibles make the mapping between digital objects and physical objects more representative. Thus, its ‘interaction’ has more meanings than traditional HCI. It contains abstract representations of human intention and nature.



RQ: How previous studies have designed it? How to design abstract representations to make tangible interaction more nature?

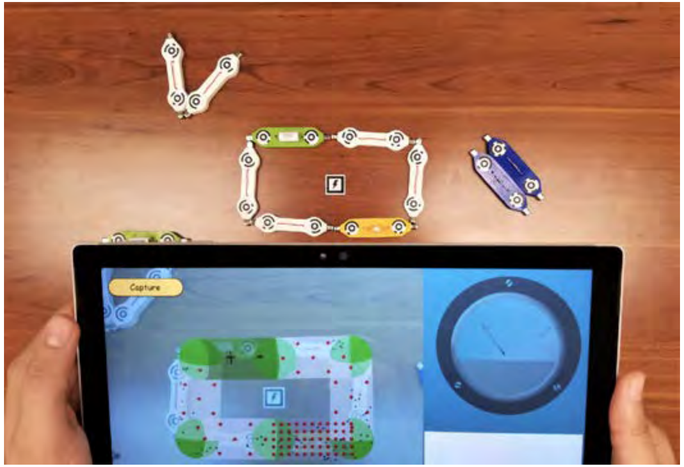
Price, S. (2008, February). A representation approach to conceptualizing tangible learning environments. In *Proceedings of the 2nd international conference on Tangible and embedded interaction* (pp. 151-158).

Ishii, H. (2008, February). Tangible bits: beyond pixels. In *Proceedings of the 2nd international conference on Tangible and embedded interaction* (pp. xv-xxv).

Amy Yanhong Li (Email: yanhong.li@ifi.lmu.de)

Tangible and Ubiquitous Technology for Teaching Physics Concepts

- Physics phenomena occurring in our environment can be measured and visualised with ubiquitous and tangible technology
- Examples:
  - acceleration measurements with smartphone sensors
  - tangibles representing elements of an electric circuit
- It is argued that representations based on the real world promote learning
- Concepts are often not restricted to classroom settings



Beheshti et al.

Tasks and Research Questions

- Research Questions
  - What are benefits of tangibles and ubiquitous technology for teaching physics concepts?
  - What requirements must they meet in order to promote learning?
  - What are promising areas for future projects?
- Literature research on technology for teaching physics concepts and connection to underlying cognitive psychology principles and learning theory (e.g., multimedia learning, situated learning)
- Clustering and summarising results of the literature research
- Discussion of the research questions, with specific references to examples

Literature

- González, M. Á., da Silva, J. B., Cañedo, J. C., Huete, F., Martínez, Ó., Esteban, D., Manso, J., Rochadel, W., & González, M. Á. (2015). Doing physics experiments and learning with smartphones. *Proceedings of the 3rd International Conference on Technological Ecosystems for Enhancing Multiculturality - TEEM '15*, 303–310. https://doi.org/10.1145/2808580.2808626
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- Ibáñez, M.-B., & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. *Computers & Education*, *123*, 109–123. https://doi.org/10.1016/j.compedu.2018.05.002
- Bano, M., Zowghi, D., Kearney, M., Schuck, S., & Aubusson, P. (2018). Mobile learning for science and mathematics school education: A systematic review of empirical evidence. *Computers & Education*, *121*, 30–58. https://doi.org/10.1016/j.compedu.2018.02.006
- Beheshti, E., Kim, D., Ecanow, G., & Horn, M. S. (2017). Looking Inside the Wires: Understanding Museum Visitor Learning with an Augmented Circuit Exhibit. *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems - CHI '17*, 1583–1594. https://doi.org/10.1145/3025453.3025479

How to measure immersion in VR?

Francesco Chiossi

francesco.chiossi@um.ifi.lmu.de

How to measure immersion in VR?

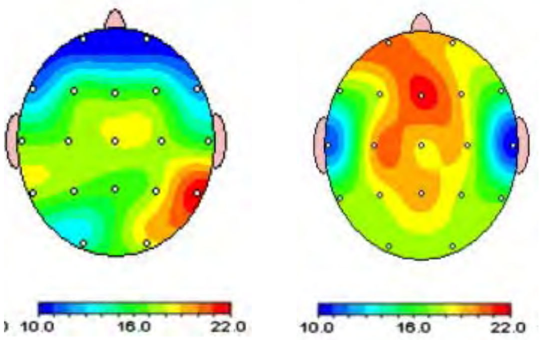
The use of the term ‘immersion’ to describe a multitude of varying experiences in the absence of a definitional consensus has obfuscated and diluted the term. The goal of this HS paper is to :

- Provide an operationalizable definition of immersion and its components (sensory immersion, challenge immersion, system immersion);
- Review how such studies proposed to evaluate immersion on a subjective and behavioral level.

Francesco Chiossi

francesco.chiossi@um.ifi.lmu.de

Electrophysiological correlates of Immersion in VR



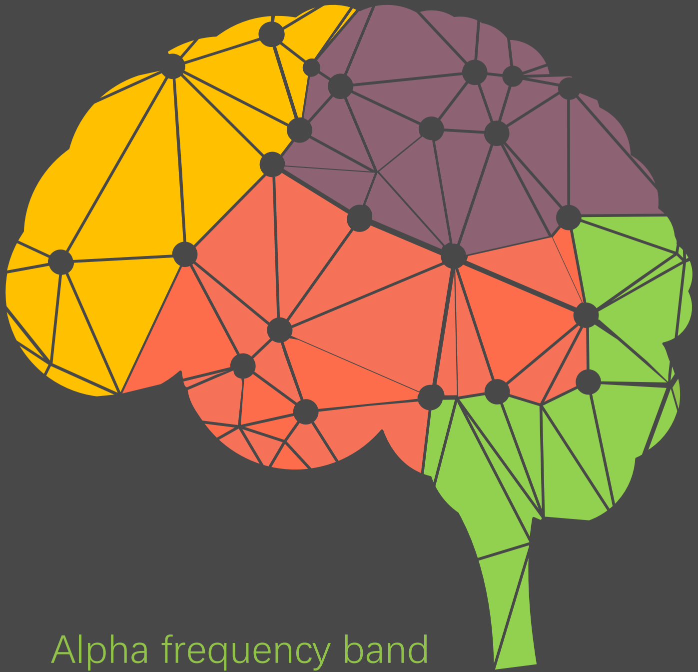
Francesco Chiossi

francesco.chiossi@um.ifi.lmu.de

EEG correlates of immersion

Theta frequency band
sensory information coordination with a motor plan, working memory

Task Engagement Index
ratio of beta to (alpha + theta)



Event Related Potentials

Measured brain response that is the direct result of a specific sensory, cognitive, or motor event.

Alpha frequency band

Perception, internal and external attention, processing of relevant information

Francesco Chiossi

francesco.chiossi@um.ifi.lmu.de

Electrophysiological correlates of Immersion in VR

Goal of the HS paper

The paper will identify ERP and EEG correlates of immersion in VR environments.

This will be organized and specified by first providing a definition of immersion, its categorization into sensory, challenge and system immersion presence and how this is disentangled from presence.

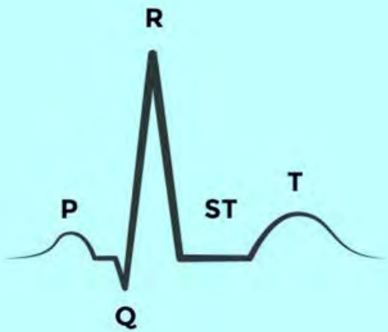
The goal is to identify indicators that can be employed to evaluate Virtual Environments.

Francesco Chiossi

francesco.chiossi@um.ifi.lmu.de

Francesco Chiossi & Luke Haliburton

Notification overload elicited by notifications : evaluation using physiological sensing



Goal of the HS paper

We often experience interruption overload caused by large numbers of notifications from our device. Smartphones, smartwatches, laptops, and other connected systems that are the main sources of interruptions.

- **Research Focus:**

How evaluate the impact of interruption due to notification (productivity, emotional and social) using psychophysiological measures (e.g. skin conductance, EKG and EEG).

Francesco Chiossi & Steeven Villa

francesco.chiossi@um.ifi.lmu.de
steeven.villa@um.ifi.lmu.de

Neuromarketing

EEG Metrics for evaluating shopping experiences in Virtual Environments

Goal of the HS paper

Francesco Chiossi & Steeven Villa

francesco.chiossi@um.ifi.lmu.de
steeven.villa@um.ifi.lmu.de

As focus on neural recording tools and interpretational methodologies used in this field is unclear, we aim to answer the following questions:

- What are the types of marketing stimuli currently being used in Neuromarketing in Virtual Environments?
- Which EEG signals are currently of interest for Neuromarketing?

Eye tracking on handheld devices

Handheld devices (e.g. phones, tablets) have all the hardware inside to do eye tracking. There are even some games on available nowadays that make use of the front facing camera of your device to do eye tracking. Questions that should be tackled in this project are:

1. What are current (hardware) limitations of eye tracking in handheld devices?
2. What are state-of-the-art techniques used to enhance the capabilities of the current hardware available used in eye tracking for handheld devices?

References:

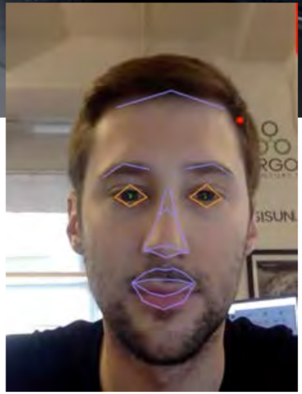
- The Past, Present, and Future of Gaze-enabled Handheld Mobile Devices: Survey and Lessons Learned (http://florian-alt.org/unibw/wp-content/publications/khamis2018mobilehci.pdf)
- Heiko Drewes, Alexander De Luca, and Albrecht Schmidt. 2007. Eye-gaze interaction for mobile phones. In <i>Proceedings of the 4th international conference on mobile technology, applications, and systems and the 1st international symposium on Computer human interaction in mobile technology</i> (<i>Mobility '07</i>). Association for Computing Machinery, New York, NY, USA, 364–371. DOI:https://doi.org/10.1145/1378063.1378122

Supervisor: Jesse Grootjen, jesse.grootjen@ifi.lmu.de

Eye tracking through your browser

There are multiple publicly available javascript libraries available that allow for the collection of gaze data while browsing a website. It allows for designers of websites to verify what they think is drawing the attention of visitors. One of the things that is interesting right now, especially in covid times where physical experiments are hard to do, is if we can set up an experiment via a website and collect “meaningful” gaze data. Questions that should be tackled in this project are:

1. How does the quality of the data differ from one webcam to another? Is this spread narrow?
2. How would the setting affect the data collected? E.g. light from the background
3. Since this would be an experiment run completely online, how do we deal with latency?



References:

- https://webgazer.cs.brown.edu
- Valtakari, N.V., Hooge, I.T.C., Viktorsson, C. *et al.* Eye tracking in human interaction: Possibilities and limitations. *Behav Res* (2021). https://doi.org/10.3758/s13428-020-01517-x

Supervisor: Jesse Grootjen, jesse.grootjen@ifi.lmu.de

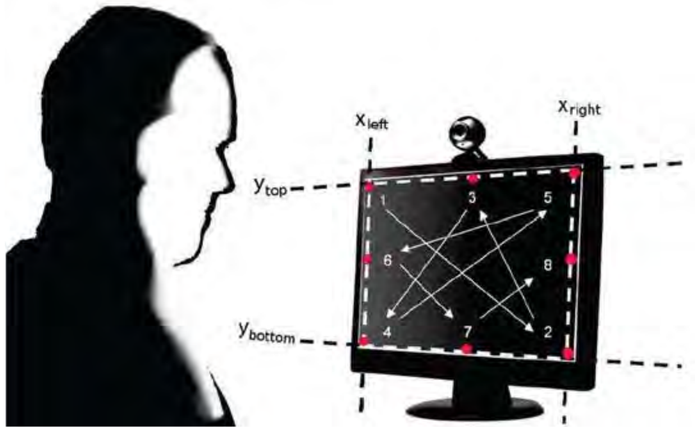
Implicit vs. Explicit eye tracking

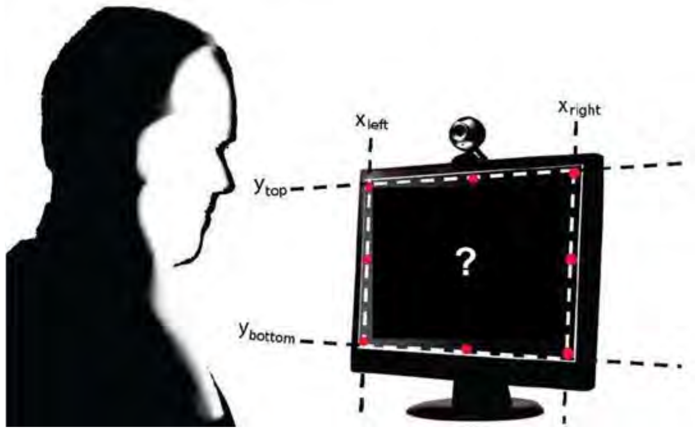
In experimental setups we explicitly know where a participant/user of a system is looking by presenting certain stimuli or having the participant/user press a button when looking at one specific point on the screen. However, daily life we don't have this luxury and sometimes we don't even have a cenic camera for context. Thus we will not be able to determine the importance of features such as the location of where someone is fixating. Questions that should be tackled in this project are:

1. How relevant are features that we lose if we only do implicit eye-tracking in a reading scenario?
2. How can we create the illusion of implicit eye tracking in a handheld device?

References:

- Roderer, T., Roebers, C.M. Explicit and implicit confidence judgments and developmental differences in metamemory: an eye-tracking approach. *Metacognition Learning* 5, 229–250 (2010). https://doi.org/10.1007/s11409-010-9059-z
- Jang, YM., Mallipeddi, R. & Lee, M. Identification of human implicit visual search intention based on eye movement and pupillary analysis. *User Model User-Adap Inter* 24, 315–344 (2014). https://doi.org/10.1007/s11257-013-9142-7





Supervisor: Jesse Grootjen, jesse.grootjen@ifi.lmu.de

The effect of bad eyes on eye movements

At some point you realise you can no longer read the subtitles of your favorite tv show, you do to the optician and they tell you you need glasses. This is a more common occurrence than one would think and it doesn’t only happen to glasses but also diseases that affect the eyes. It all happens so gradually you only notice it when you’re already walking around with it for a longer period. As with glasses you try to compensate for the lose in sight by squinting your eyes. But do you also compensate for this in the way you move your eyes around?

1. In what way do your eye movements differ while you have “bad eyes” compared to when you have “good eyes” (please pick one scenario and one type of *simulated* visual impairment)

References:

- Patching, G. R., & Jordan, T. R. (2005). Spatial frequency sensitivity differences between adults of good and poor reading ability. *Investigative ophthalmology & visual science*, *46*(6), 2219-2224.
- Jordan, T. R., McGowan, V. A., & Paterson, K. B. (2014). Reading with filtered fixations: Adult age differences in the effectiveness of low-level properties of text within central vision. *Psychology and Aging*, *29*(2), 229.

Supervisor: Jesse Grootjen, jesse.grootjen@ifi.lmu.de

The effect of age on eye movements

Your eyes tell a lot about you, when you are engaged in a task you can tell from how large the pupils are, when you are searching for an item you can tell from the way someone moves their eyes around the room. Age also plays a role to how your eyes behave. Questions for this project are:

1. What eye movement features are indicators for a change in age? (e.g. saccade length)
2. How accurate can we be in determining the age of a person by only looking at eye movements?

References:

- Paterson, K. B., McGowan, V. A., & Jordan, T. R. (2013). Filtered text reveals adult age differences in reading: Evidence from eye movements. *Psychology and Aging*, *28*(2), 352.
- Porter, G., Tales, A., Troscianko, T., Wilcock, G., Haworth, J., & Leonards, U. (2010). New insights into feature and conjunction search: I. Evidence from pupil size, eye movements and ageing. *Cortex*, *46*(5), 621-636.

Supervisor: Jesse Grootjen, jesse.grootjen@ifi.lmu.de

Mobile Sensing for Sustainability: Current Status, Challenges and Opportunities

How can Mobile Sensing technology support sustainable behaviour to combat climate change?

Sensing sustainability-related behaviours [2]

Predict triggers for misbehaviour

Suggest sustainable alternatives in opportune moments [1]

Starting Points

[1] Sensing opportunities for personalized feedback technology to reduce consumption

[2] Towards sustainable mobility behavior: research challenges for location-aware information and communication technology

Florian Bemmann

Mobile XAI

Mobile Sensing data can predict a lot about their origin users [1]

How can we explain Mobile Sensing data based predictions to their origin users?

- How can we make the user understand which real world behaviour predicts a target variable?
- How can these explanations be presented on a Mobile device?
- How can the user be engaged in the Machine Learning process, e.g. by training a personalized model locally?

Florian Bemmann

florian.bemmann@ifi.lmu.de

[1] Stachl et al. 2020. Predicting personality from patterns of behaviour collected with smarthones. PNAS 117, 30 (2020)

AR as Assistive Technology

LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

- People with visual impairments –even legally blind– often have residual vision -> Augment interfaces

StateLens: A Reverse Engineering Solution for Making Existing Dynamic Touchscreens

Figure 1. StateLens is a system that enables blind users to interact with touchscreen devices in the real world by *(i)* reverse engineering a structured model of the underlying interface, and *(ii)* using the model to provide interactive conversational and audio guidance to the user about how to use it. A set of 3D-printed accessories enable capacitive touchscreens to be used non-visually by preventing accidental touches on the interface.

Supporting Older Adults in Using Complex User Interfaces with Augmented Reality

Haptic XR

HapticXR: A Review of Different Types of Haptic Feedback in Extended Reality

Tasks:

1. Literature Review:
   ["haptic" OR "touch"] AND ["virtual reality" OR "augmented reality" OR "mixed reality"]
2. To identify categories of haptic feedback in VR;
3. To identify requirements of testing environments;
4. To identify evaluation criteria and measurement of hapticVR.

References:
[1] Julian Kreimeier, Sebastian Hammer, Daniel Friedmann, Pascal Karg, Clemens Bühner, Lukas Bankel, and Timo Götzelmann. 2019. Evaluation of different types of haptic feedback influencing the task-based presence and performance in virtual reality. In Proceedings of the 12th ACM International Conference on PErvasive Technologies Related to Assistive Environments (PETRA '19), 289–298. https://doi.org/10.1145/3316782.3321536
[2] Yuntao Wang, Zichao (tyson) Chen, Hanchuan Li, Zhengyi Cao, Huiyi Luo, Tengxiang Zhang, Ke Ou, John Raiti, Chun Yu, Shwetak Patel, and Yuanchun Shi. 2020. MoveVR: Enabling Multiform Force Feedback in Virtual Reality using Household Cleaning Robot. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20), 1–12. https://doi.org/10.1145/3313831.3376286

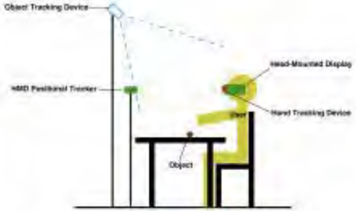
Jingyi Li
jingyi.li@ifi.lmu.de

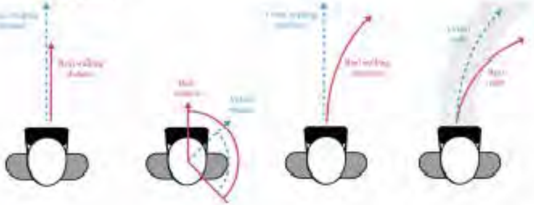
Confined VR

ConfinedVR: A Review of User Redirection in Virtual Environments

Tasks:

1. Literature Review:
   ["limitations" OR "constraints" OR "restraints"] AND ["redirect"] AND ["virtual reality"]
2. To identify clusters of user redirection techniques in VR;
3. To identify requirements of testing environments;
4. To identify evaluation criteria and measurement of user redirection in virtual environments.





References:
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[2] Niels Christian Nilsson, Stefania Serafin, Frank Steinicke, and Rolf Nordahl. 2018. Natural Walking in Virtual Reality: A Review. Comput. Entertain. 16, 2: 1–22. https://doi.org/10.1145/3180658

Jingyi Li
jingyi.li@ifi.lmu.de

Social VR

Jingyi Li
jingyi.li@ifi.lmu.de

SocialVR: A Design Space of Social Interaction in Virtual Reality

Tasks:

1. Literature Review:
   ["social interaction" OR "avatar" OR "co-presence"] AND ["virtual reality"]
2. To identify categories of social VR applications: the self, interaction with others, the environment;
3. To identify application scenarios;
4. To identify evaluation criteria and measurement of social VR applications.

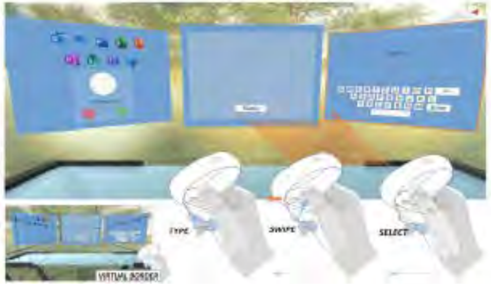
References:
[1] Marcel Jonas, Steven Said, Daniel Yu, Chris Aiello, Nicholas Furlo, and Douglas Zytko. 2019. Towards a Taxonomy of Social VR Application Design. In Extended Abstracts of the Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts (CHI PLAY '19 Extended Abstracts), 437–444. https://doi.org/10.1145/3341215.3356271
[2] Brian E. Mennecke, Janea L. Triplett, Lesya M. Hassall, Zayira Jordán Conde, and Rex Heer. 2011. An examination of a theory of embodied social presence in virtual worlds: Examination of a theory of embodied social presence. Decision sciences 42, 2: 413–450. https://doi.org/10.1111/j.1540-5915.2011.00317.x


Mobile Office

Mobile Office: A Review of Productivity Interaction in Cars and Other Transportation

Tasks:

1. Literature Review:
   ["productivity" OR "work"] AND ["car" OR "transport" OR "transit"]
2. To identify clusters of productivity interaction (task sets and modalities) in VR;
3. To identify testing environments;
4. To identify evaluation criteria and measurement of productivity interactionduring transit.

References:
[1] Jingyi Li, Ceenu George, Andrea Ngao, Kai Holländer, Stefan Mayer, and Andreas Butz. 2021. Rear-Seat Productivity in Virtual Reality: Investigating VR Interaction in the Confined Space of a Car. Multimodal Technologies and Interaction 5, 4: 15. https://doi.org/10.3390/mti5040015
[2] C. Schartmüller, P. Wintersberger, A. Frison, and A. Riener. 2019. Type-o-Steer: Reimagining the Steering Wheel for Productive Non-Driving Related Tasks in Conditionally Automated Vehicles. In 2019 IEEE Intelligent Vehicles Symposium (IV). 1699–1706. https://doi.org/10.1109/IVS.2019.8814088

Jingyi Li
jingyi.li@ifi.lmu.de

Asynchronous Social Awareness in VR

VR enables meetings in the virtual world. However, it is still very limited when it comes to social cues. Especially, when working in a globally distributed team with timezones, increasing the social awareness within the same virtual space is challenging. Questions that should be tackled in this project are:

1. What is the current status in research to approach asynchronous social awareness in VR?
2. What are approaches or strategies in other realities that VR could benefit from?

https://medium.com/reese-innovate/the-best-platform-for-virtual-reality-classrooms-26d48cf2c9aa

References

- Shao-Heng Ko, Hsu-Chao Lai, Hong-Han Shuai, Wang-Chien Lee, Philip S. Yu, and De-Nian Yang. 2020. Optimizing item and subgroup configurations for social-aware VR shopping. <i>Proc. VLDB Endow.</i> 13, 8 (April 2020), 1275–1289. DOI:https://doi-org.emedien.ub.uni-muenchen.de/10.14778/3389133.3389143
- Ali Almutawa and Ryoko Ueoka. 2019. The Influence of Spatial Awareness on VR: Investigating the influence of the familiarity and awareness of content of the real space to the VR. In <i>Proceedings of the 2019 3rd International Conference on Artificial Intelligence and Virtual Reality</i> (<i>AIVR 2019</i>). Association for Computing Machinery, New York, NY, USA, 26–30. DOI:https://doi-org.emedien.ub.uni-muenchen.de/10.1145/3348488.3348502

Supervisor: Linda Hirsch linda.hirsch@ifi.lmu.de

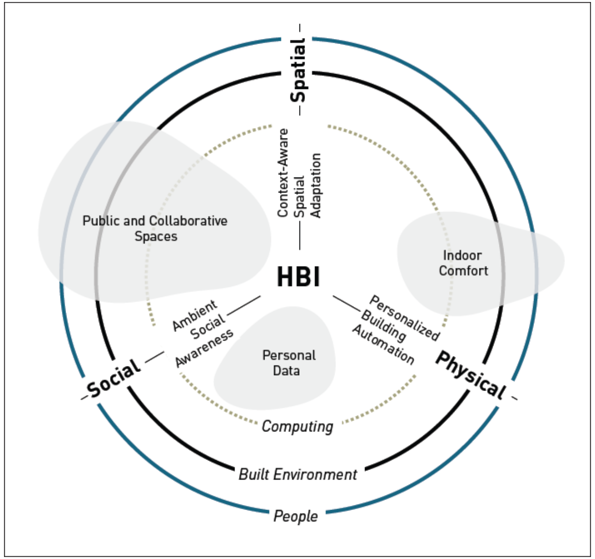
Trends and Perspectives in Human-Building Interaction

Human-Building Interaction is a novel research field dealing with the development of smart environments from a user-centred perspective. It enhances current trends of smart cities to a whole new environment interaction level. Questions for you are, e.g.:

1. What are current research trends in HBI?
2. In which direction is the field heading?
3. And how does it differ to the current smart city (IoT) developments?

References

- Hamed S. Alavi, Elizabeth F. Churchill, Mikael Wiberg, Denis Lalanne, Peter Dalsgaard, Ava Fatah gen Schieck, and Yvonne Rogers. 2019. Introduction to Human-Building Interaction (HBI): Interfacing HCI with Architecture and Urban Design. DOI:10.1145/3309714
- Stine S. Lundgaard, Jesper Kjeldskov, and Mikael B. Skov. 2019. Temporal Constraints in Human--Building Interaction. <i>ACM Trans. Comput.-Hum. Interact.</i> 26, 2, Article 8 (April 2019), 29 pages. DOI:10.1145/3301424
- Binh Vinh Duc Nguyen, Adalberto L. Simeone, and Andrew Vande Moere. 2021. Exploring an Architectural Framework for Human-Building Interaction via a Semi-Immersive Cross-Reality Methodology. In Proceedings of the 2021 ACM/IEEE International Conference on Human-Robot Interaction (HRI '21). Association for Computing Machinery, New York, NY, USA, 252–261. DOI:10.1145/3434073.3444643



https://interactions.acm.org/archive/view/july-august-2019/human-building-interaction

Supervisor: Linda Hirsch linda.hirsch@ifi.lmu.de

Reflecting on Naturecultural Design for HCI

Designing for more than humans and in “co-creation with nature” – various attempts move aways from a purely human-centered design perspective toward a more holistic and sustainable strategy. Naturecultural Design is one of those. Questions for you are, e.g.:

1. What does Naturecultural design mean?
2. What is its philosophy and how is it related to HCI?
3. What is your opinion about its potential?

References

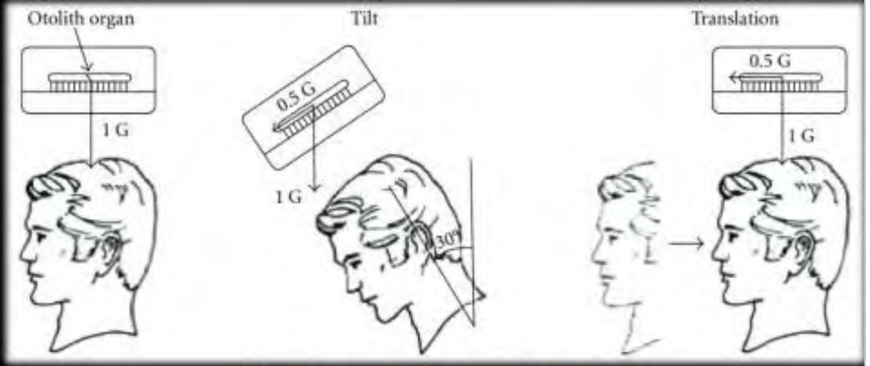
- Szu-Yu (Cyn) Liu, Jeffrey Bardzell, and Shaowen Bardzell. 2019. Decomposition as Design: Co-Creating (with) Natureculture. In <i>Proceedings of the Thirteenth International Conference on Tangible, Embedded, and Embodied Interaction</i> (<i>TEI '19</i>). Association for Computing Machinery, New York, NY, USA, 605–614. DOI:https://doi-org.emedien.ub.uni-muenchen.de/10.1145/3294109.3295653

- Szu-Yu (Cyn) Liu, Jeffrey Bardzell, and Shaowen Bardzell. 2018. Photography as a Design Research Tool into Natureculture. In <i>Proceedings of the 2018 Designing Interactive Systems Conference</i> (<i>DIS '18</i>). Association for Computing Machinery, New York, NY, USA, 777–789. DOI:https://doi-org.emedien.ub.uni-muenchen.de/10.1145/3196709.3196819

https://fkertmy0pg-flywheel.netdna-ssl.com/wp-content/uploads/2021/03/20200224_123718_VAI.jpg

Supervisor: Linda Hirsch linda.hirsch@ifi.lmu.de

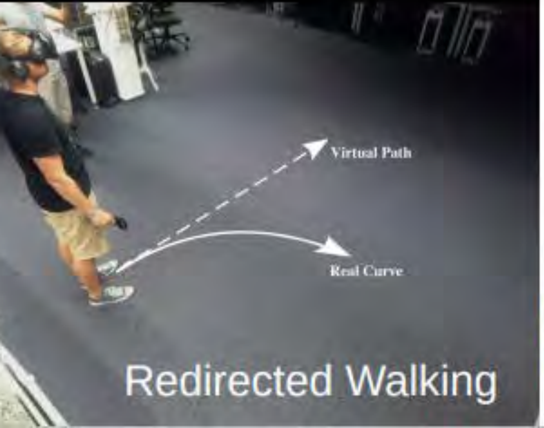
Illusions in VR / How to trick people



Illusion of Self-Motion

Matthias Hoppe
matthias.hoppe@um.ifi.lmu.de

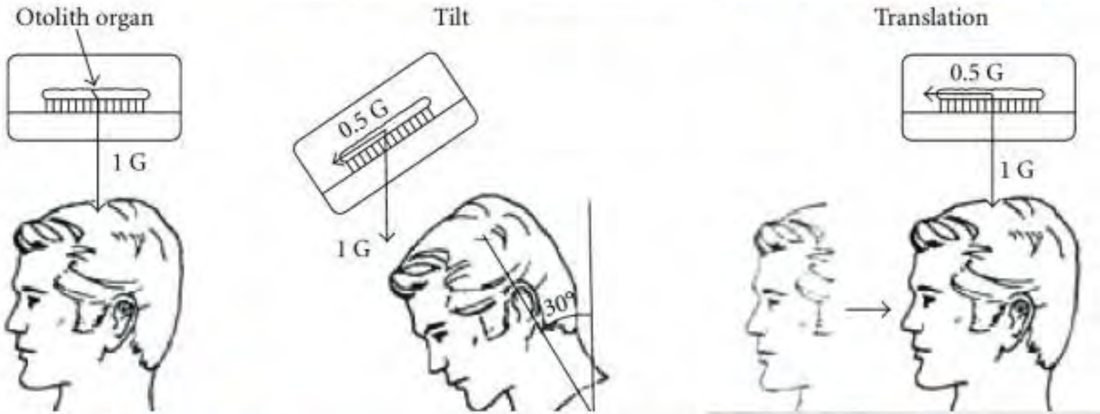
Pseudo-Haptics



Redirected Walking

Haptic Retargeting

Matthias Hoppe
matthias.hoppe@um.ifi.lmu.de



Simulation/Illusion of Physical Forces in VR

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Pierre Selva, J Morlier, and Y Gourinat. 2009. Development of a dynamic virtual reality model of the inner ear sensory system as a learning and demonstrating tool. Modelling and simulation in engineering 2009 (2009).

Chang, Hong-Yu, et al. "Facepush: Introducing normal force on face with head-mounted displays." Proceedings of the 31st Annual ACM Symposium on User Interface Software and Technology. 2018.

Matthias Hoppe
matthias.hoppe@um.ifi.lmu.de

Affective Interfaces

Affective Computing became quite popular over the last two decades. While measurement & prediction of affective states is well addressed (e.g. from facial expressions, HRV, speech features ...), we want to **focus on the application side.**

Your Tasks

Provide an overview on **current** affective computing applications and affective interfaces.

Clarify definitions
- what are „affective states“ (emotions, non-verbal expressions, attention, stress, ...)

Categorize applications
- processed affective states
- visualization / system adaptation
- application type & goals / effect on the user)
- evaluation design
- ...

Some Examples & Basics

https://arxiv.org/abs/2101.12284
https://arxiv.org/abs/2004.09685
https://annawiederkehr.com/Fine
https://www.media.mit.edu/publications/tweet-moodifier-towards-giving-emotional-awareness-to-twitter-users/
http://www.macs.hw.ac.uk/~yjc32/project/ref-social%20media%20campaign/1995-affective%20computing.pdf

Contact

matthias.schmidmaier@ifi.lmu.de

Autobiographical memories in MR

- Human memory is essential for functioning in the world
- MR will enable us to live more and more in virtual worlds
- MR can create digital content that is encoded in our memory

RQ: What traces does VR experiences leave in our memory? How are they encoded? How is this investigated?

Robin Welsch
robin.welsch@ifi.lmu.de

Kisker, J., Gruber, T. & Schöne, B. Virtual reality experiences promote autobiographical retrieval mechanisms: Electrophysiological correlates of laboratory and virtual experiences. *Psychological Research* (2020). https://doi.org/10.1007/s00426-020-01417-x

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Social interaction in AR

Social VR is well-established in HCI-research. However, creating immersive virtual environments may not be necessary. Lately, holoportation, depicting avatars of people in AR, has been realized.

RQ:
How does AR holoportation affect social interaction? How can co-presence be realized?

Robin Welsch
robin.welsch@ifi.lmu.de

Miller, M. R., Jun, H., Herrera, F., Yu Villa, J., Welch, G., & Bailenson, J. N. (2019). Social interaction in augmented reality. *PloS one*, *14*(5), e0216290.

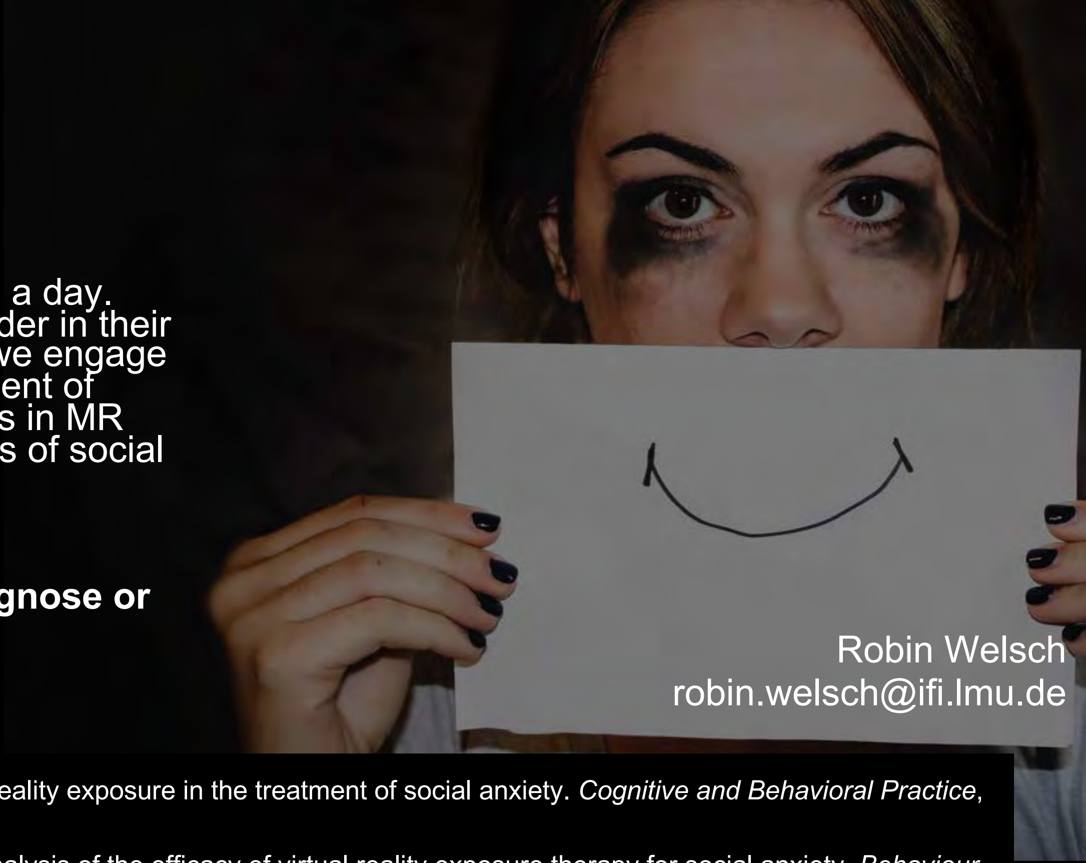
Hartholt, A., Mozgai, S., Fast, E., Liewer, M., Reilly, A., Whitcup, W., & Rizzo, A. S. (2019, September). Virtual humans in augmented reality: A first step towards real-world embedded virtual roleplayers. In *Proceedings of the 7th International Conference on Human-Agent Interaction* (pp. 205-207).

Yoon, B., Kim, H. I., Lee, G. A., Billinghurst, M., & Woo, W. (2019, March). The effect of avatar appearance on social presence in an augmented reality remote collaboration. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)* (pp. 547-556). IEEE.

Social anxiety and MR

People engage in about 13 social interactions a day. 1.5% of people develop a social anxiety disorder in their lifetime that gravely affects the way in which we engage with others, e.g. avoidance of gaze, enlargement of distance. Lately, social interaction with avatars in MR has been explored for treatment and diagnosis of social anxiety.

RQ: How can social VR/AR be used to diagnose or treat social anxiety?



Robin Welsch
robin.welsch@ifi.lmu.de

Anderson, P., Rothbaum, B. O., & Hodges, L. F. (2003). Virtual reality exposure in the treatment of social anxiety. *Cognitive and Behavioral Practice*, *10*(3), 240-247.

Chesham, R. K., Malouff, J. M., & Schutte, N. S. (2018). Meta-analysis of the efficacy of virtual reality exposure therapy for social anxiety. *Behaviour Change*, *35*(3), 152-166.

Dechant, M., Trimpl, S., Wolff, C., Mühlberger, A., & Shiban, Y. (2017). Potential of virtual reality as a diagnostic tool for social anxiety: a pilot study. *Computers in Human Behavior*, *76*, 128-134.

Virtual reality as an empathy machine

- VR allows the user to experience the world from another perspective (e.g. changing one’s gender, experiencing dangerous situations)
- VR experiences can change both explicit and implicit attitudes

RQ: How does VR produce empathetic experiences? Where is the limit?

Robin Welsch
robin.welsch@ifi.lmu.de

Schutte, N. S., & Stilinović, E. J. (2017). Facilitating empathy through virtual reality. *Motivation and emotion*, *41*(6), 708-712.

Shin, D. (2018). Empathy and embodied experience in virtual environment: To what extent can virtual reality stimulate empathy and embodied experience?. *Computers in Human Behavior*, *78*, 64-73.

van Loon, A., Bailenson, J., Zaki, J., Bostick, J., & Willer, R. (2018). Virtual reality perspective-taking increases cognitive empathy for specific others. *PloS one*, *13*(8), e0202442.

Hamilton-Giachritsis, C., Banakou, D., Quiroga, M. G., Giachritsis, C., & Slater, M. (2018). Reducing risk and improving maternal perspective-taking and empathy using virtual embodiment. *Scientific reports*, *8*(1), 1-10.

Mouse-movement tracking to understand user-motivation

Mouse position and trajectory have been used as a cheap eye-tracker. Following the dogma, of the cursor following the eyes. Lately, some HCI research have used mouse-movement to predict implicit biases that are not covered by this.

RQ: What does mouse-movement tell us about the user beyond where the cursor meets the eye?

Robin Welsch
robin.welsch@ifi.lmu.de

[1] Freeman, J.B. and Dale, R. 2013. Assessing bimodality to detect the presence of a dual cognitive process. *Behavior Research Methods*. 45, 1 (Mar. 2013), 83–97. DOI:https://doi.org/10.3758/s13428-012-0225-x.
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[3] Koop, G.J. and Johnson, J.G. 2013. The response dynamics of preferential choice. *Cognitive Psychology*. 67, 4 (Dec. 2013), 151–185. DOI:https://doi.org/10.1016/j.cogpsych.2013.09.001.
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Behavioral change with health apps

There is an abundance of health-related apps that want to facilitate behavioral change. There is however no broad consensus on what criteria to evaluate them on.

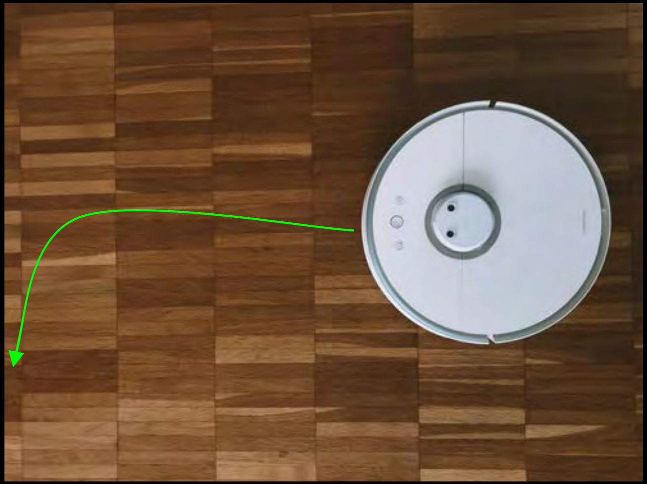
RQ:

What makes apps effective in facilitating behavioural change? How can we measure this?

Contact:
Robin Welsch
robin.welsch@ifi.lmu.de

[1] Anthes, E. 2016. Mental health: There's an app for that. *Nature News*. 532, 7597 (Apr. 2016), 20. DOI:https://doi.org/10.1038/532020a.
[2] Lim, D., Norman, R. and Robinson, S. 2020. Consumer preference to utilise a mobile health app: A stated preference experiment. *PLOS ONE*. 15, 2 (Feb. 2020), e0229546. DOI:https://doi.org/10.1371/journal.pone.0229546.
[3] Paay, J., Kjeldskov, J., Skov, M.B., Lichon, L. and Rasmussen, S. 2015. Understanding Individual Differences for Tailored Smoking Cessation Apps. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (New York, NY, USA, Apr. 2015), 1699–1708.
[4] Rohani, D.A., Quemada Lopategui, A., Tuxen, N., Faurholt-Jepsen, M., Kessing, L.V. and Bardram, J.E. 2020. MUBS: A Personalized Recommender System for Behavioral Activation in Mental Health. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (New York, NY, USA, Apr. 2020), 1–13.

Intent communication in autonomous systems (aside from the car)



Autonomous systems take actions on their own. For such proactive computing systems it is a key challenge to keep the user in control, even if the user is not initiating actions. Therefore, these systems have to communicate what they will do; They have to display intent.

RQ:
What studies have investigated intent in autonomous systems beyond the car? How should intent be communicated?

Contact:
Robin Welsch
robin.welsch@ifi.lmu.de

[1] Niess, J. and Woźniak, P.W. 2020. Embracing Companion Technologies. *Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society* (New York, NY, USA, Oct. 2020), 1–11.
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The Placebo effect in Human-Computer Interaction

The placebo effect is well-established in pharmacological trials. It refers to acquiring real benefits from sham treatment (e.g., a sugar pill) compared to not receiving any treatment. We want to review literature on placebo effects in HCI to identify gaps in the literature and identify areas of application.

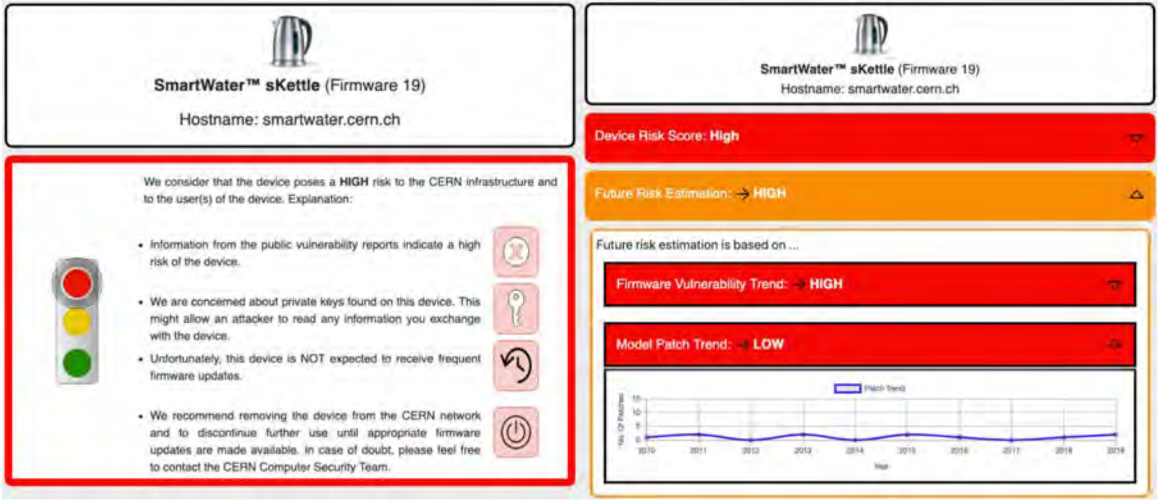
Robin Welsch
robin.welsch@ifi.lmu.de

Luca Chittaro and Riccardo Sioni. 2014. Affective computing vs. affective placebo: Study of a biofeedback-controlled game for relaxation training.International Journal of Human-Computer Studies72, 8 (2014), 663 – 673. https://-doi.org/10.1016/j.ijhcs.2014.01.007 Designing for emotionalwellbeing.

Alena Denisova and Eliott Cook. 2019. Power-Ups in Digital Games: The Rewarding Effect of Phantom Game Elements on Player Experience. In Proceedings of the Annual Symposium on Computer-Human Interaction in Play (CHI PLAY '19). Association for Computing Machinery, New York, NY, USA, 161–168. DOI:https://doi.org/10.1145/3311350.3347173

IoT **Privacy** and IoT **Security**: Is there a difference from a user perspective?

The number of Internet of Things (IoT) devices we own and use in our private and business spaces is rapidly increasing. Often, we even connect private devices in our workplace. Given the range of security and privacy concerns associated with many of those IoT devices, we increasingly perceive implications for users' privacy and network security. Thus, communicating security and privacy assessments of IoT devices to their users becomes important, enabling them to take informed decisions. But, does it make sense to differentiate between security and privacy in communication with users?



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Emami-Naeini, Pardis, et al. "Exploring how privacy and security factor into IoT device purchase behavior." Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. 2019.

Sebastian Feger (sebastian.feger@um.ifi.lmu.de)

Data Science and Software Engineering: Differences and Common Ground

- We have extensive research in how devlopers operate during *traditional* software engineering
- Data science and data-driven development now offer a paradigmatic shift of how software is created

How do practices from Software Engineering apply to Data-Driven Development?*

* from an HCI perspective

Saleema Amershi, Andrew Begel, Christian Bird, Robert DeLine, Harald C. Gall, Ece Kamar, Nachiappan Nagappan, Besmira Nushi, Thomas Zimmermann: **Software engineering for machine learning: a case study**. ICSE (SEIP) 2019: 291-300

Marc Hesenius, Nils Schwenzfeier, Ole Meyer, Wilhelm Koop, Volker Gruhn: **Towards a software engineering process for developing data-driven applications**. RAISE@ICSE 2019: 35-41

Stress X Digital Social Interactions

Luke Haliburton

luke.haliburton@um.ifi.lmu.de

Digital Stress: stress caused by digital technologies and online interactions

Some causes:

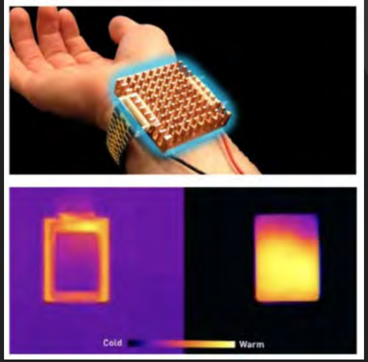
- Permanent connectedness
- FOMO when disconnected
- Information & notification overload

How can change digital technologies to improve their impact on wellbeing? How can we manage our digital communication load to reduce stress and digital burnout?

Thermal Social Interactions

Luke Haliburton

luke.haliburton@um.ifi.lmu.de



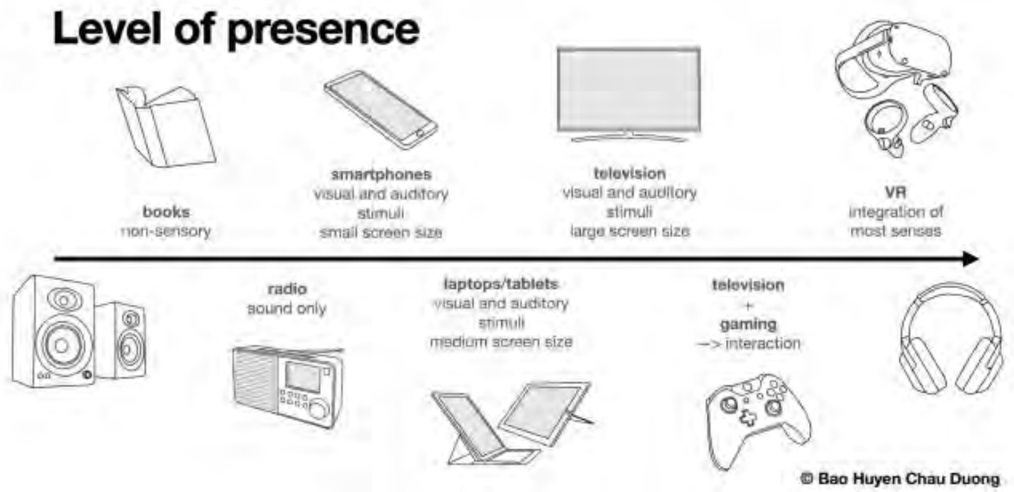
Thermal Feedback: interaction paradigm that uses temperature changes for user feedback. Thermal changes are psychologically associated with emotions

Cool: calm, fear

Warm: happiness, anger

How can thermal feedback be incorporated into communication technologies to enhance virtual social interactions?

Presence besides VR – Presence in everyday life

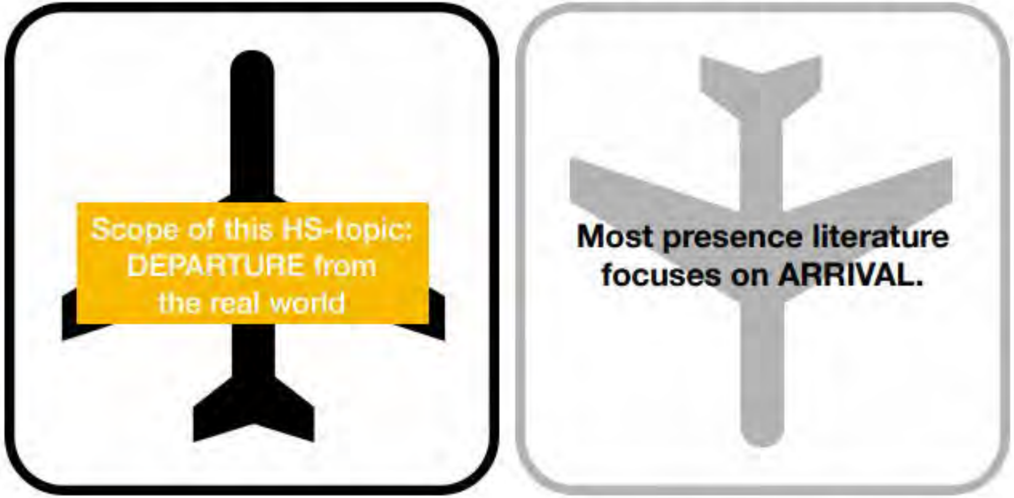


Supervisor: Nada Terzimehić (nadja.terzimehic@ifi.lmu.de)

Literature:

Kim, T., & Biocca, F. (1997). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. Journal of computer-mediated communication, 3(2), JCMC325.
Lee, K. M. (2004). Presence, explicated. Communication theory, 14(1), 27-50.
Skarbez, R., Brooks, Jr, F. P., & Whitton, M. C. (2017). A survey of presence and related concepts. ACM Computing Surveys (CSUR), 50(6), 1-39.

The Real World in Presence Literature



DEPARTURE FROM THE REAL WORLD

ARRIVAL IN THE VIRTUAL WORLD

Supervisor: Nada Terzimehić (nadja.terzimehic@ifi.lmu.de)

Literature:

Kim, T., & Biocca, F. (1997). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. Journal of computer-mediated communication, 3(2), JCMC325.
Lee, K. M. (2004). Presence, explicated. Communication theory, 14(1), 27-50.
Skarbez, R., Brooks, Jr, F. P., & Whitton, M. C. (2017). A survey of presence and related concepts. ACM Computing Surveys (CSUR), 50(6), 1-39.

Technology for Engagement with the Real World

Supervisor: Nada Terzimehić (nadja.terzimehic@ifi.lmu.de)

Literature:

Robinson, S., Marsden, G., & Jones, M. (2014). There's not an app for that: Mobile user experience design for life. Morgan Kaufmann.

Doherty, K., & Doherty, G. (2018). Engagement in HCI: conception, theory and measurement. ACM Computing Surveys (CSUR), 51(5), 1-39.

Saba Kawas, Nicole S. Kuhn, Mina Tari, Alexis Hiniker, and Katie Davis. 2020. "Otter this world": can a mobile application promote children's connectedness to nature? In Proceedings of the Interaction Design and Children Conference (IDC '20).