

Augmenting Humans

**Japan Style – Was passiert
außerhalb Europas – welche
neuen Entwicklungen aus
Japan könnten bald auch zu
uns kommen?**

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Augmenting Humans

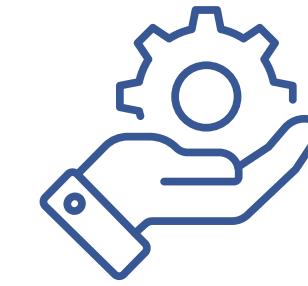
Overview

Activity Recognition

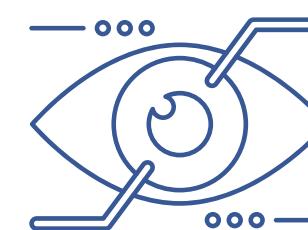


System Development

MEME



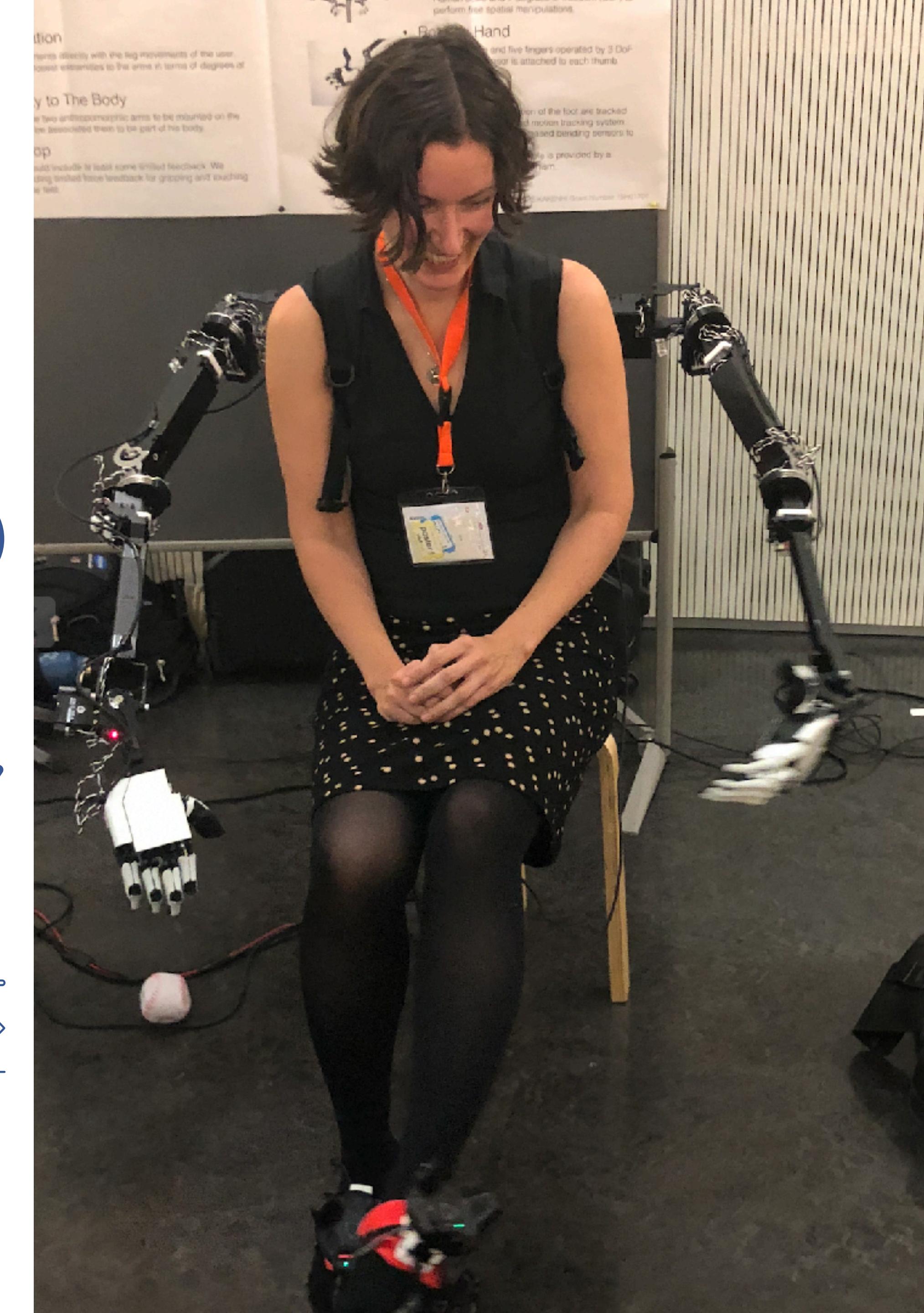
Physiological Sensing Platform



Augmented

HCI Studies and Beyond

Outlook





Activity Recognition



With the computers surrounding us in everyday life, worn on our bodies, the performance bottleneck is
Human Attention.

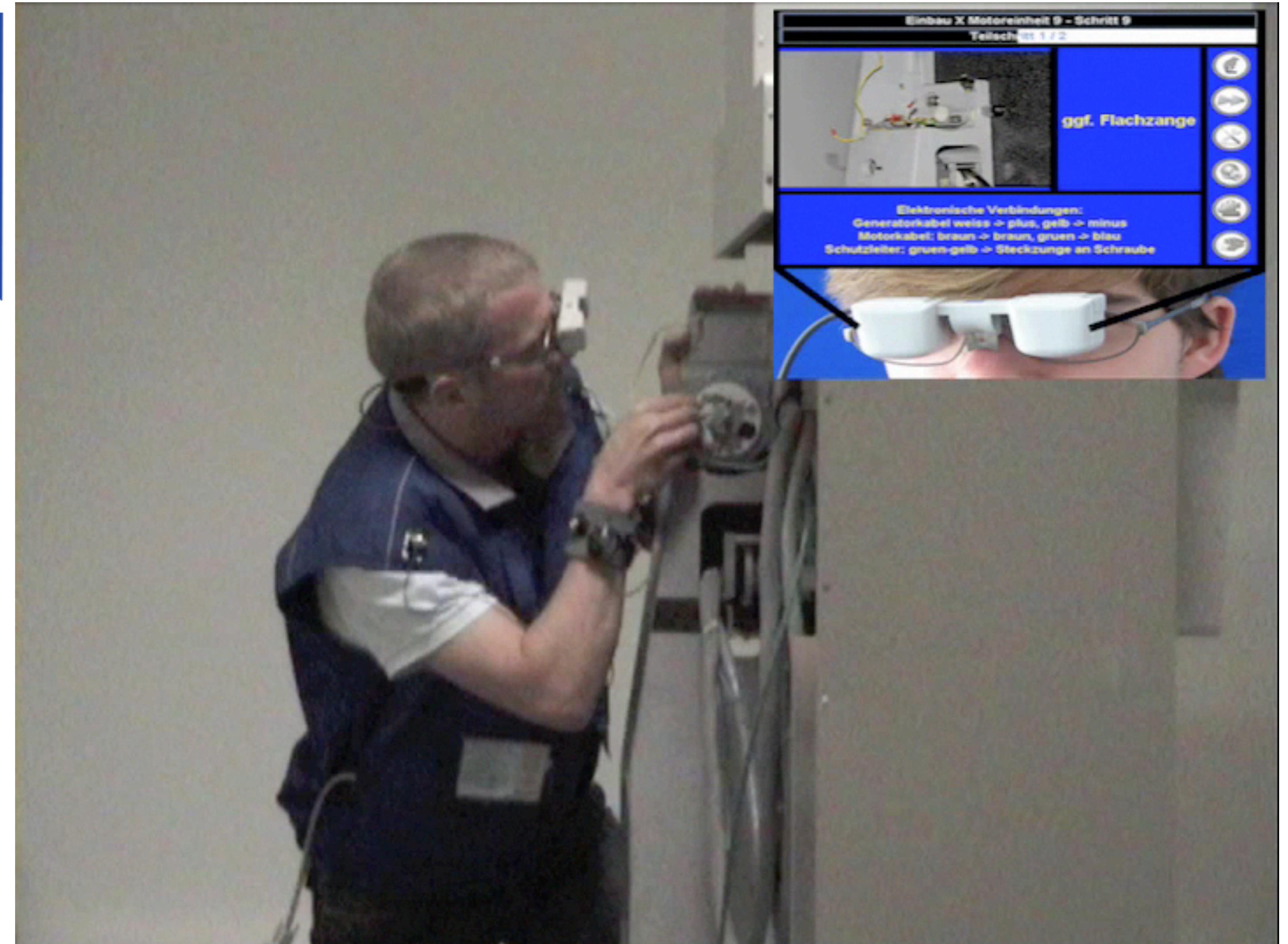
Key challenge: intuitive cooperation between humans and computers

Activity Recognition, Context-Aware Systems
Using a Combination of Sensors, Signal Processing, Applied Machine Learning to Support Users in Everyday Situations



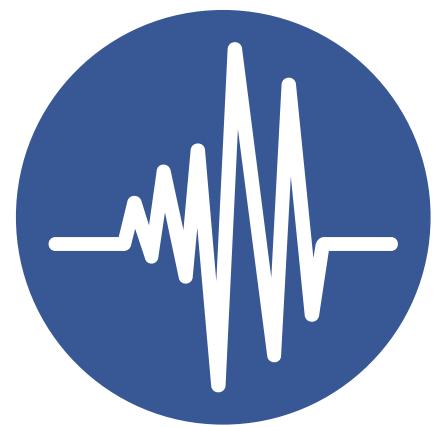
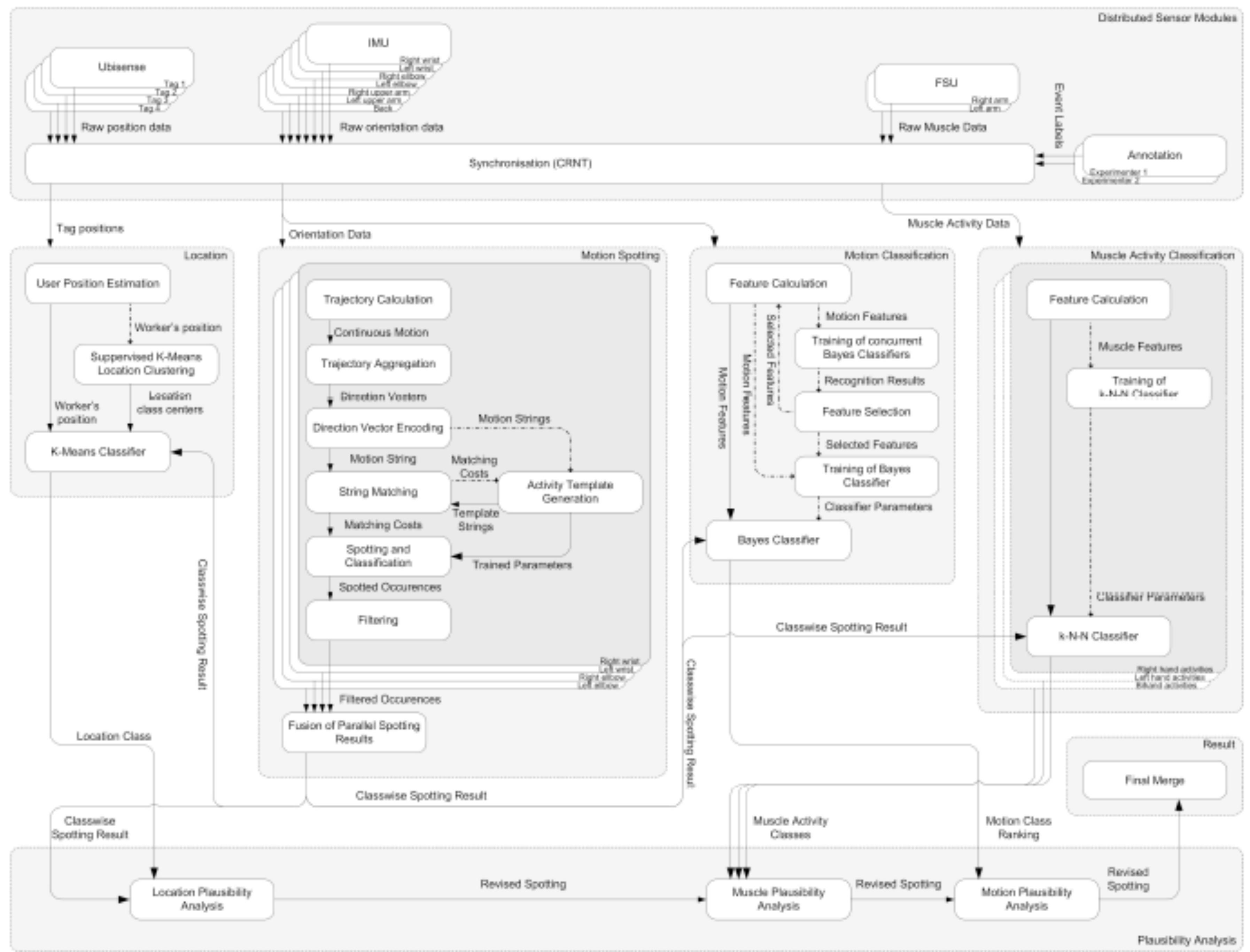
Wearable Computing around 2007

Maintenance Scenario, Collaboration with University Bremen and Zeiss.

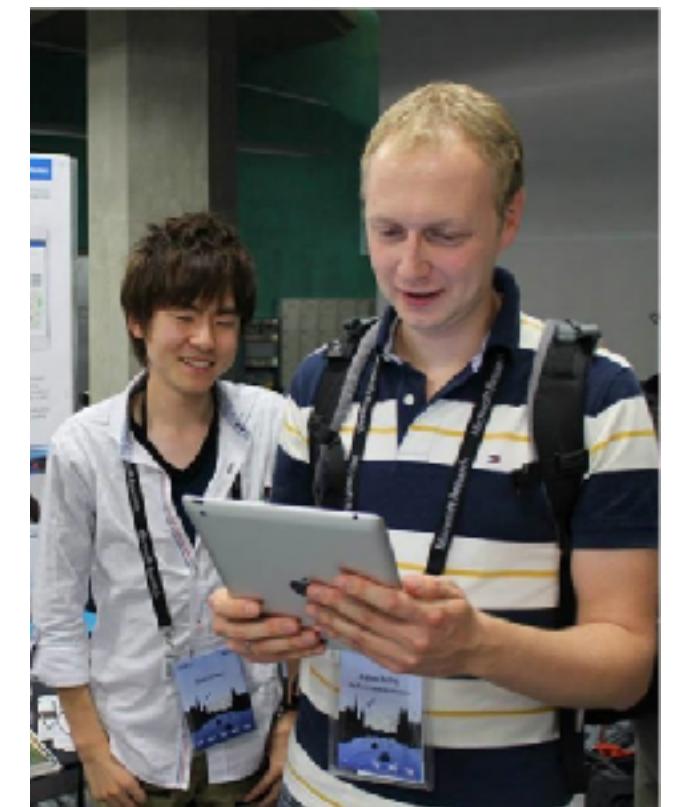
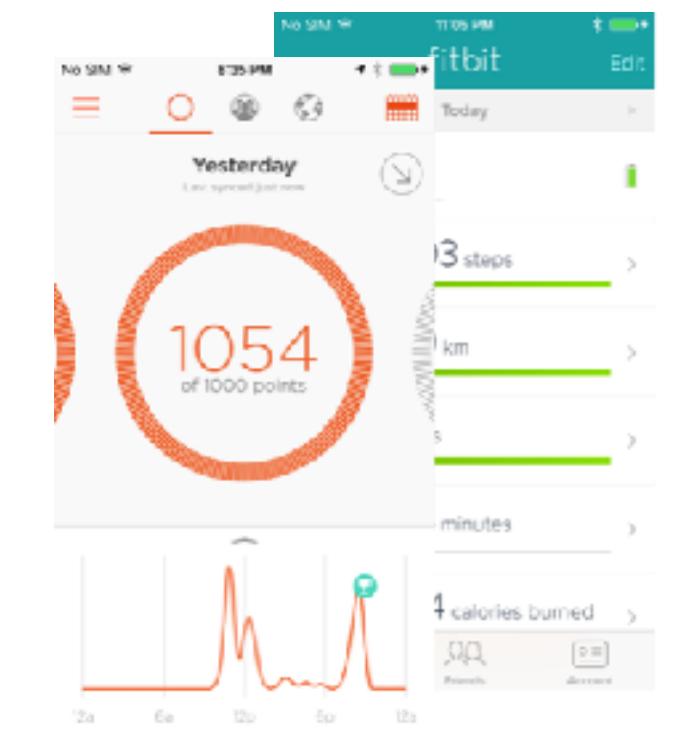
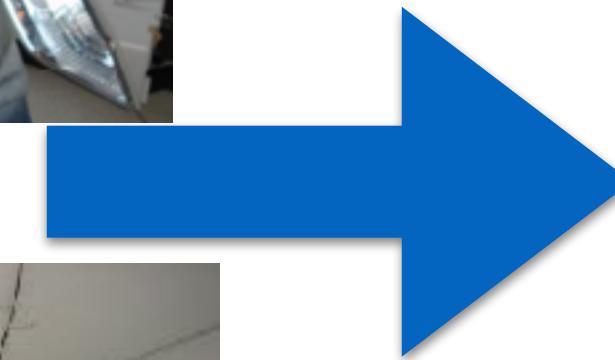


Kunze, Kai, et al. "Does context matter? - a quantitative evaluation in a real world maintenance scenario." *Pervasive Computing: 7th International Conference, 2009.*



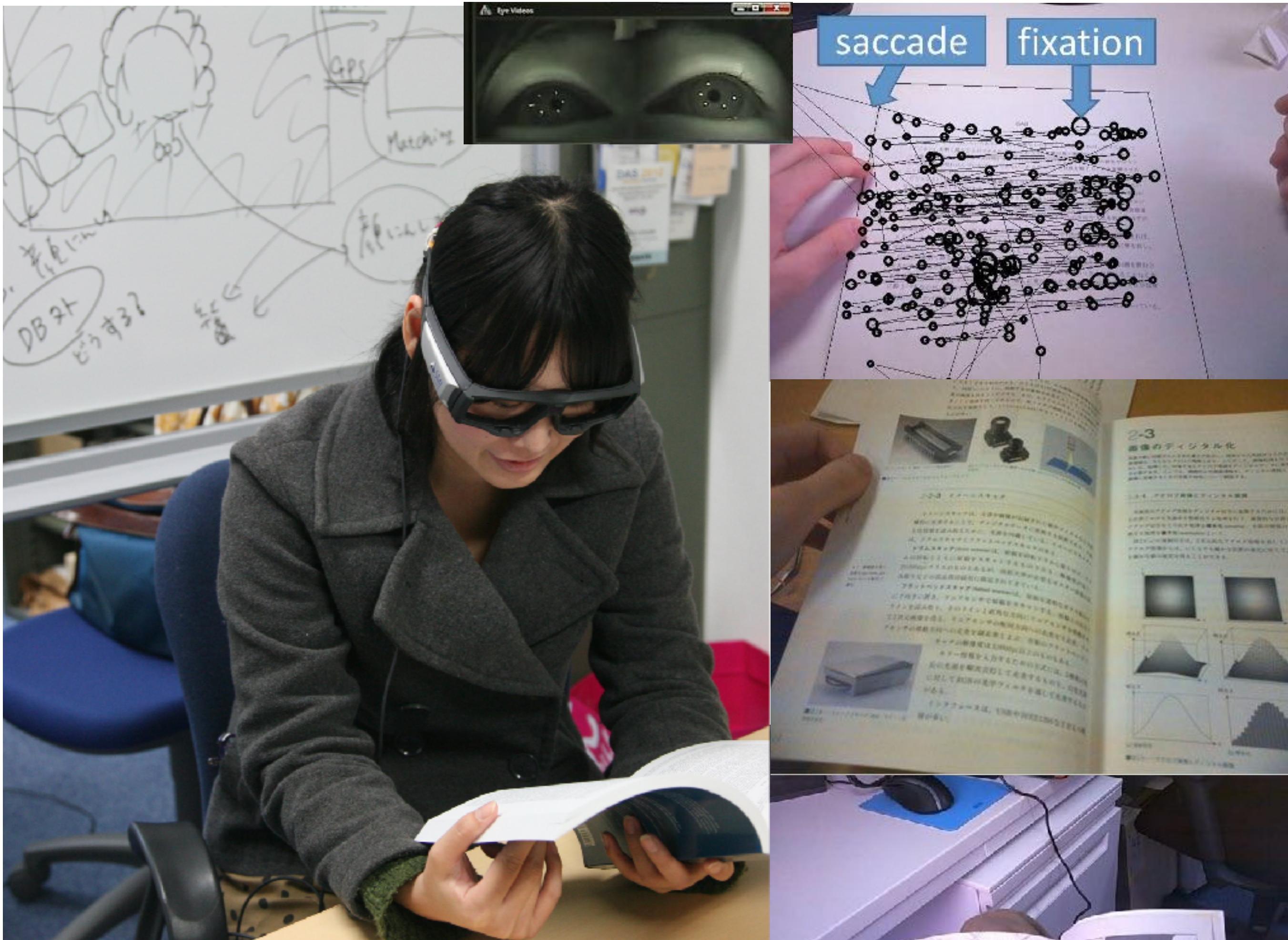
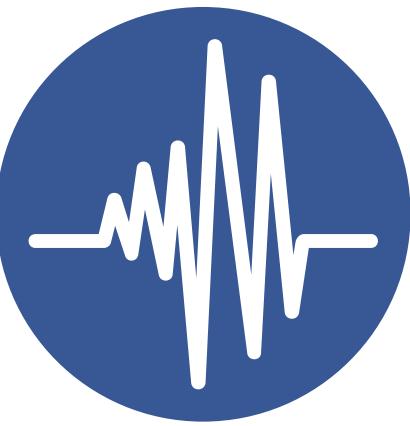


Wearable Computing — Activity Recognition becomes Mainstream



Kunze Kai. Compensating for On-Body Placement Effects in Activity Recognition, 2011.

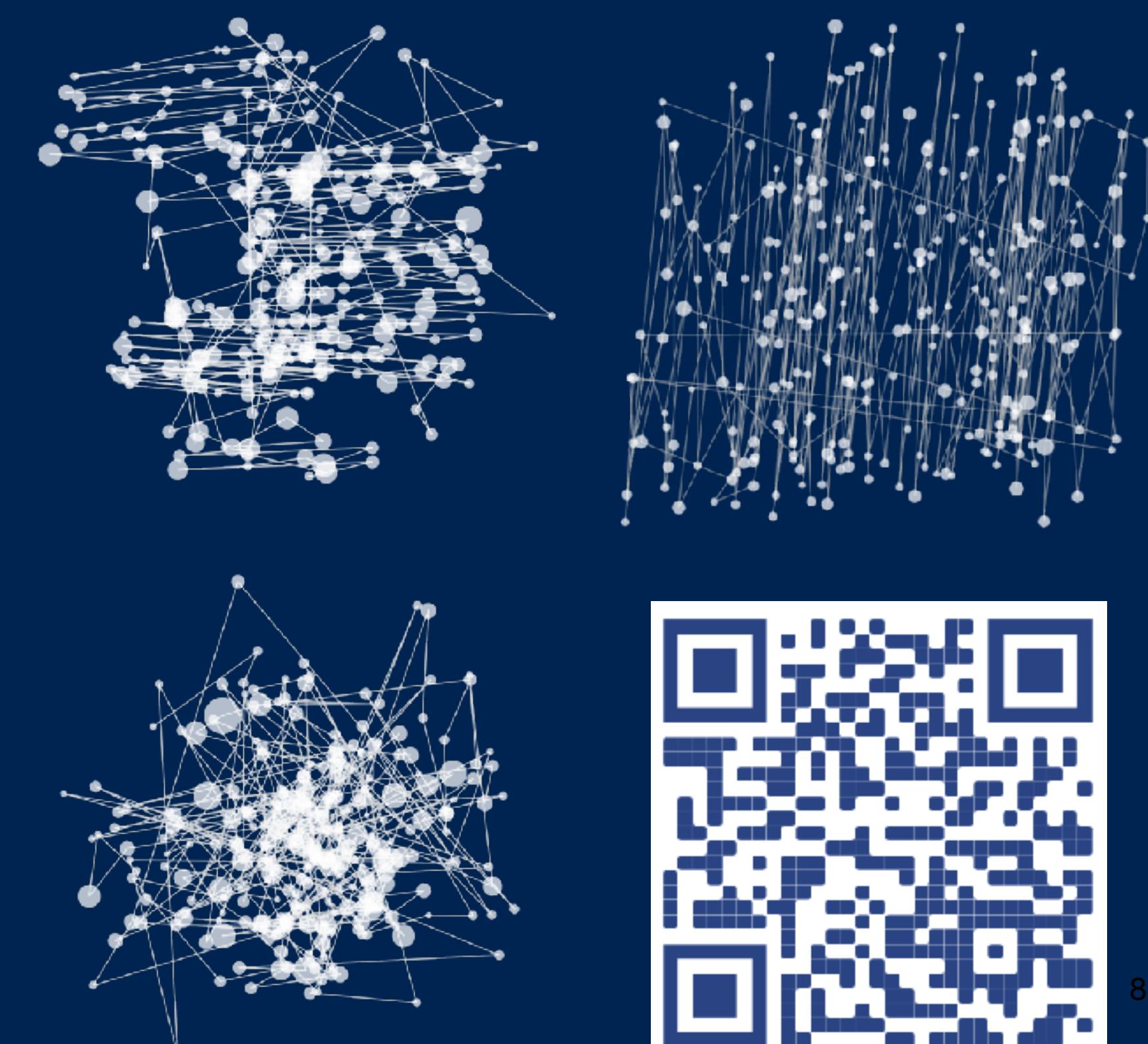
Tracking Cognitive Tasks— Reading Habits

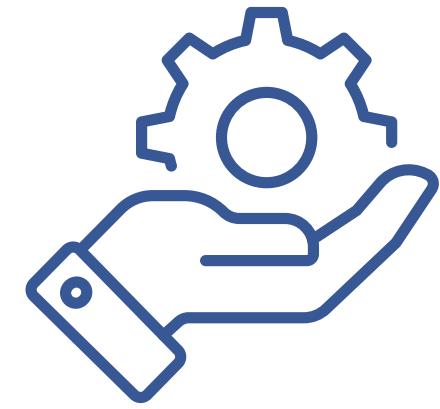


Kai Kunze, Yuzuko Utsumi, Yuki Shiga, Koichi Kise, and Andreas Bulling. 2013. I know what you are reading: recognition of document types using mobile eye tracking. ISWC '13

Where to start?

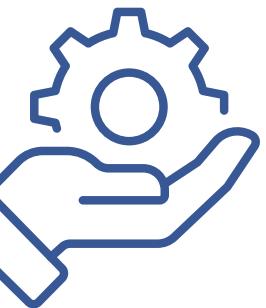
Ubiquitous learning activity: reading





System Development

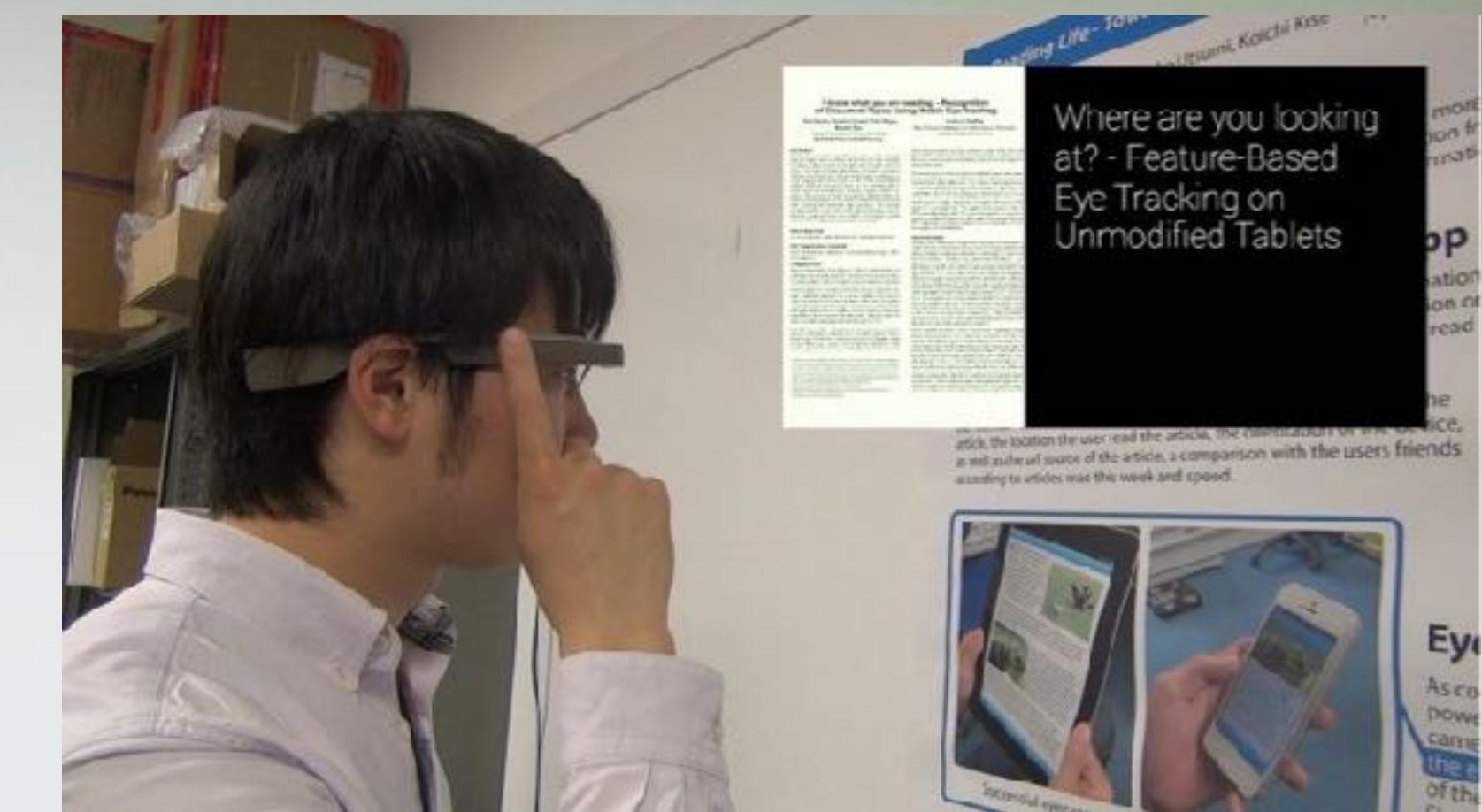
J!NS MEME and more



Is this how our brains work when we interact with the world?



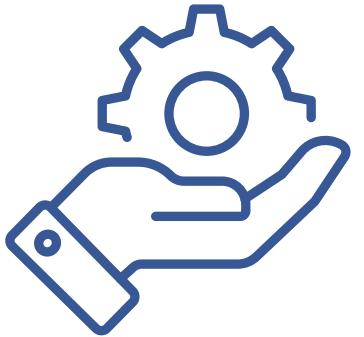
Cognitive Activity Tracking in Everyday Life



J!NS MEME



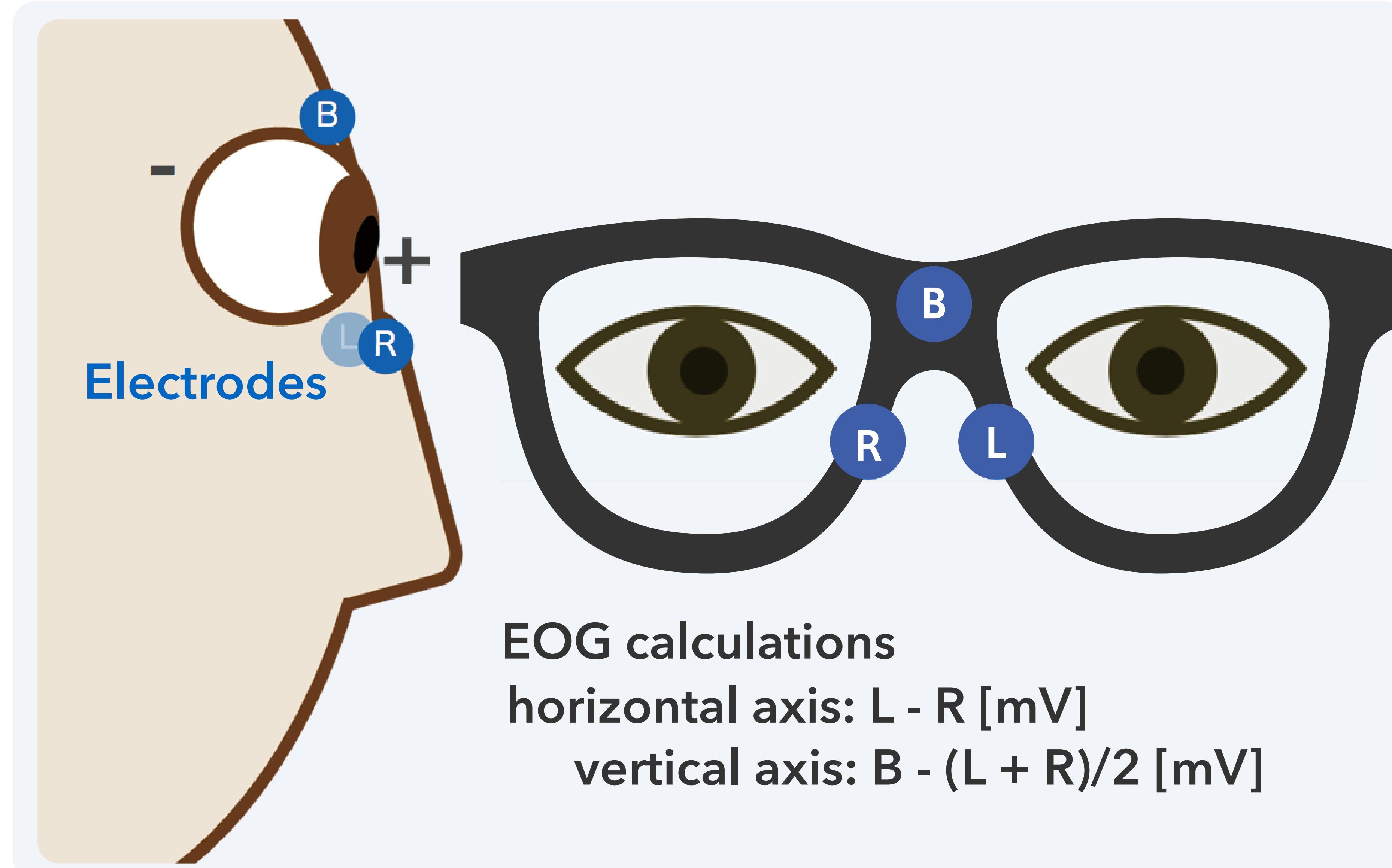
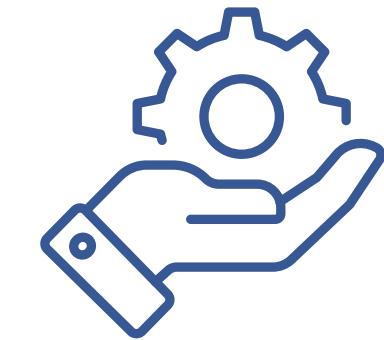
Overview of J!NS MEME



J!NS MEME

3-axis accelerometer
3-axis gyroscope
2-axis EOG

J!NS MEME - Electrooculography





My Responsibilities: J!NS MEME

The longest, continuous, external research and development member of the team (over 8 years now)

Consulting:

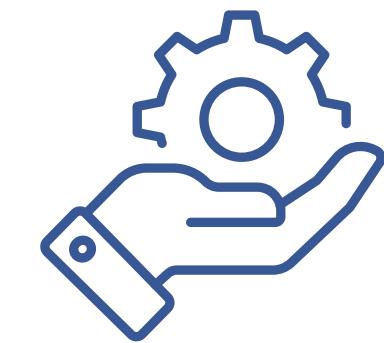
Software / Hardware

Application Scenarios

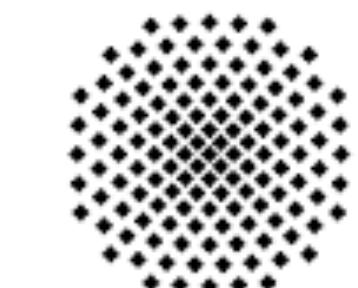
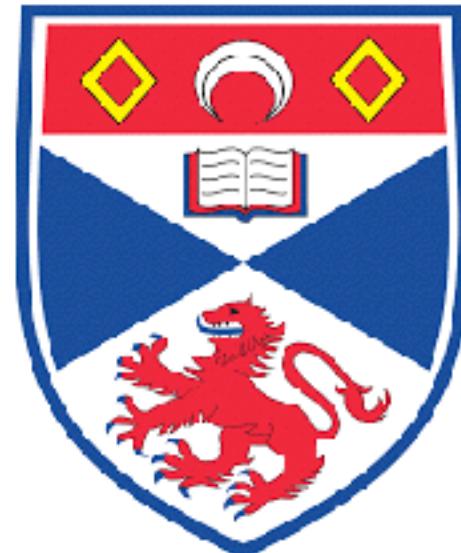
Academic Outreach Program



Meme Academic Collaborations



Used by over 100 research institutes (just the most prominent ones are highlighted)



Universität
Bremen



Karlsruher Institut für Technologie



THE UNIVERSITY OF
SYDNEY

Goldsmiths
UNIVERSITY OF LONDON

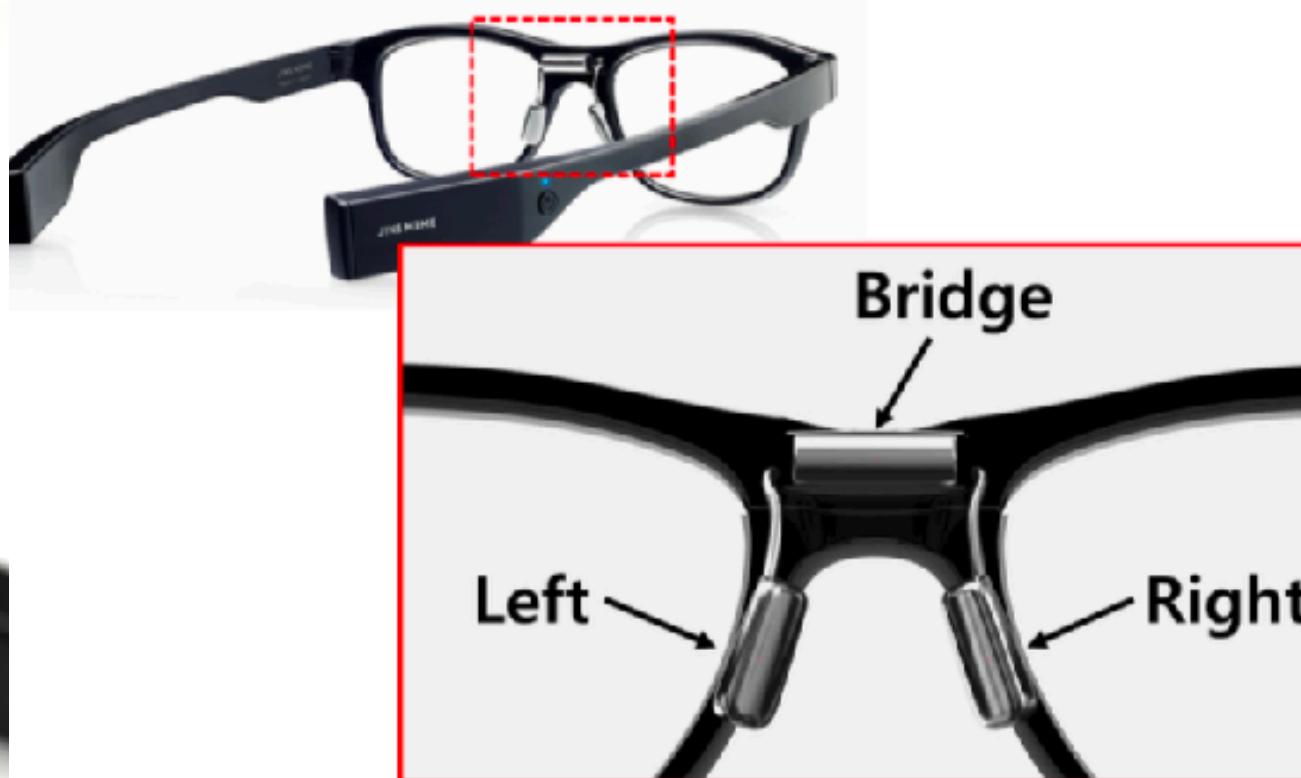
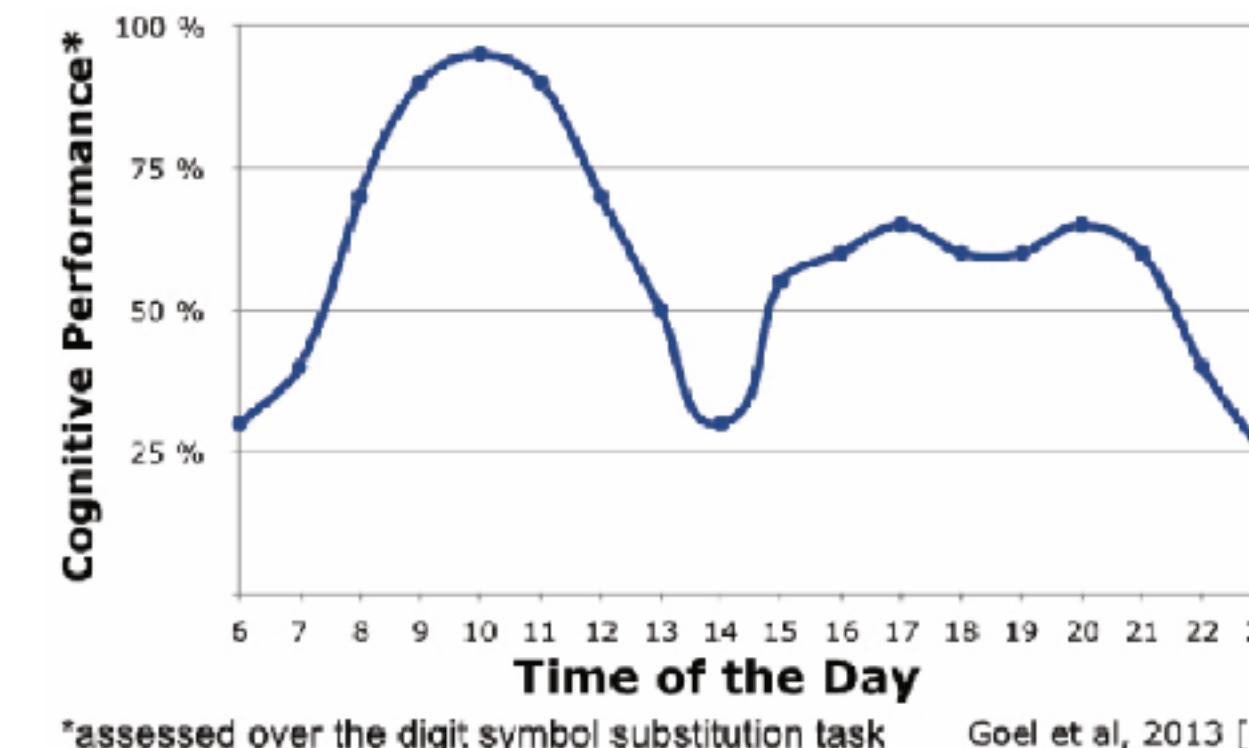
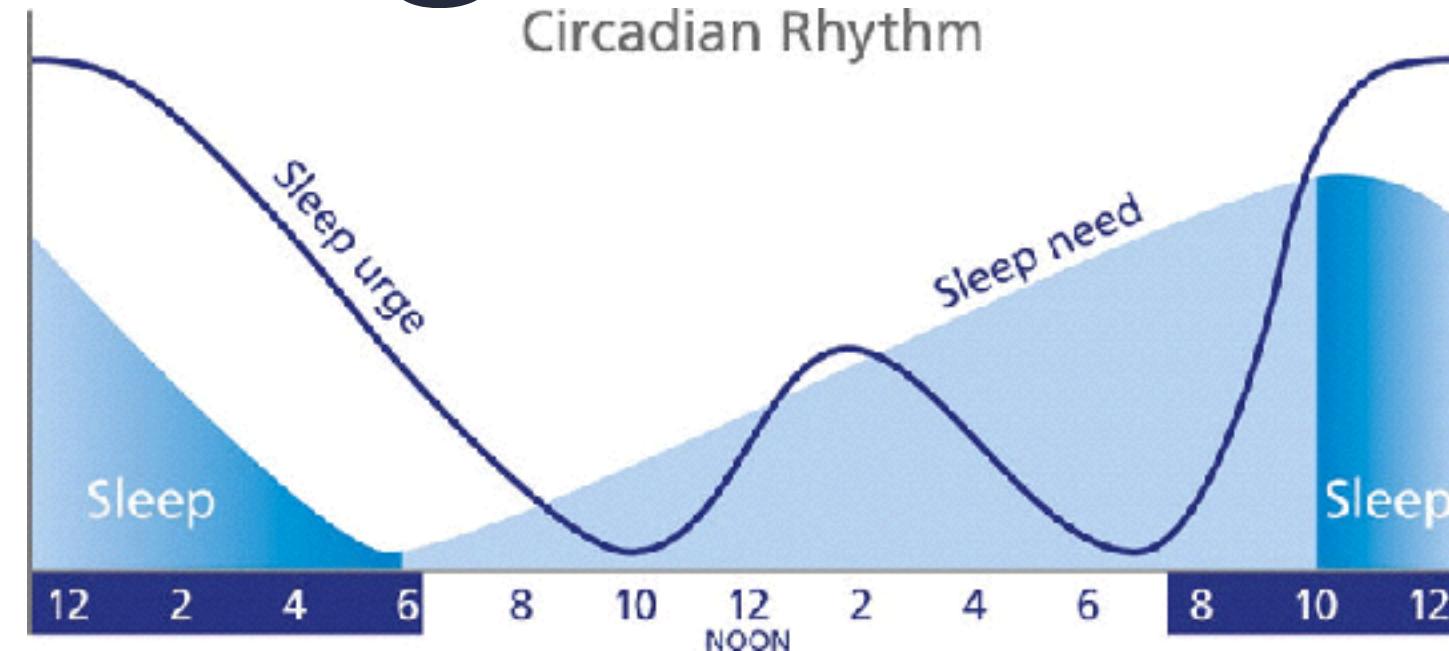


University of
South Australia

KAIST



Cognitive Fluctuation Studies



Cognitive load, Circadian Rhythm, **Fatigue/Alterness**

20 participants, 3 weeks

At least 10 hours a day:

Electrooculography + Motion Sensors

“Groundtruth” every 2 hours:

Standard Cognitive Tests

Karolinska Sleepiness Scale

Psychomotor Vigilance Task (PVT)

Stroop Test

Log Caffeine intake and Naps

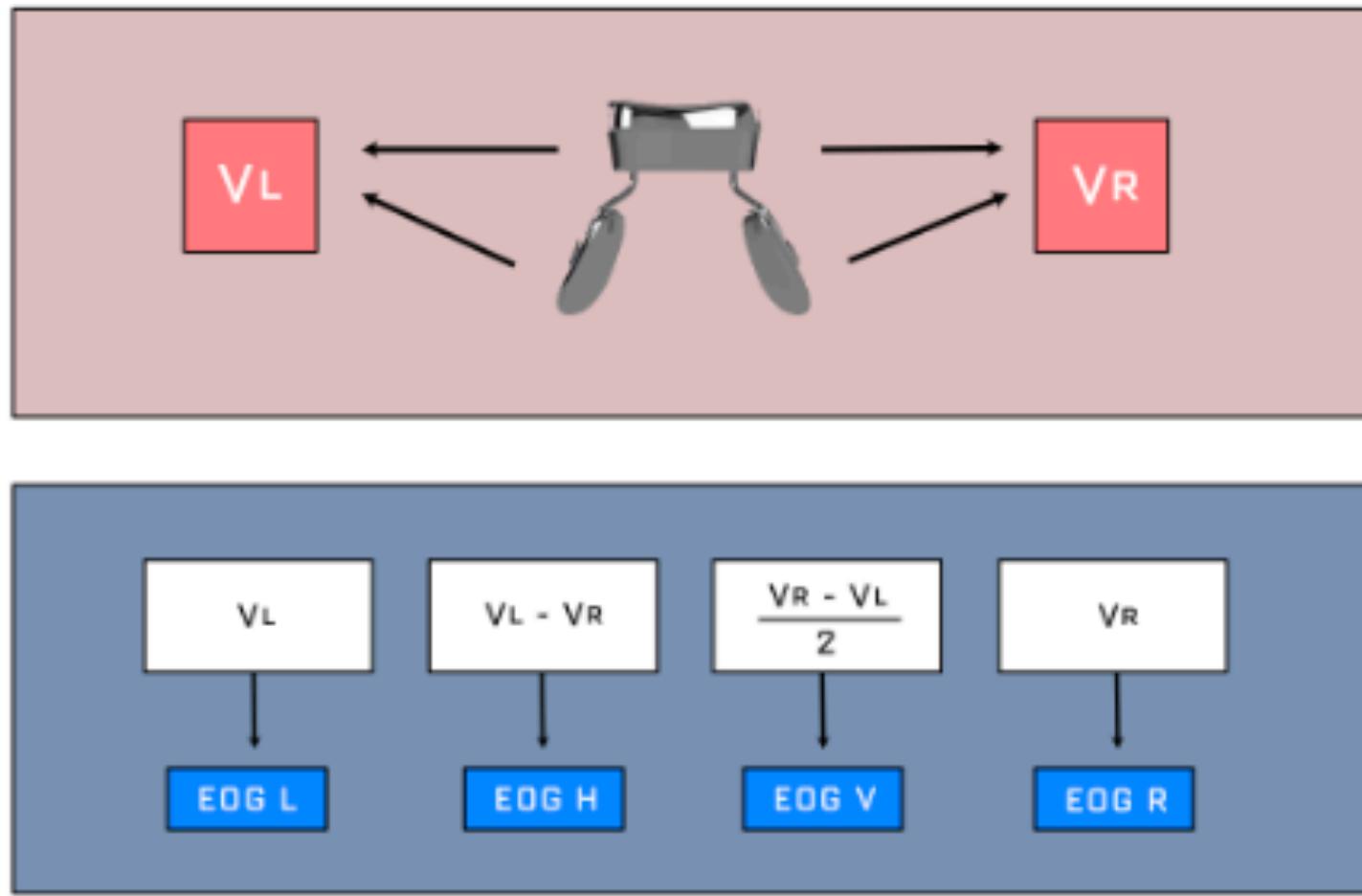
Sessions in the lab with fNIRS

Tag, Benjamin et all. "Continuous Alertness II 2019 Assessments: Using EOG Glasses to Unobtrusively Monitor Fatigue Levels In-The-Wild." CHI, 2019.

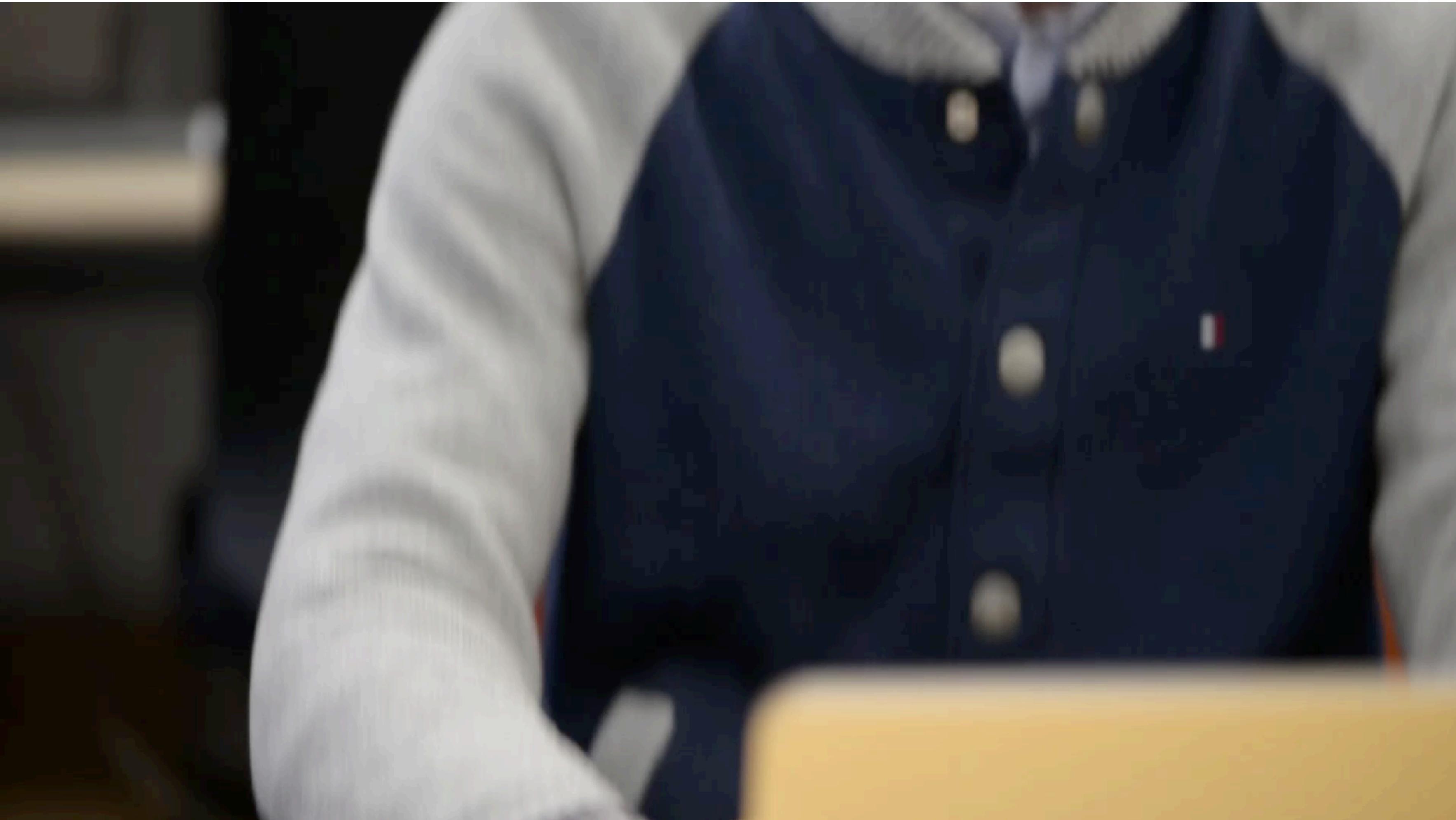
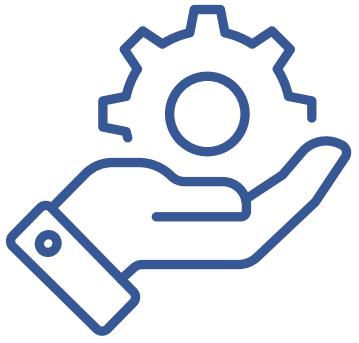




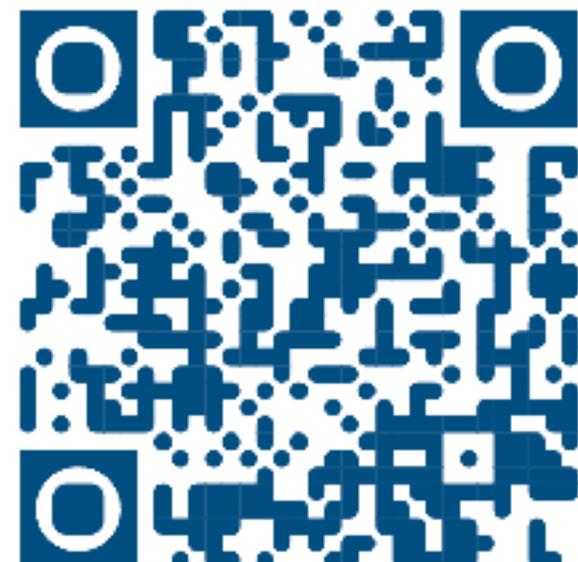
MEME 3.0



Smart Glasses to detect Facial Expression

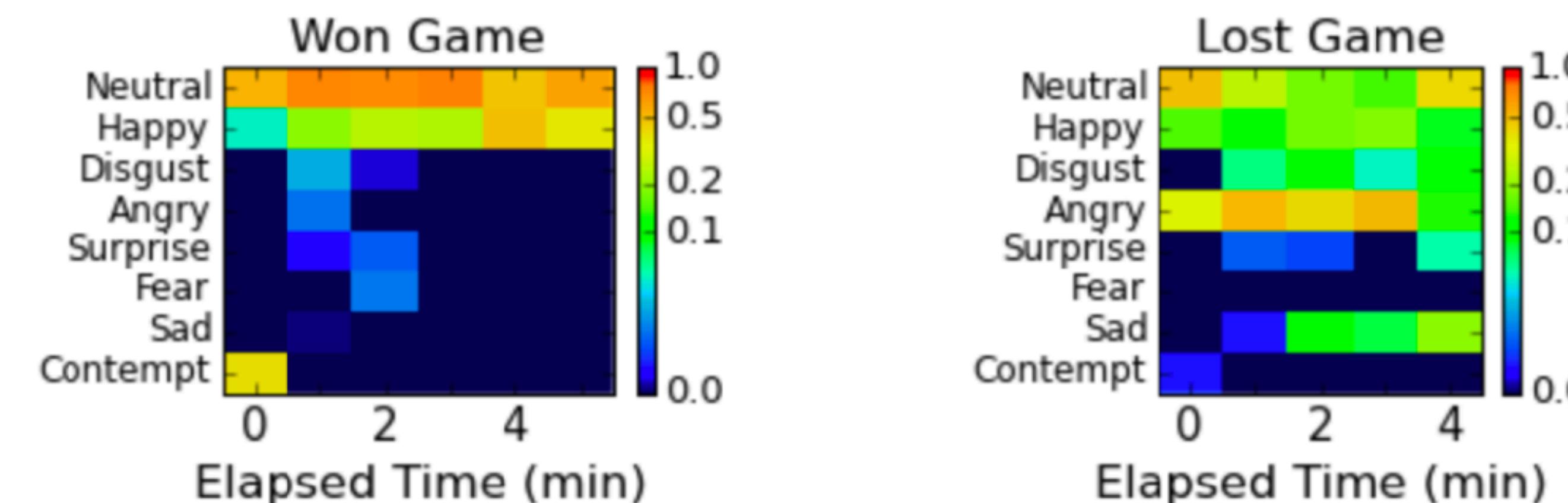
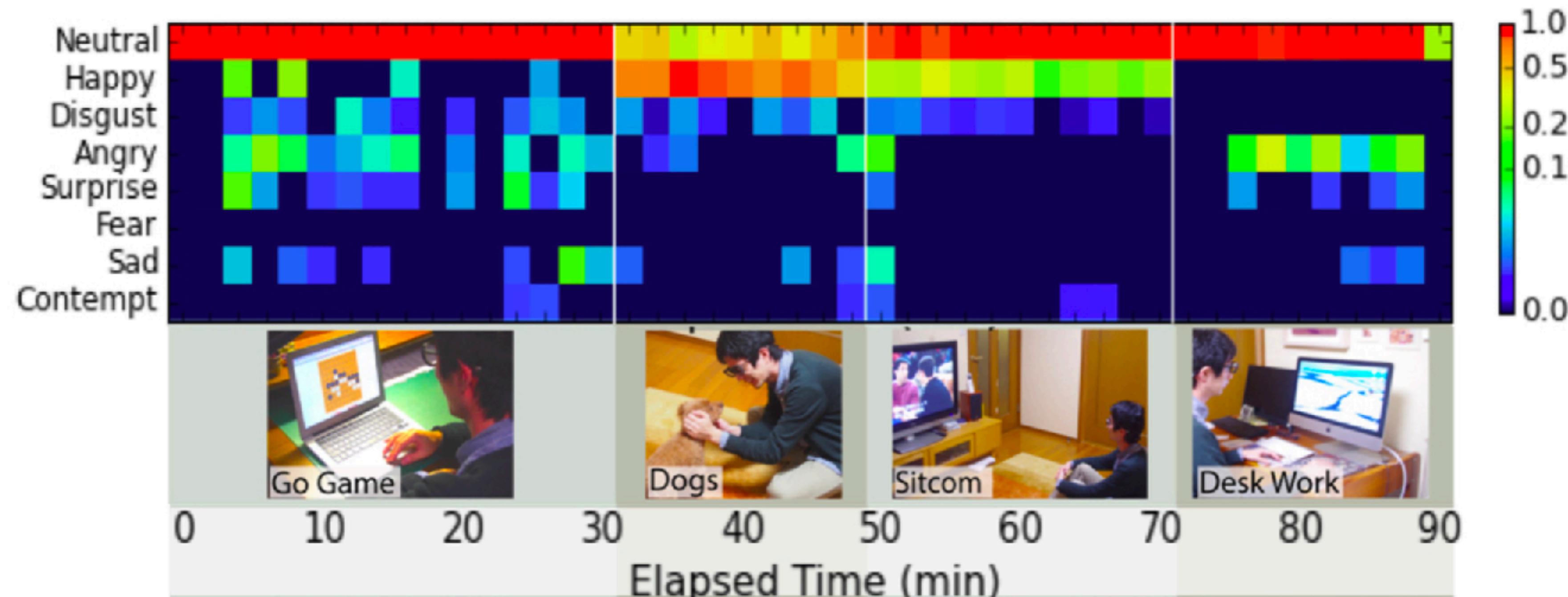


Evaluation of Facial Expression Recognition by A Smart Eyewear, ACM Transactions on Interactive Intelligent Systems, 2017.

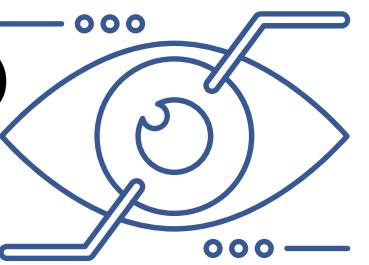




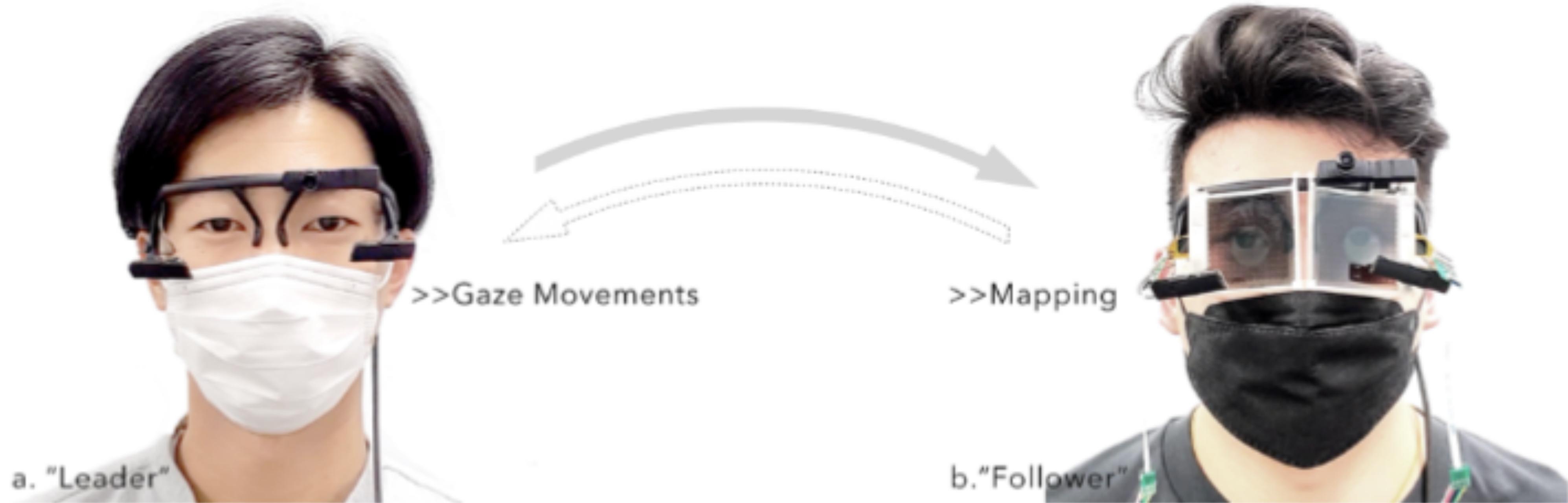
Facial Expressions Change Depending on Activities



Can we share our visual perception with others?



GazeSync (IUI 2022)



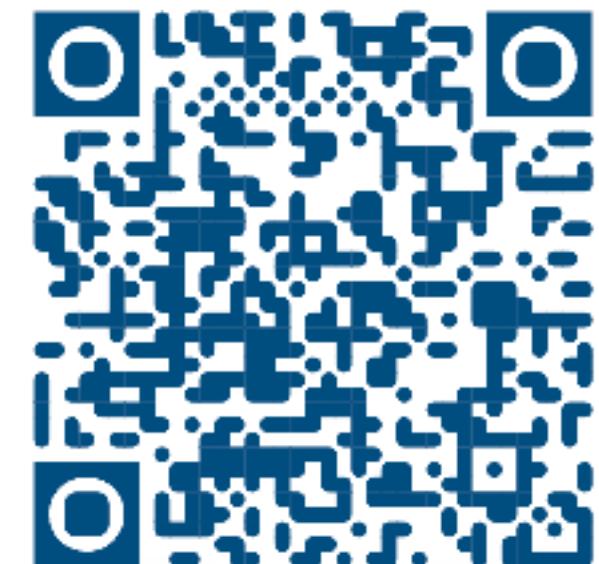
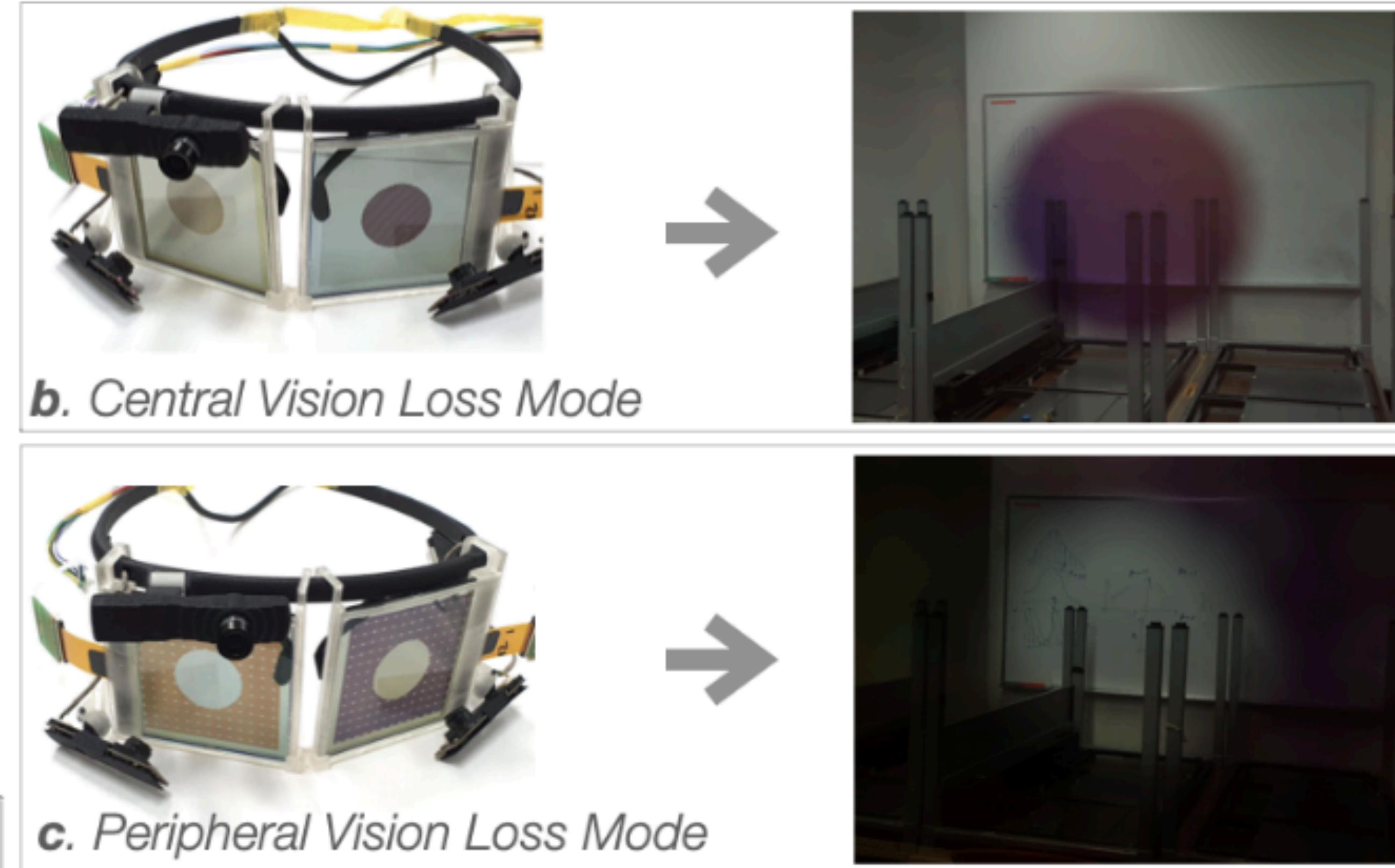
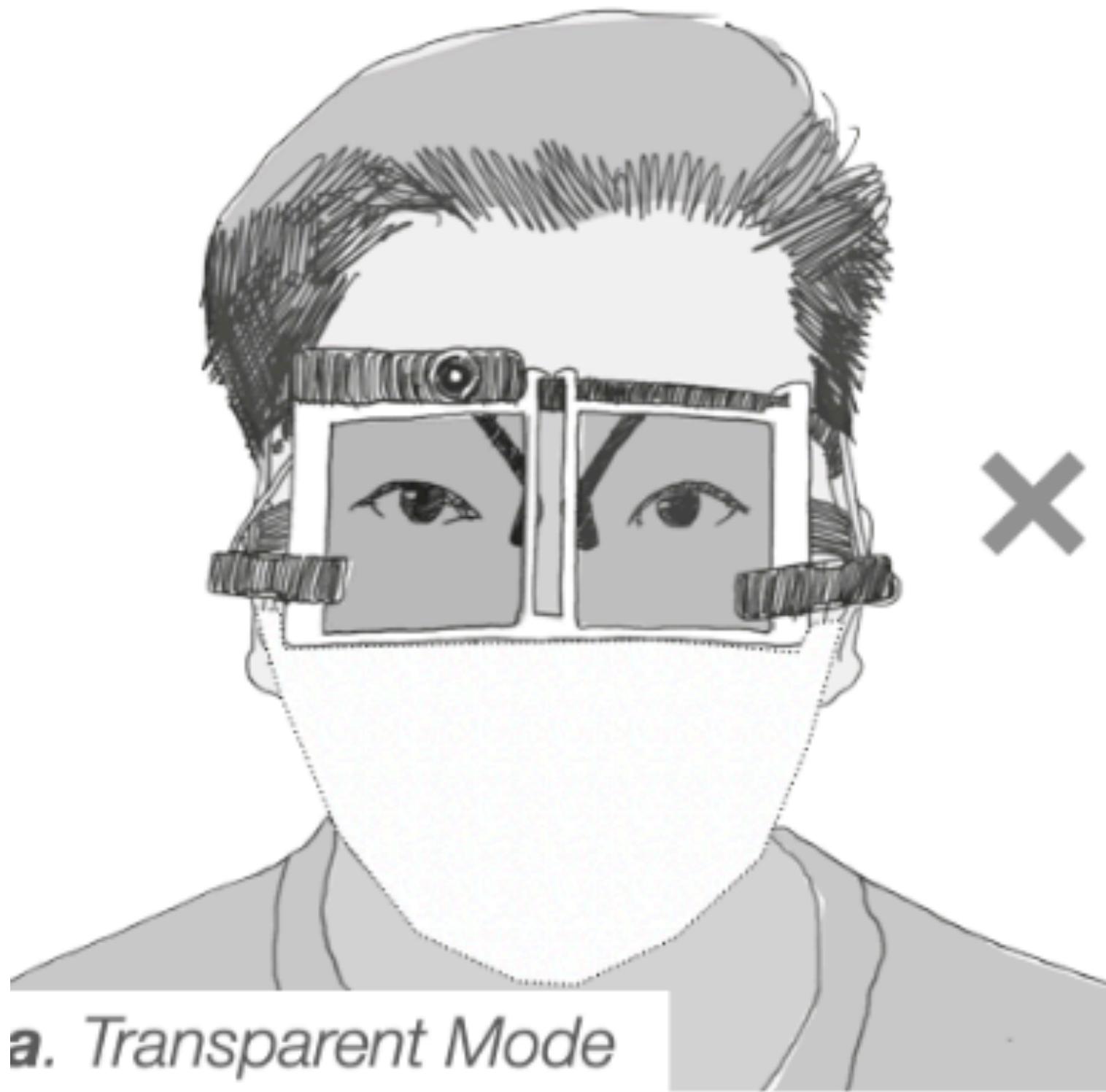
GazeSync: Eye Movement Transfer using an Optical Eye Tracker and Monochrome Liquid Crystal Displays. IUI 2022.



Eye movement mapping ➔

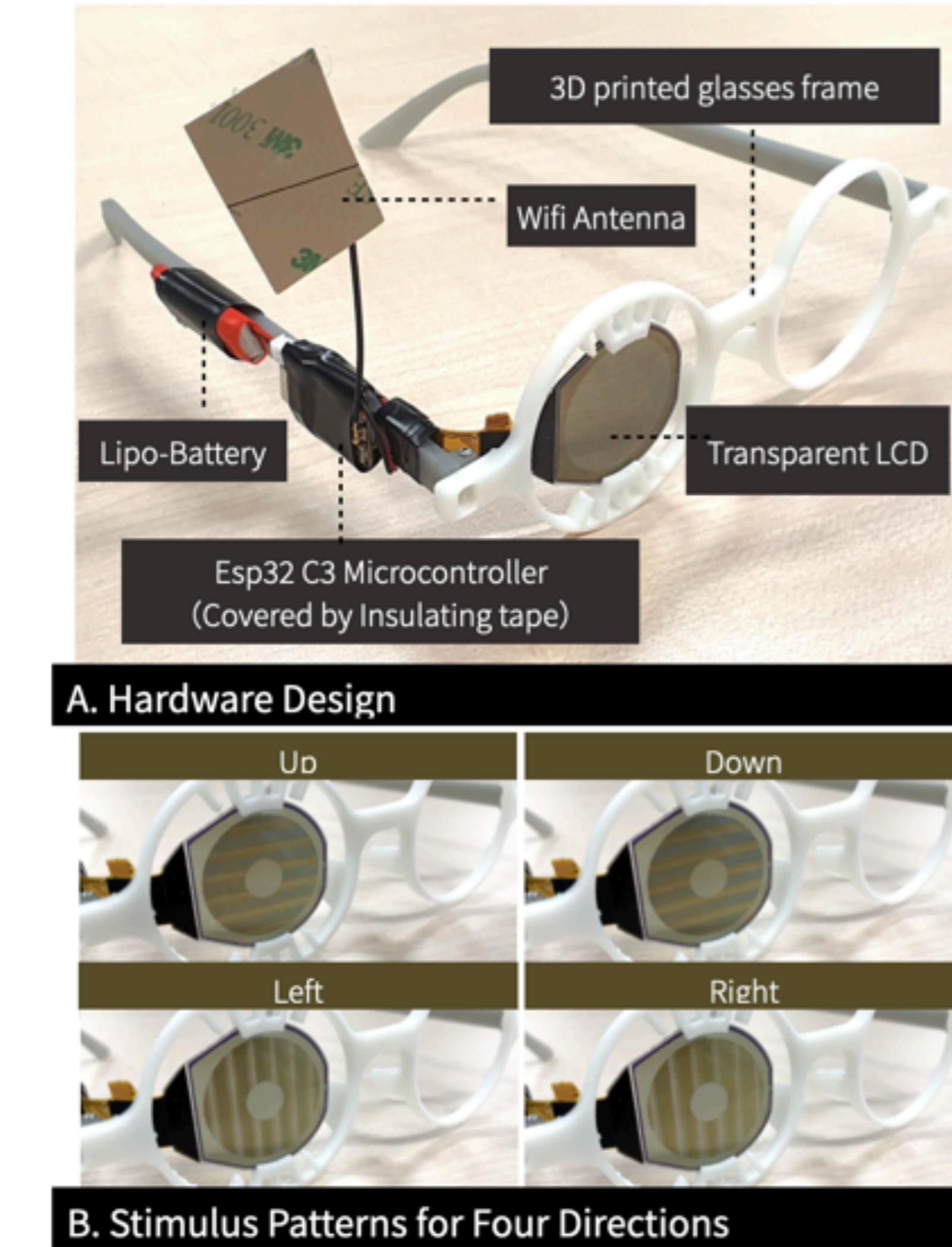
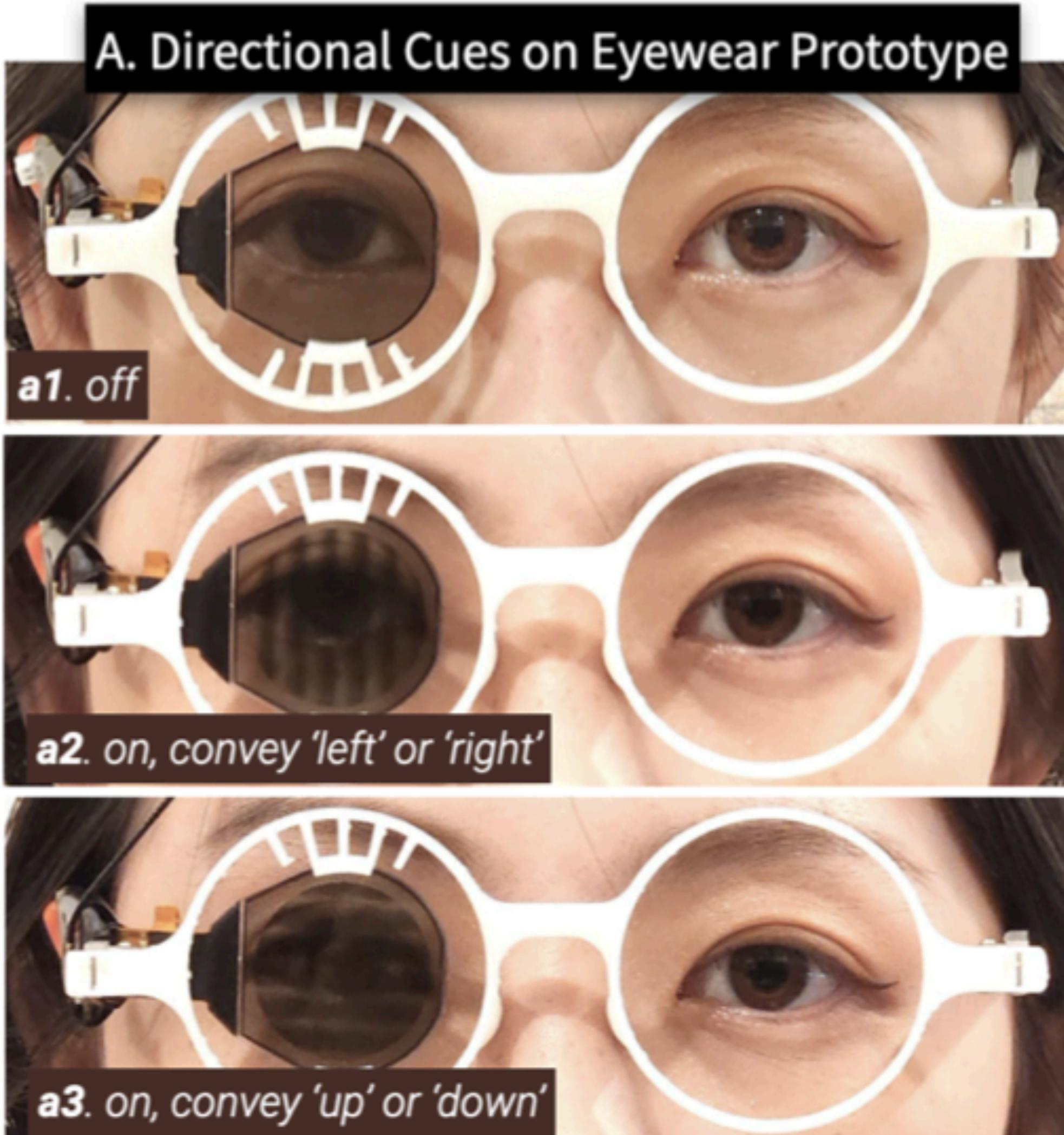
Visual Impairment Simulation

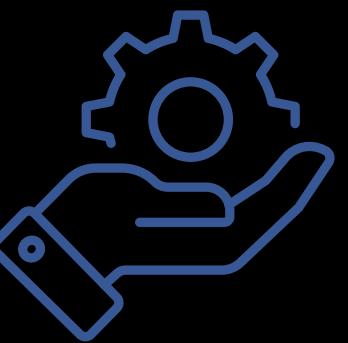
Seeing our Blind Spots: Smart Glasses-based Simulation to Increase Design Students' Awareness of Visual Impairment



Zhang, Qing, et al. "Seeing our Blind Spots: Smart Glasses-based Simulation to Increase Design Students' Awareness of Visual Impairment." UIST 2022.

Directional Cues using Peripheral Vision



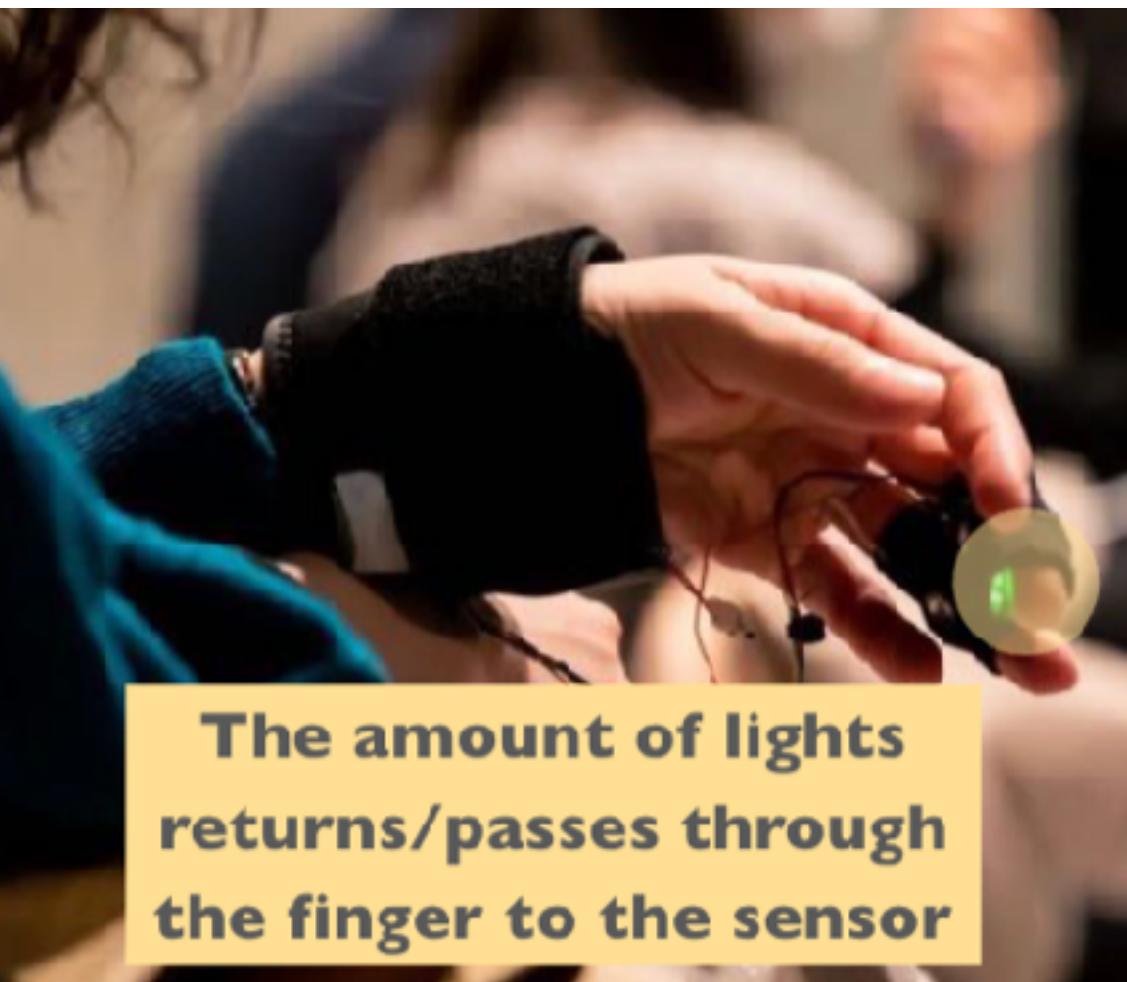
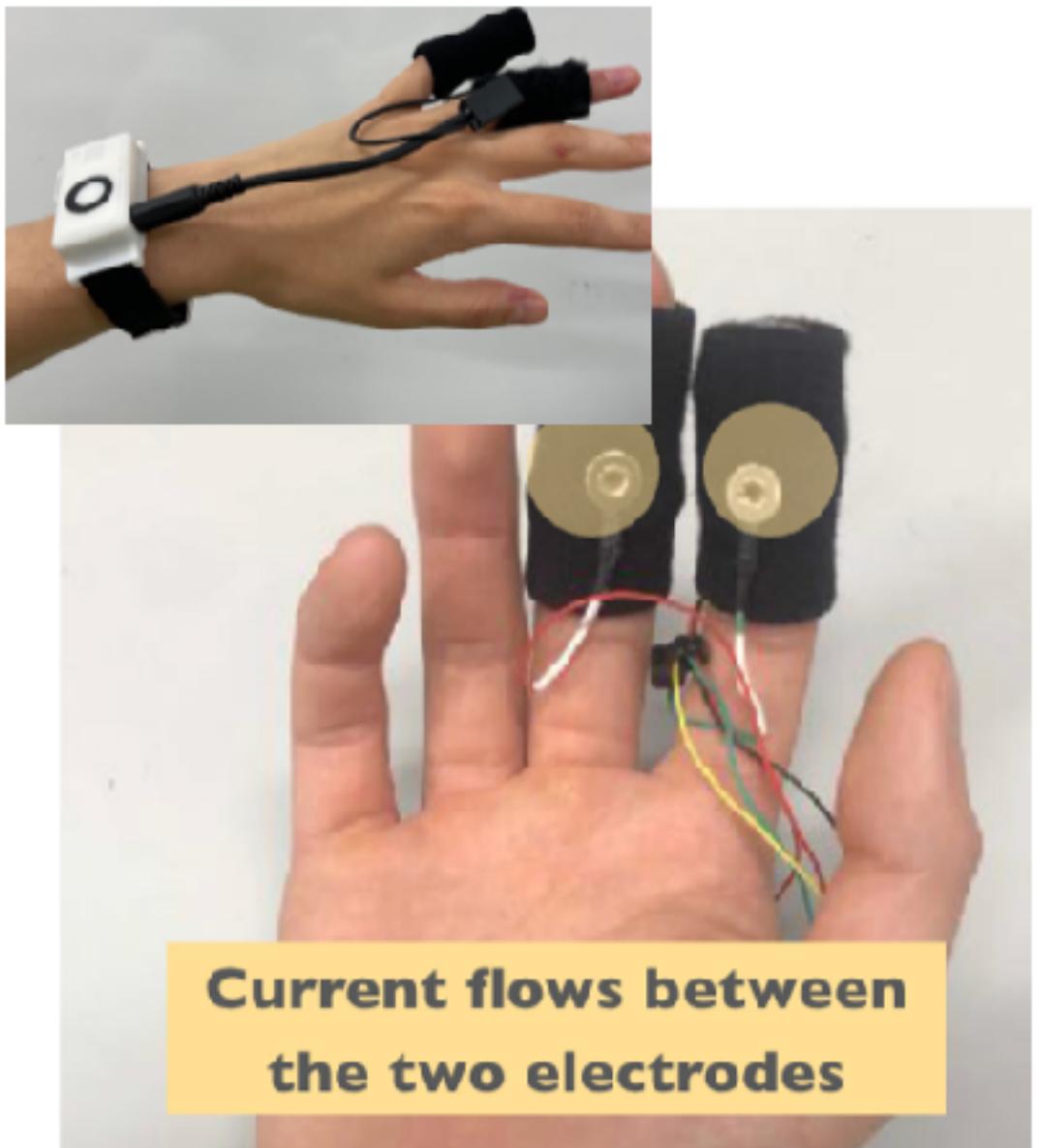


Physiological Sensing Platform

Electrodermal Activity and Blood Volume Pulse

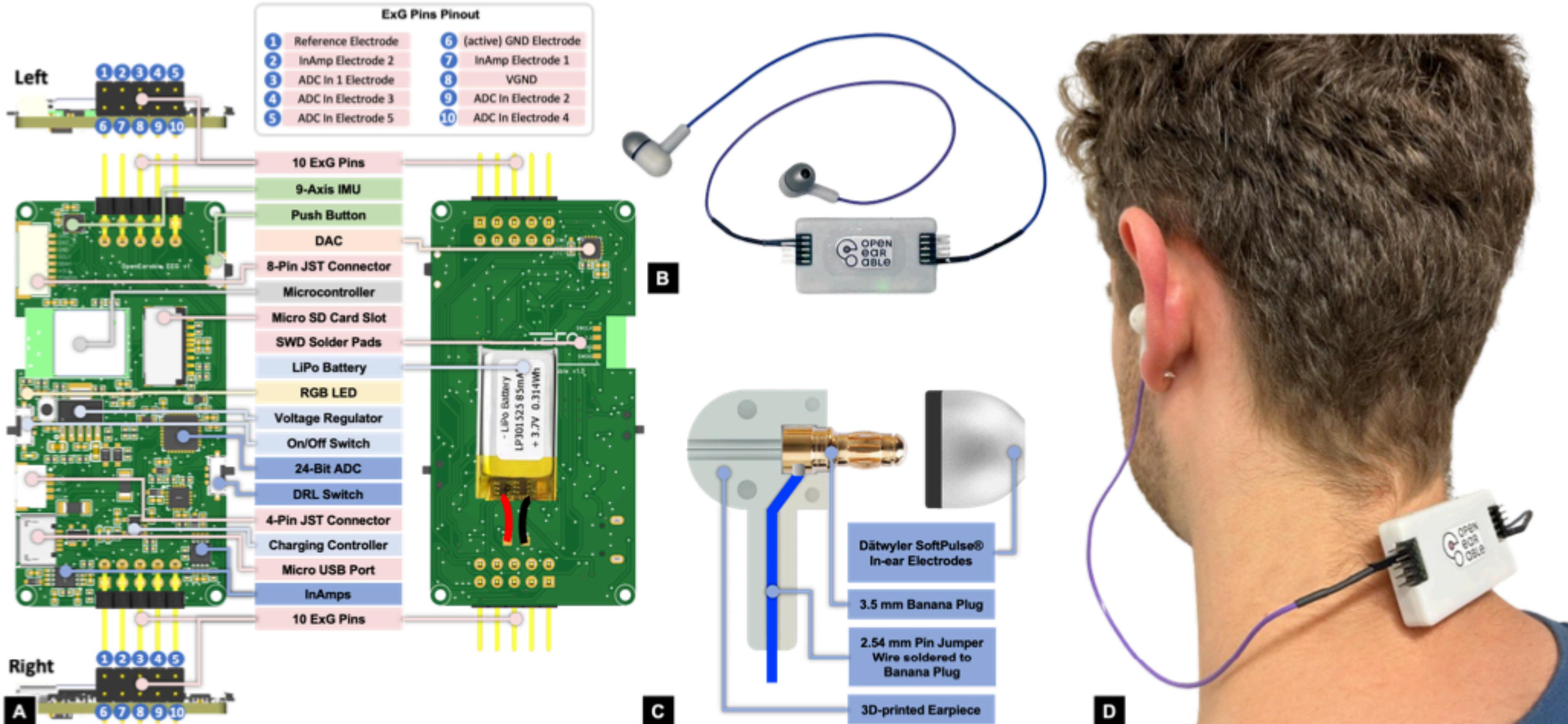
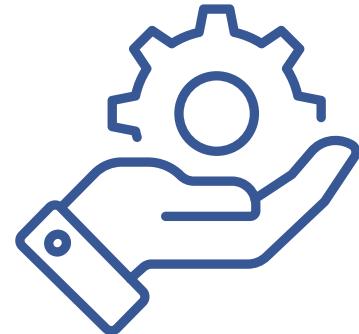
For larger scale deployments, live streaming

Electrodermal Activity and Blood Volume Pulse.



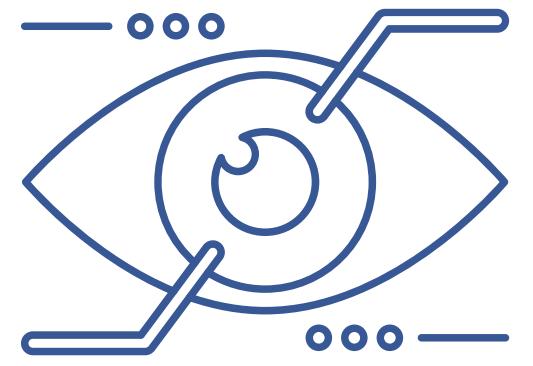
OpenEarable ExG

Open-Source Hardware for Ear-Based Biopotential Sensing Applications



Philipp Lepold, Tobias Röddiger, Tobias King, Kai Kunze, Christoph Maurer, and Michael Beigl. 2024. OpenEarable ExG: Open-Source Hardware for Ear-Based Biopotential Sensing Applications. In Companion of the 2024 on ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp '24). Association for Computing Machinery, New York, NY, USA, 916–920. <https://doi.org/10.1145/3675094.3678480>





Augmented

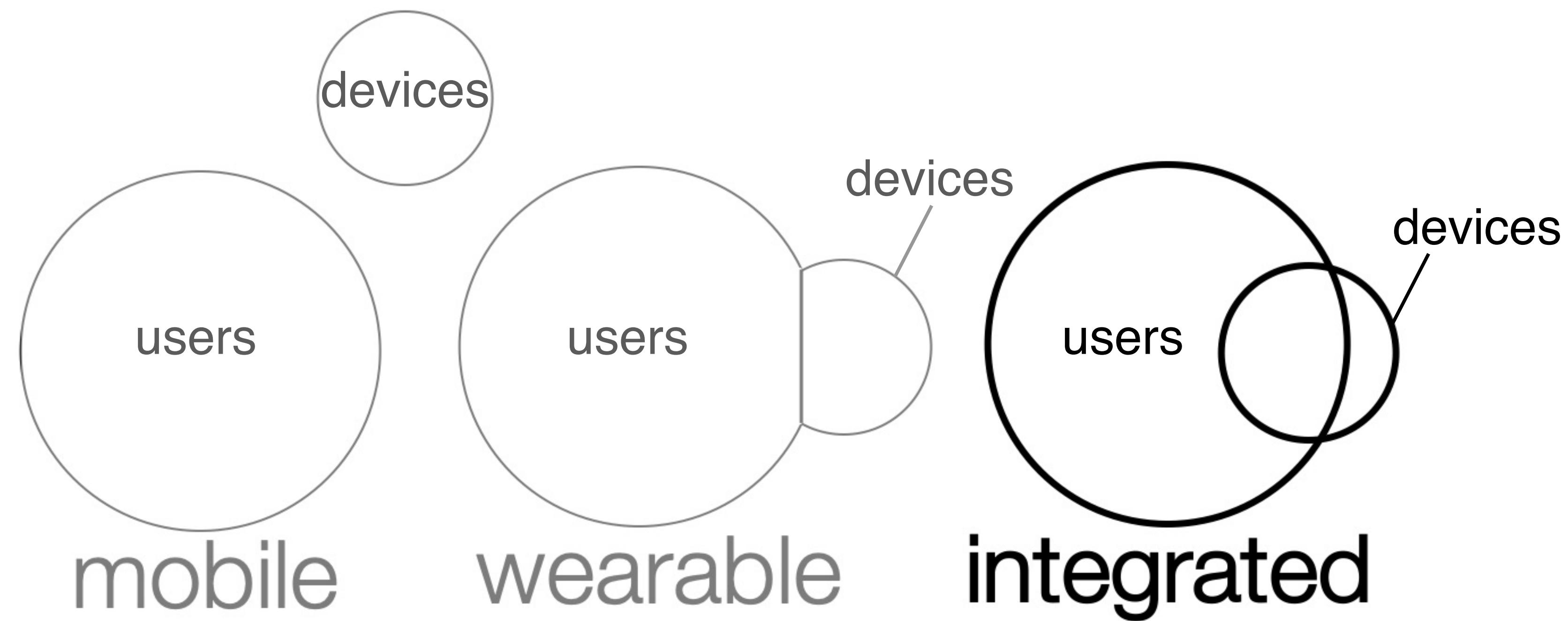
HCI Studies and beyond



“Next Steps in Human Computer Integration”

Novel paradigm moving away from Human Computer Interaction

Towards Human Computer Integration/Augmented Humans



Improves Skill Acquisition in Percussions Pneumatic Artificial Muscles

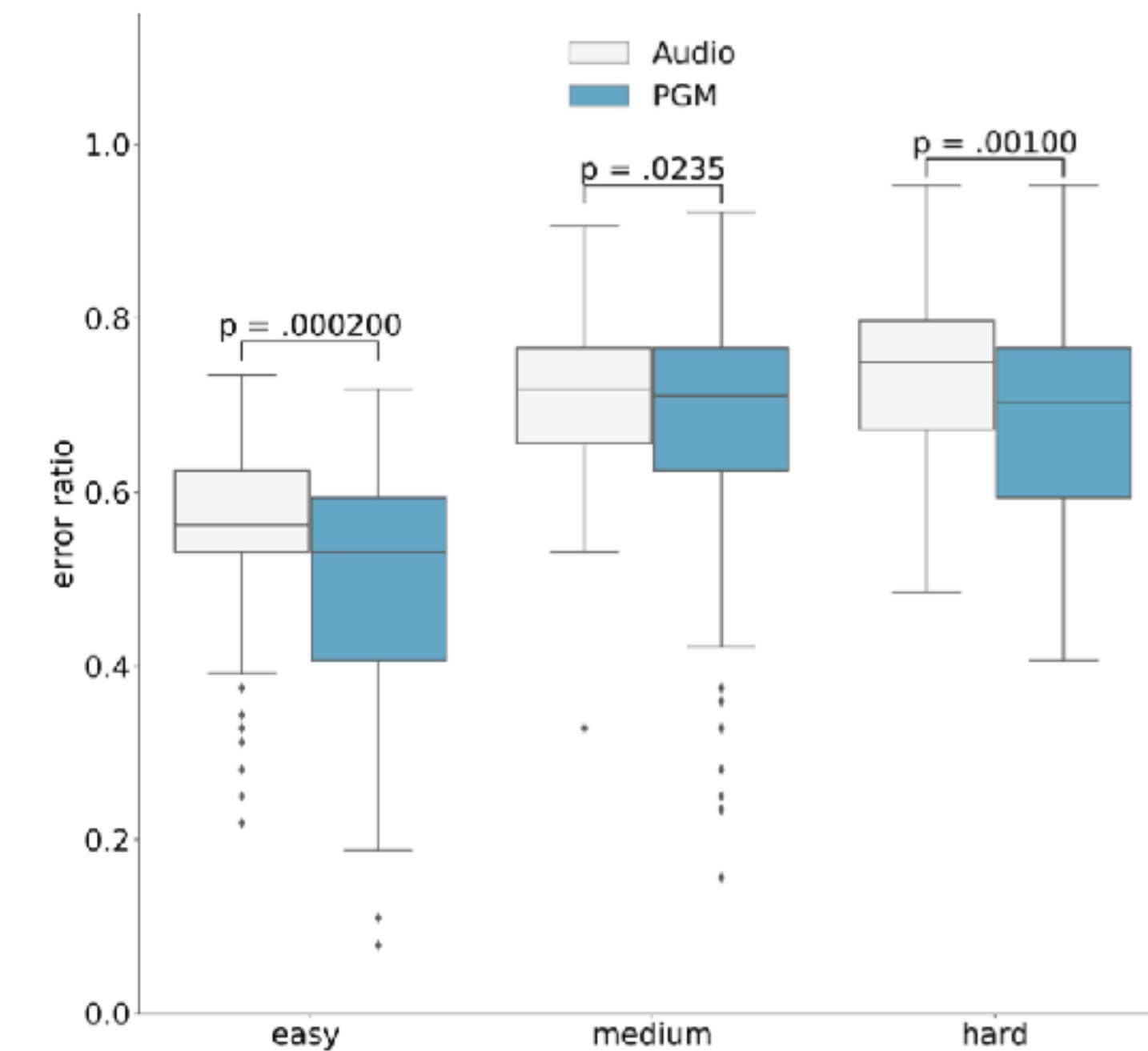
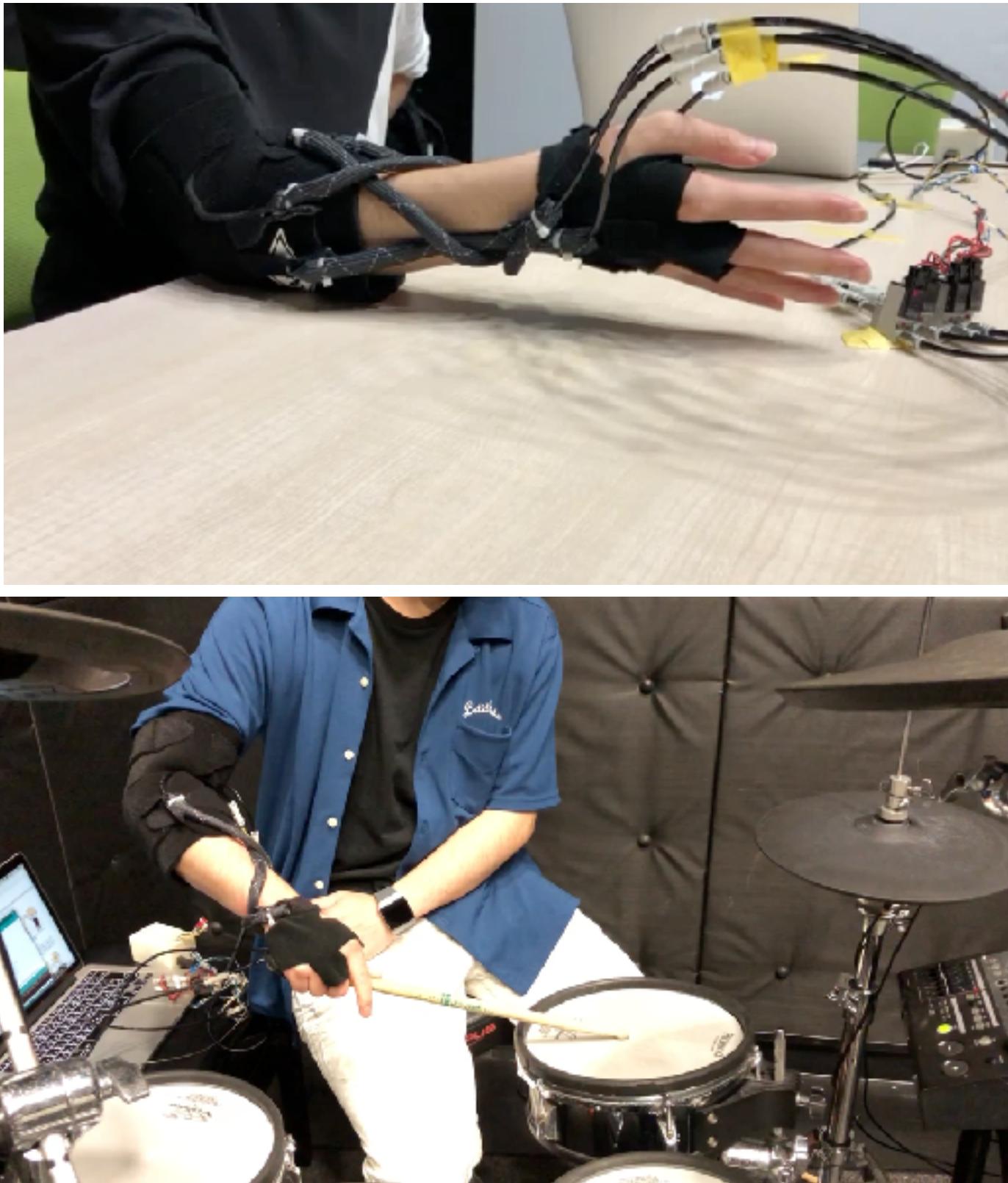
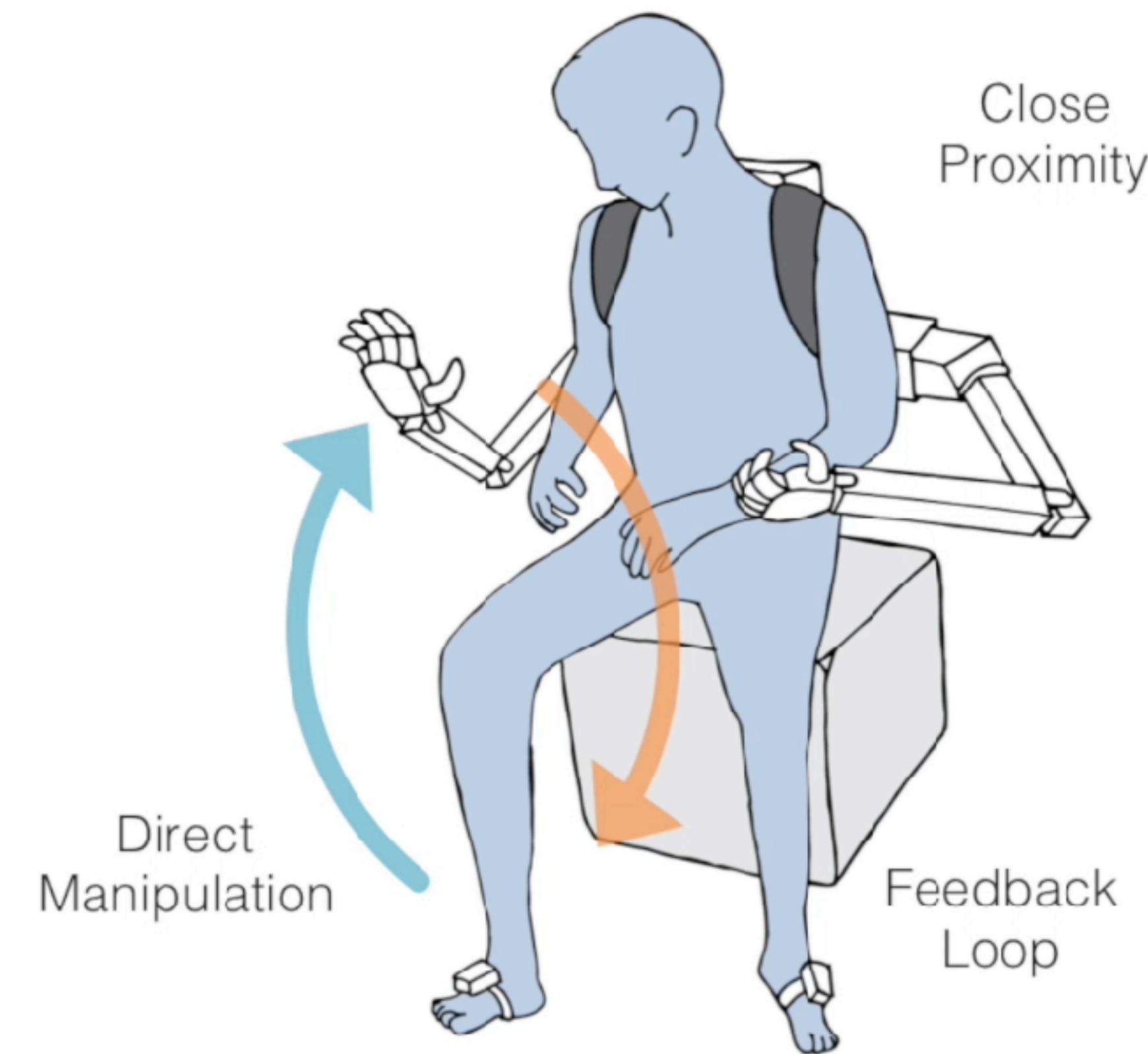


Figure 8. Results of error rate for each task.

Goto, Takashi, et al. "Accelerating Skill Acquisition of Two-Handed Drumming using Pneumatic Artificial Muscles." Proceedings of the Augmented Humans International Conference. 2020.



Explore how can Tech overlap with our bodies



Saraiji, M. H. D., et al. "MetaArmS: Body remapping using feet-controlled artificial arms." *The 31st Annual ACM Symposium on User Interface Software and Technology*. ACM, 2018.



JIZAI Body

Prof. Masahiko Inami

<https://jizai-body.com/>

allows for humans to integrate with machines (both robot and AI) and be free of limitations while maintaining a sense of agency.



JST Moonshot Effort

<https://www.jst.go.jp/moonshot/en/index.html>

- Goal 1** Realization of a society in which human beings can be free from limitations of body, brain, space, and time by 2050.

Program Director **HAGITA Norihiro**

Chair and Professor, Art Science Department, Osaka University of Arts



- Goal 3** Realization of AI robots that autonomously learn, adapt to their environment, evolve in intelligence and act alongside human beings, by 2050.

Program Director **FUKUDA Toshio**

Visiting Professor, Institute of Innovation for Future Society, Nagoya University



- Goal 5** Creation of the industry that enables sustainable global food supply by exploiting unused biological resources by 2050.

Program Director **CHIBA Kazuhiro**

President, Tokyo University of Agriculture and Technology



- Goal 2** Realization of ultra-early disease prediction and intervention by 2050.

Program Director **SOBUE Gen**

Chairperson,
Aichi Medical University



- Goal 4** Realization of sustainable resource circulation to recover the global environment by 2050.

Program Director **YAMAJI Kenji**

President, Director-General of the Research Institute of Innovative Technology for the Earth (RITE)



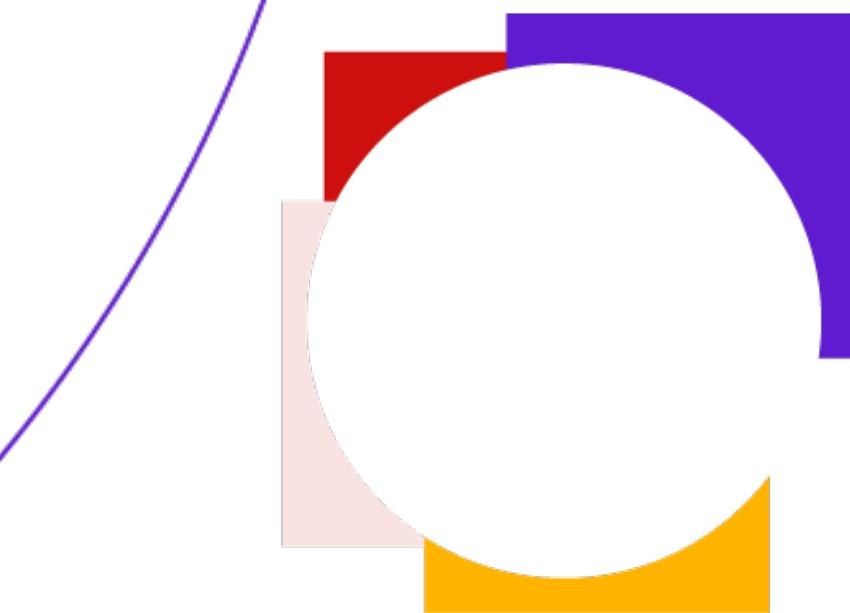
Link to external site
(NEDO) 

- Goal 6** Realization of a fault-tolerant universal quantum computer that will revolutionize economy, industry, and security by 2050.

Program Director **KITAGAWA Masahiro**

Director, Center for Quantum Information and Quantum Biology, The University of Osaka





**Cybernetic
being**



内閣府／科学技術振興機構・ムーンショット型研究開発事業・目標1
身体的共創を生み出すサイバネティック・アバター技術と社会基盤の開発

**Cybernetic Avatar Technology and Social System Design
for Harmonious Co-experience and Collective Ability**

<https://cybernetic-being.org>

How will human bodies and lives change in the era of “Cybernetic beings”, where bodies and technology merge through Cybernetic Avatars?



① Cognitive Augmentation

A body that can freely draw out your potential according to the situation and environment



② Parallel Agency & Experience Sharing

Multiple bodies that can perceive and act in different spaces at the same time

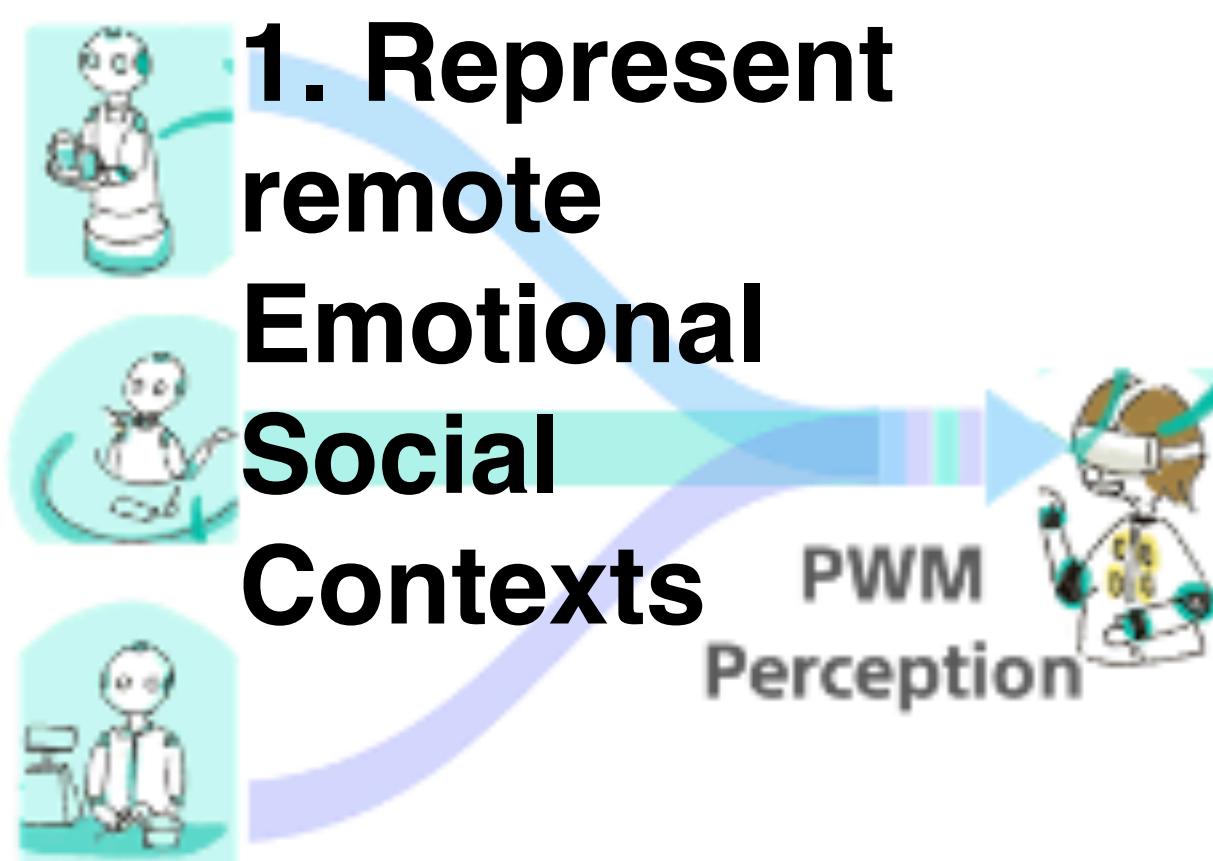


③ Collective Abilities

A body that can combine multiple peoples' skills to go beyond individual capabilities

Digitalized Emotion - Project

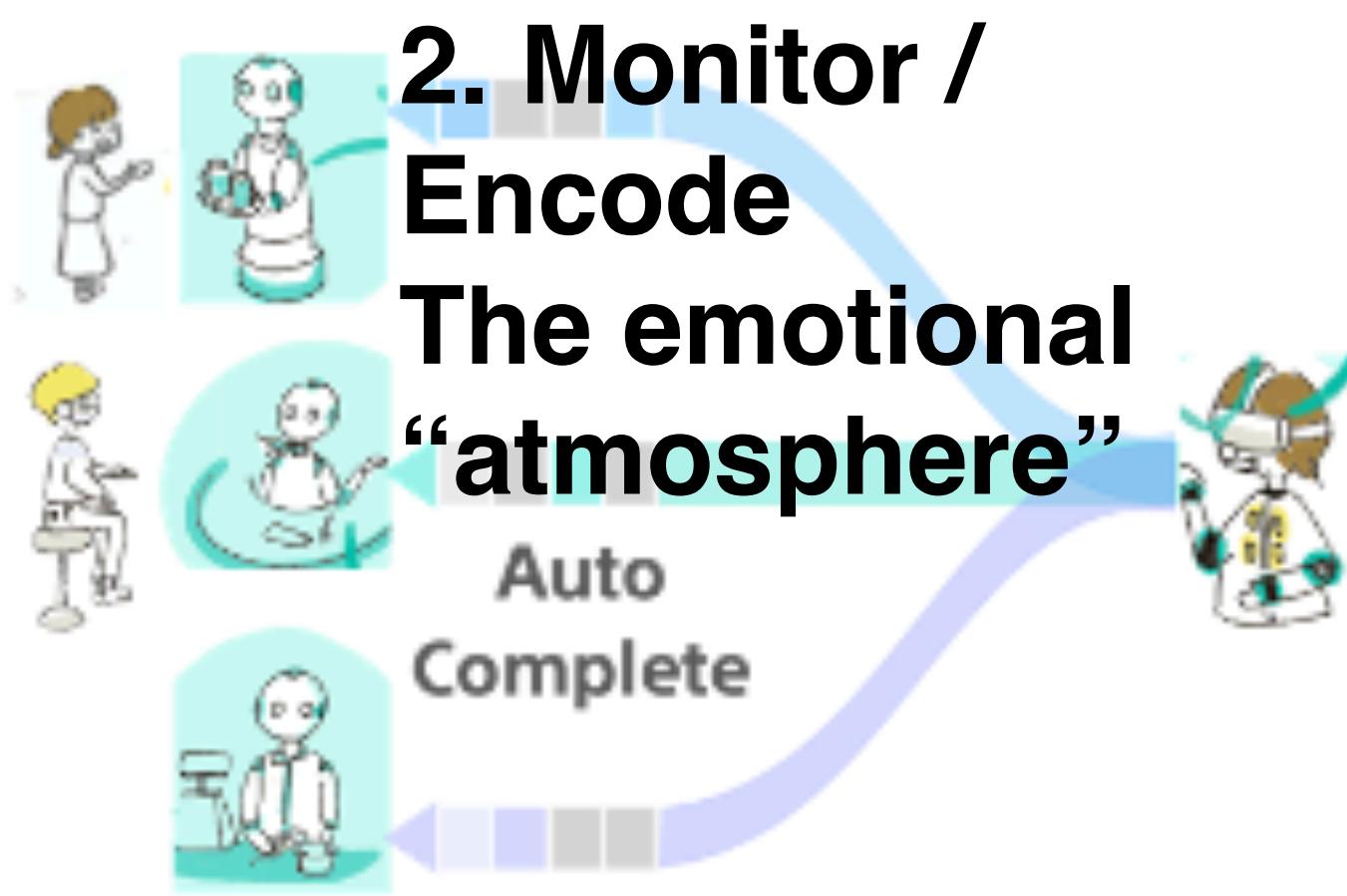
①Parallel Percept



注意と意識の切替高速化による
複数身体での並行知覚・認知

Parallel Perception and Cognition by
Accelerating attention and awareness switch frequency

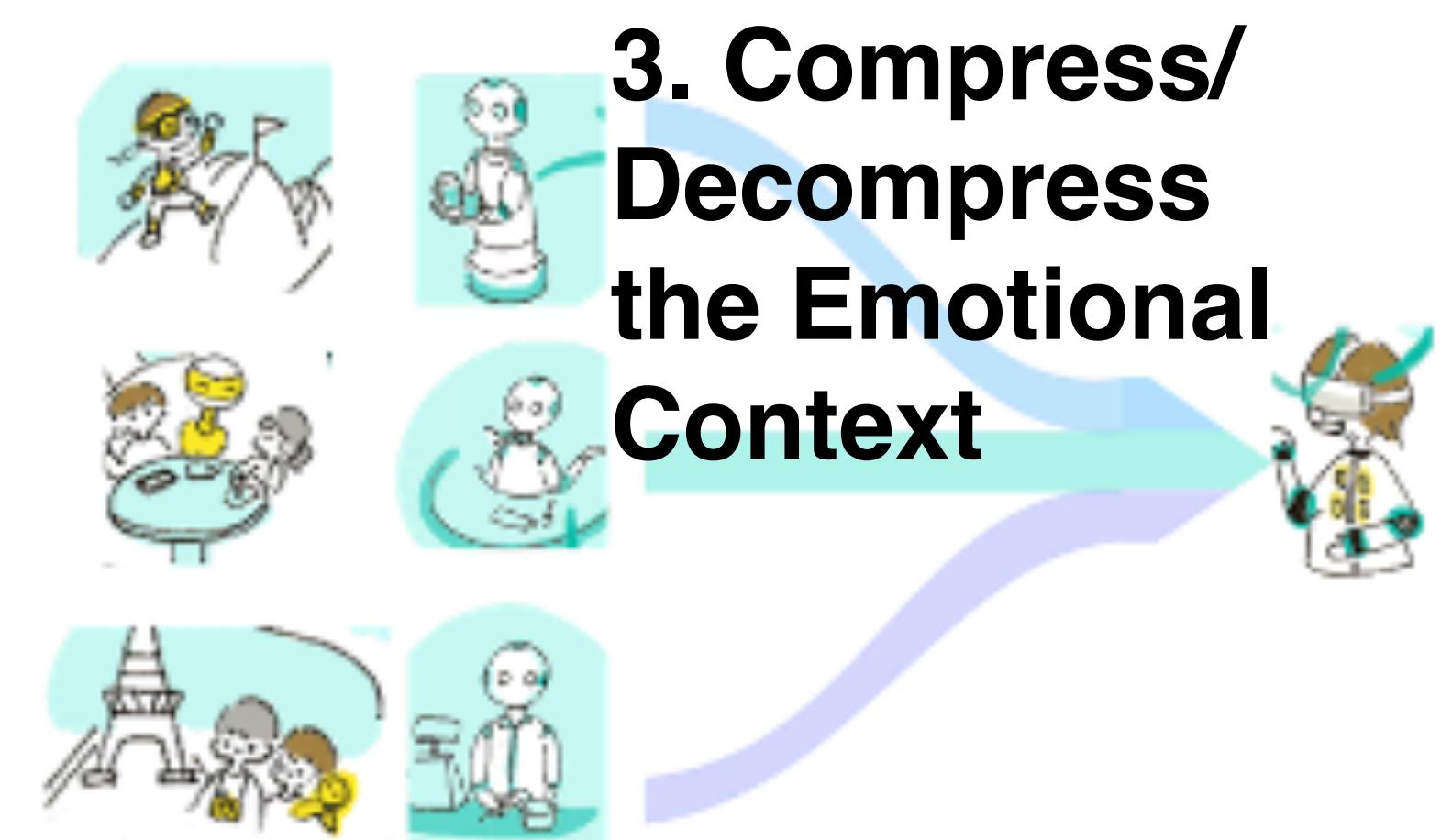
②Parallel Action



CAの自律行動補間による
並行行動での主観的連続性・対人的一貫性

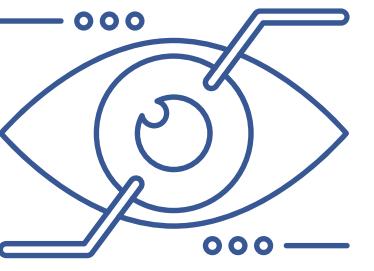
Action auto execution for compensating off attention
to provide self continuous and consistency for others.

③Parallel Attribution



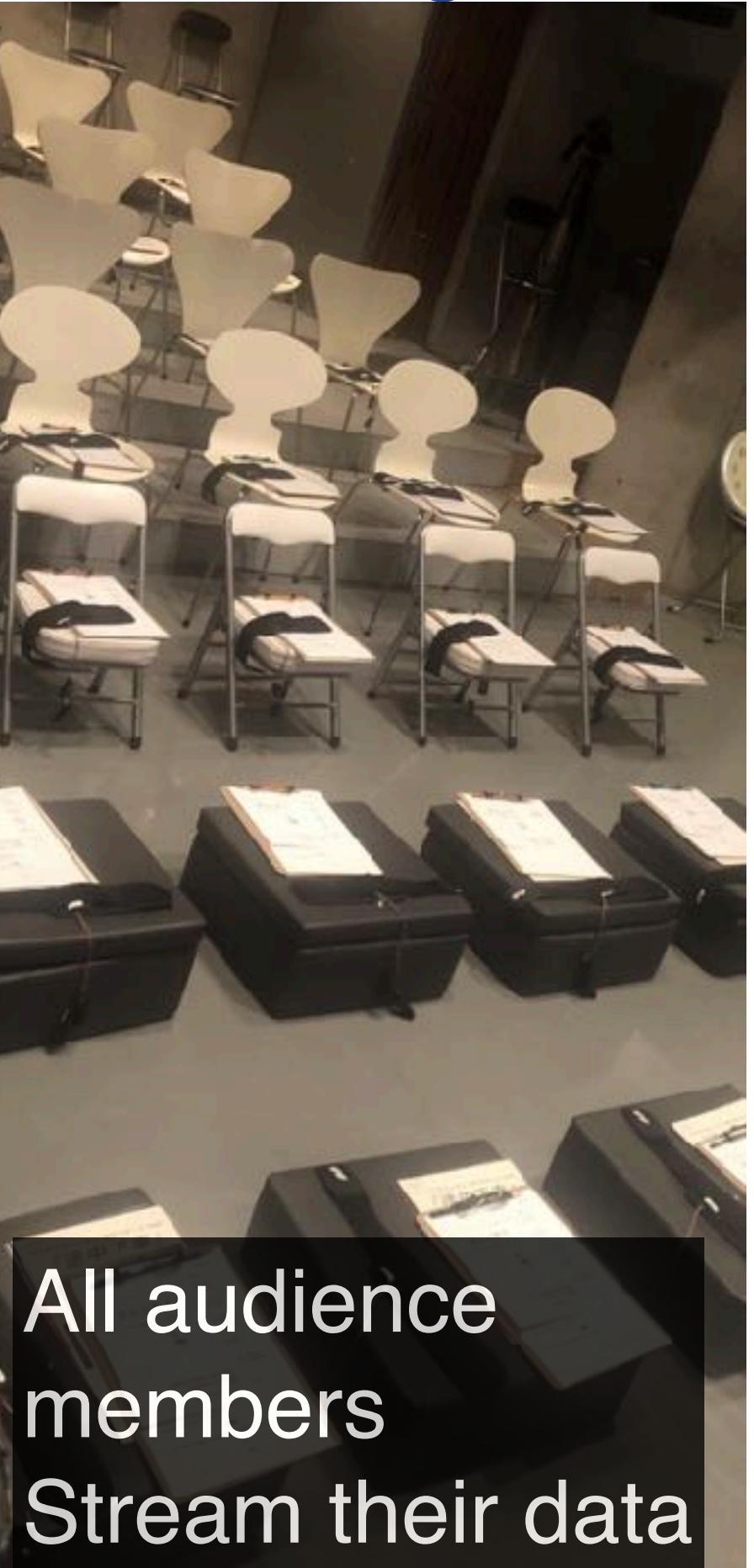
CAでの並列行動・並列体験の自己帰属

Self attribution for all paralleled action and experience
in multiple cybernetic avatar



Putting the Audience on Stage

Why we chose the setup



All audience
members
Stream their data

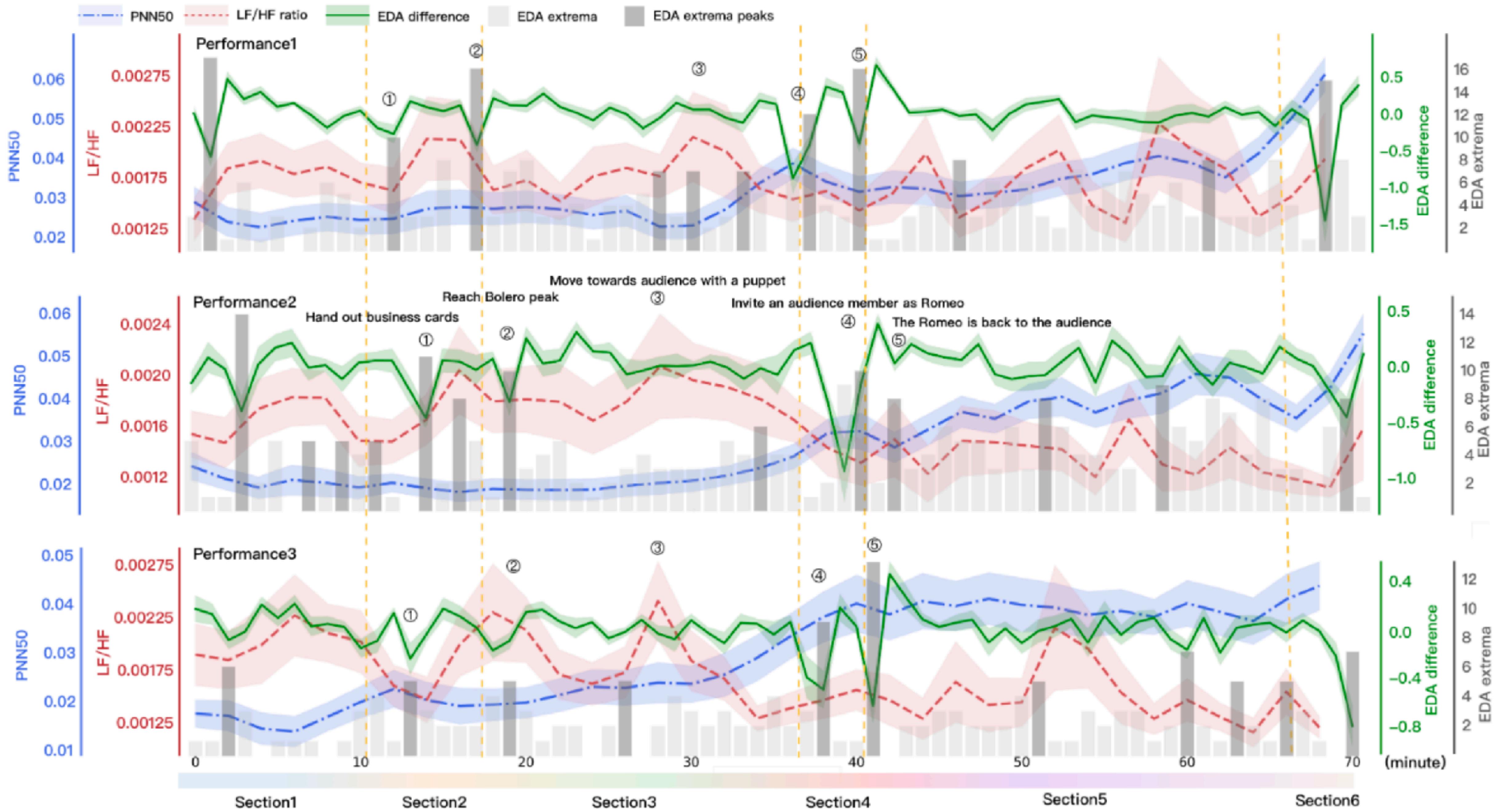


Special thanks to: Dingding Zheng, George Chenyshov,
Danny Hynds,

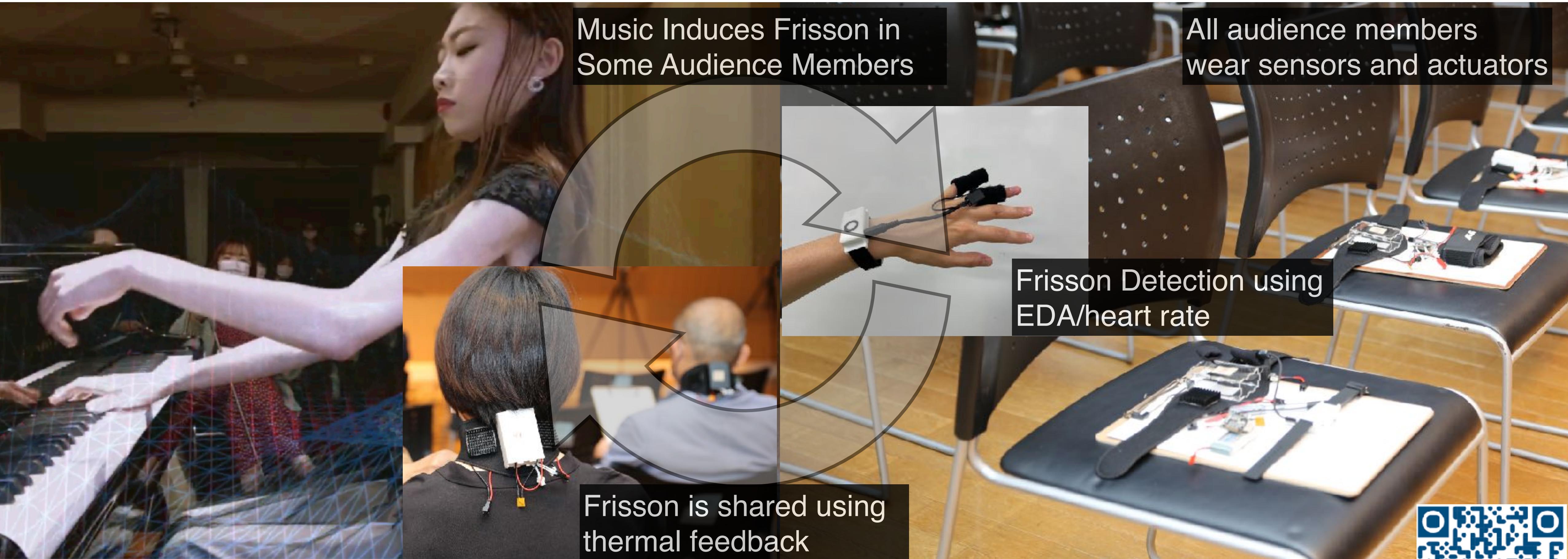
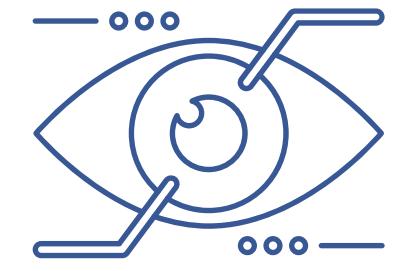


Linking Audience Physiology to Choreography.
TOCHI Journal 2023.
<https://dl.acm.org/doi/10.1145/3557887>





Recording the Physiology in Classical Concerts



Yan He, George Chernyshov, Jiawen Han, Dingding Zheng, Ragnar Thomsen, Danny Hynds, Muyu Liu, Yuehui Yang, Yulan Ju, Yun Suen Pai, Kouta Minamizawa, Kai Kunze, and Jamie A. Ward. 2022. Frisson Waves: Exploring Automatic Detection, Triggering and Sharing of Aesthetic Chills in Music Performances. Proc. ACM Interact. Mob. Wearable Ubiquitous Technol. 6, 3, Article 118 (September 2022), 23 pages. <https://doi.org/10.1145/3550324>



Physiological measurements to recreate collective experiences in VR



A Placebo Concert: The Placebo Effect for
Visualization of Physiological Audience Data
during Experience Recreation in Virtual Reality
CHI 2025



A Placebo Concert

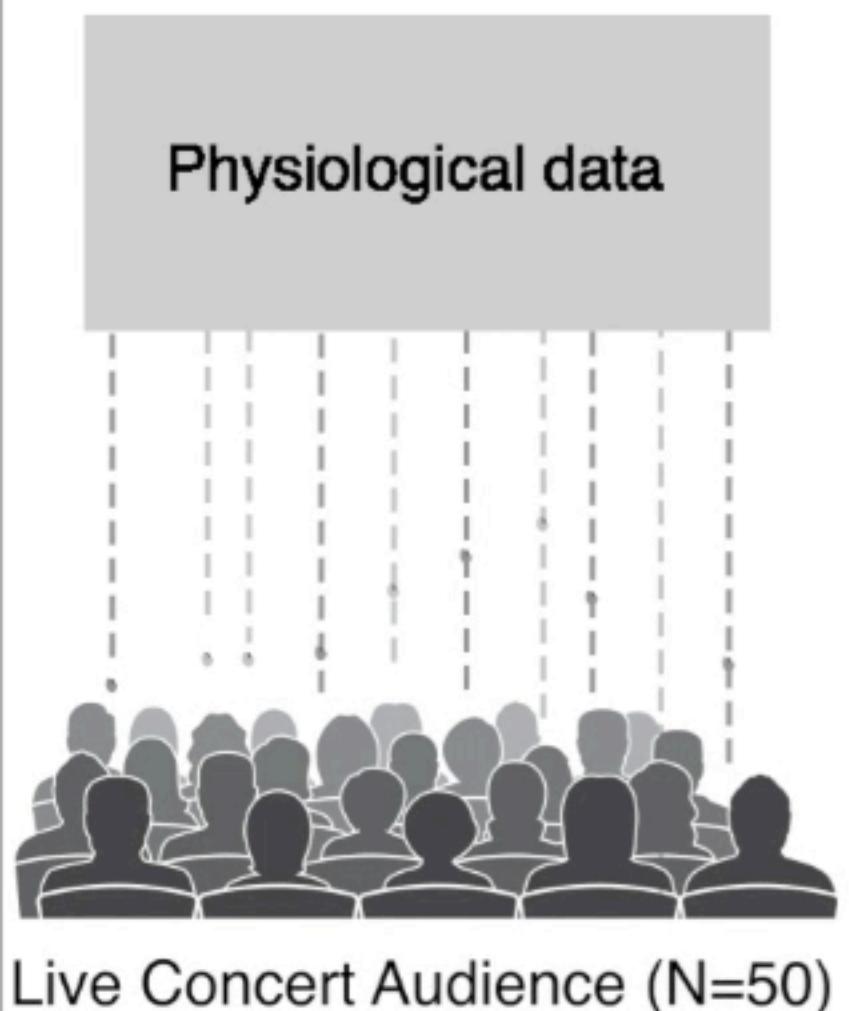
The Placebo Effect for Visualization of Physiological Audience Data
during Experience Recreation in Virtual Reality

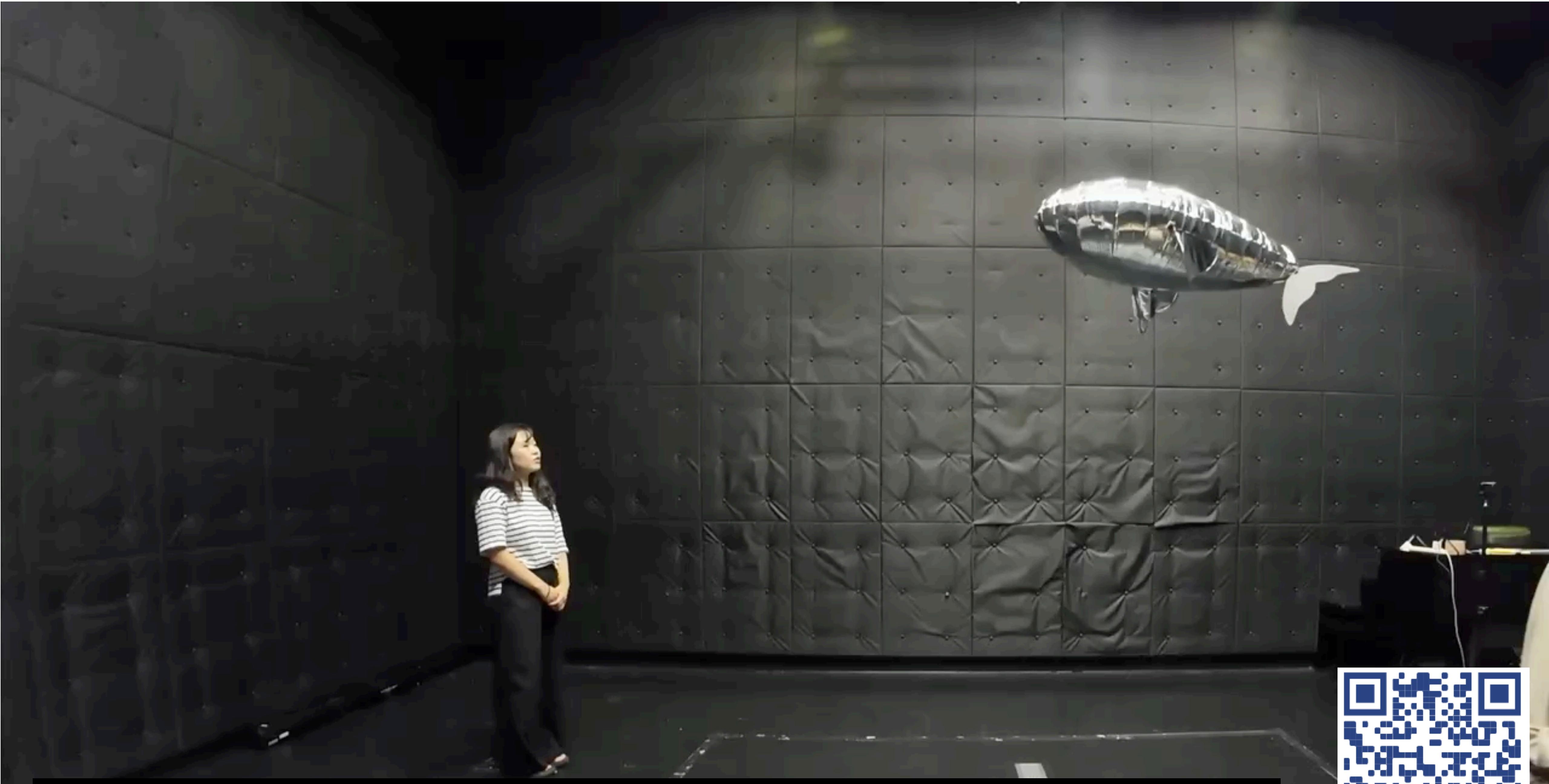
A Placebo Concert: The Placebo Effect for
Visualization of Physiological Audience Data
during Experience Recreation in Virtual Reality
CHI 2025



User Study

Mixed-Design Study ($n = 44$)



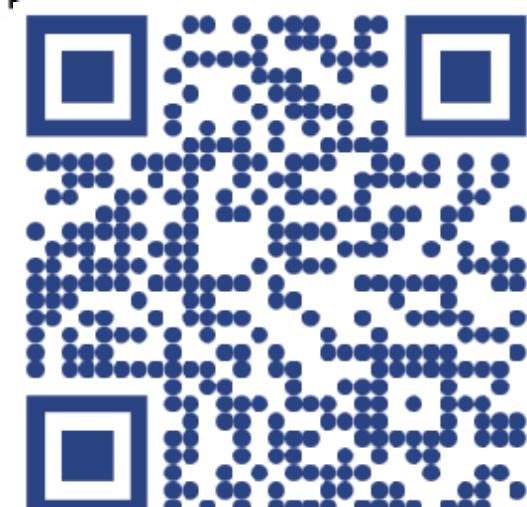
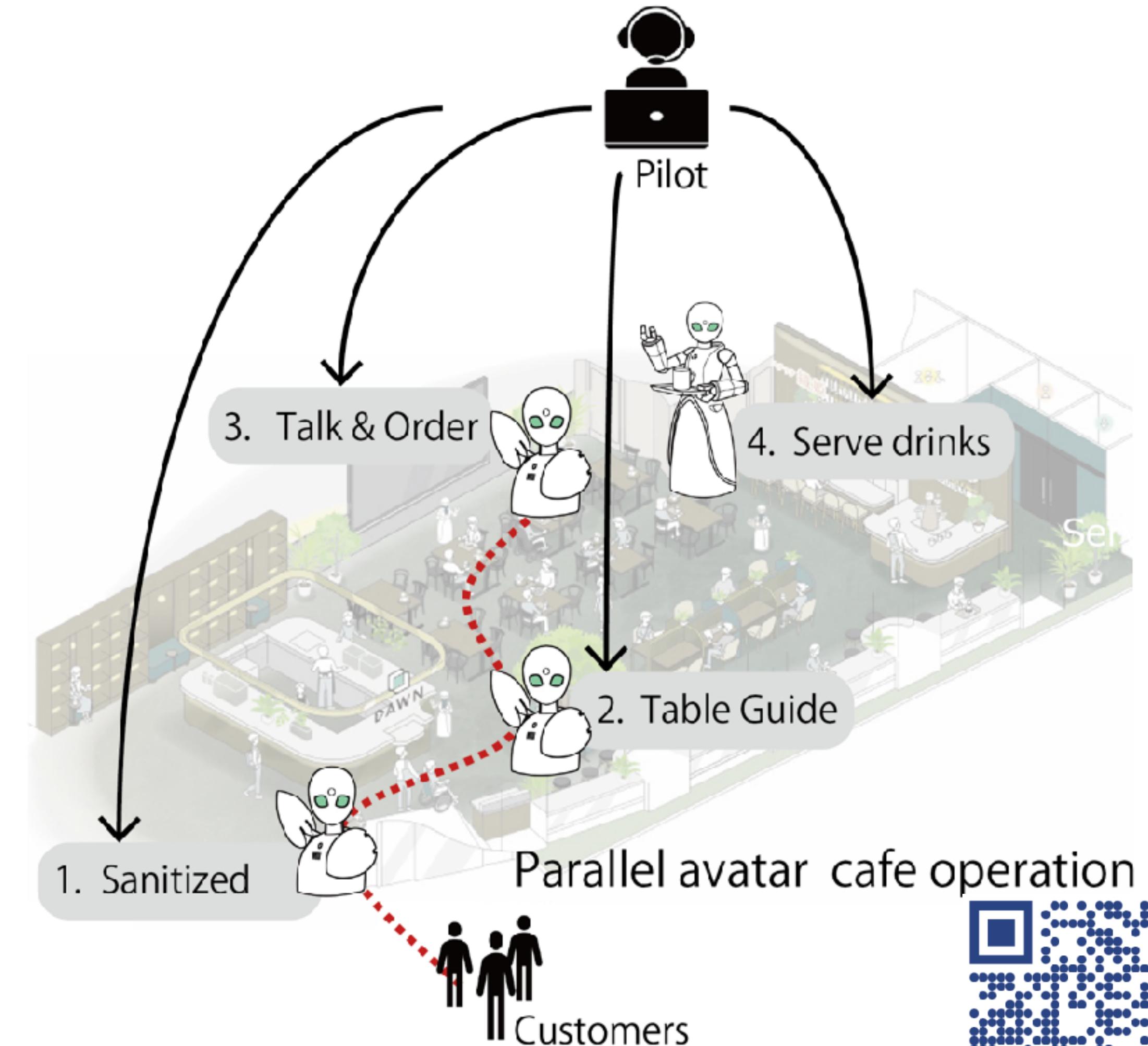
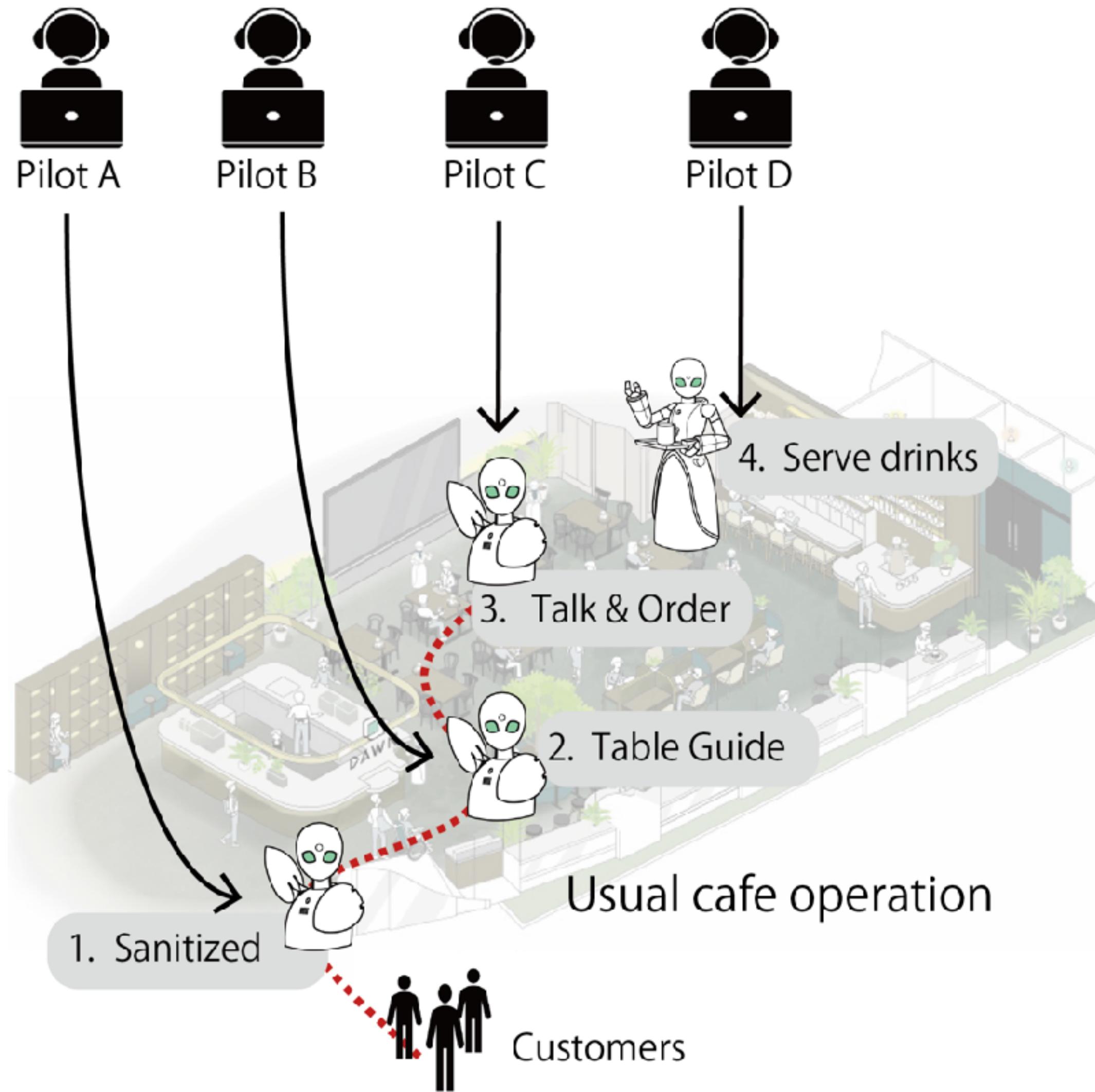


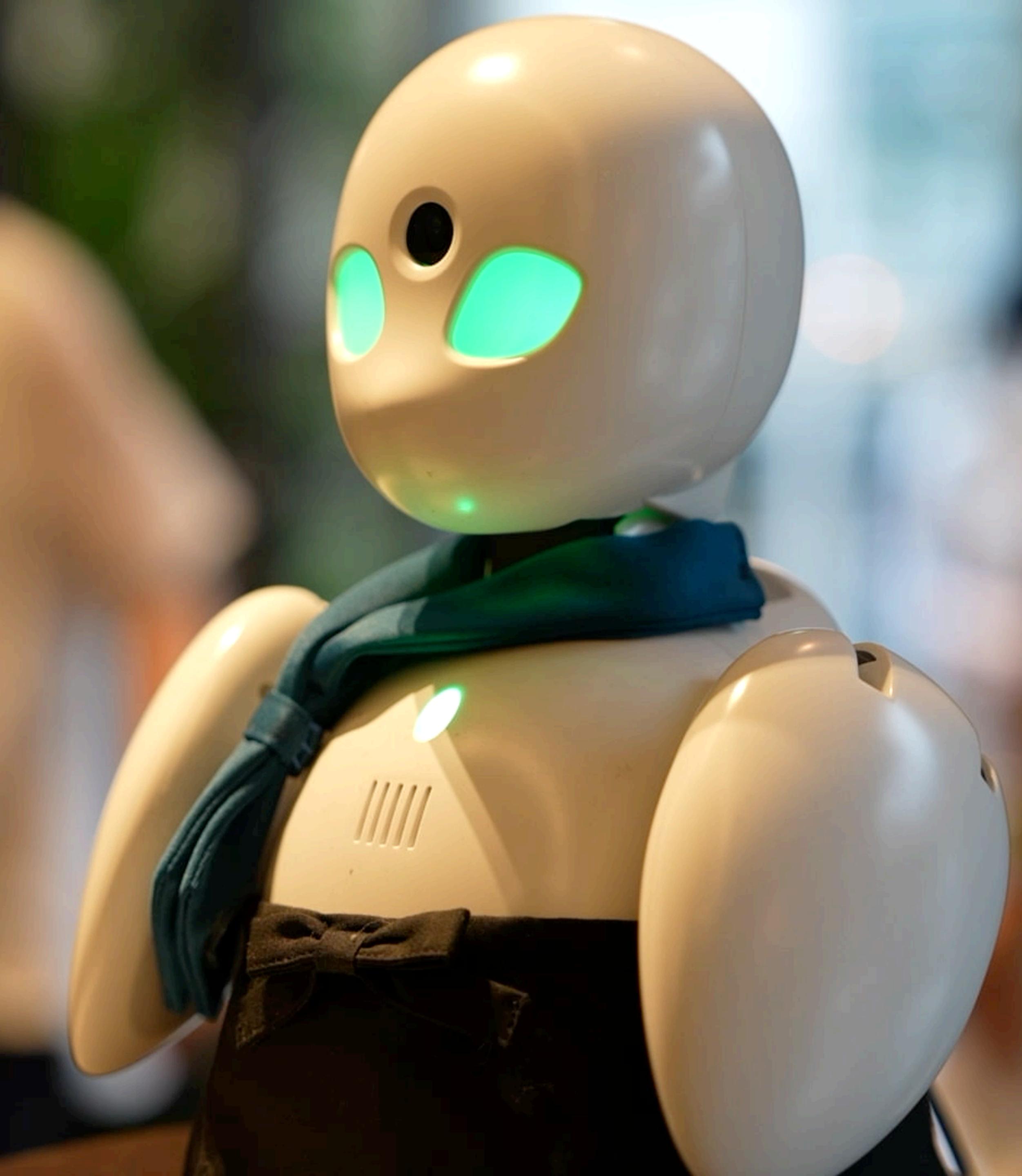
Cuddle-Fish: Exploring a Soft Floating Robot with Flapping Wings for Physical Interactions.
Augmented Humans 2025





Parallel Embodiment





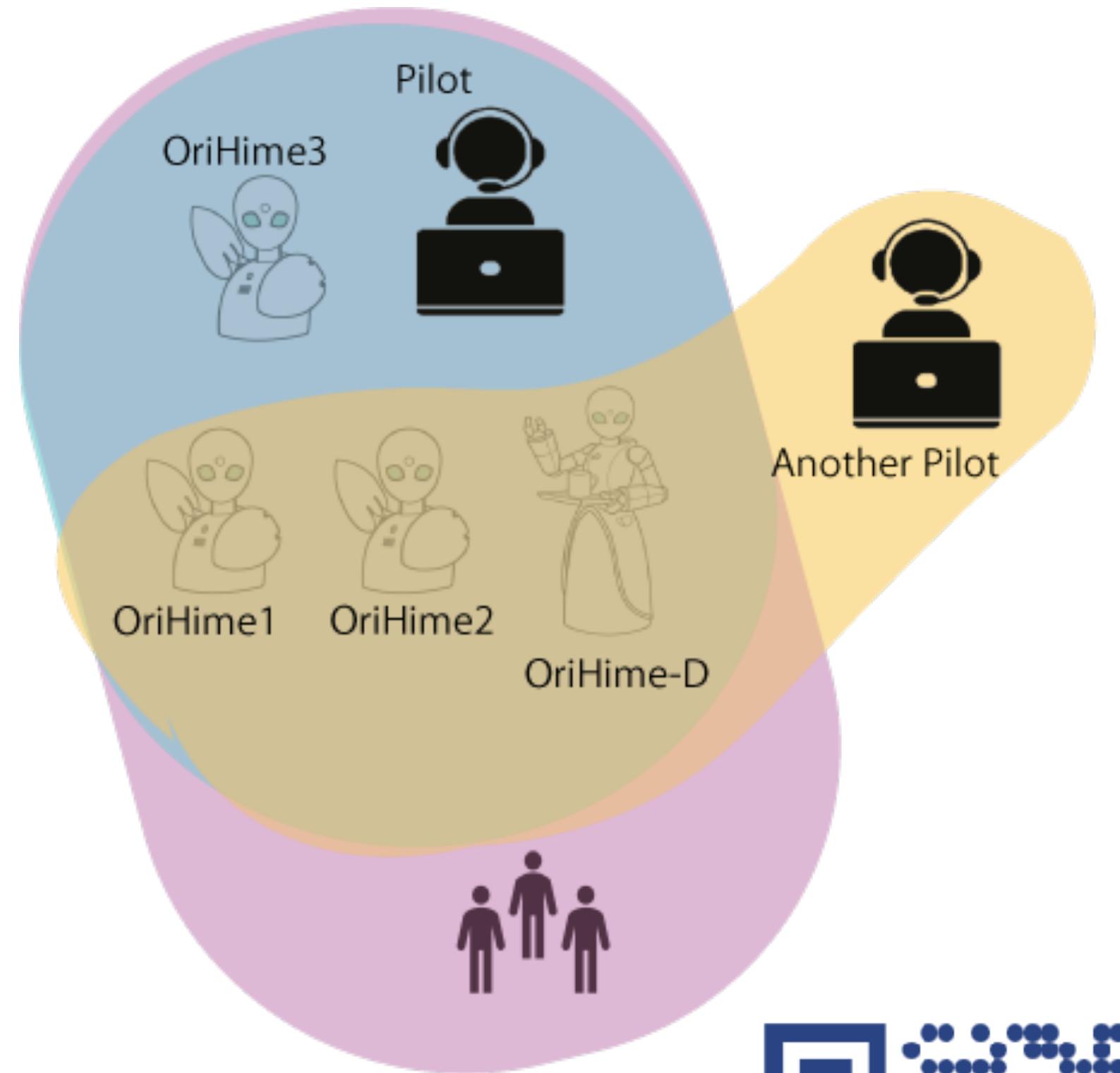
Layers of Interactions



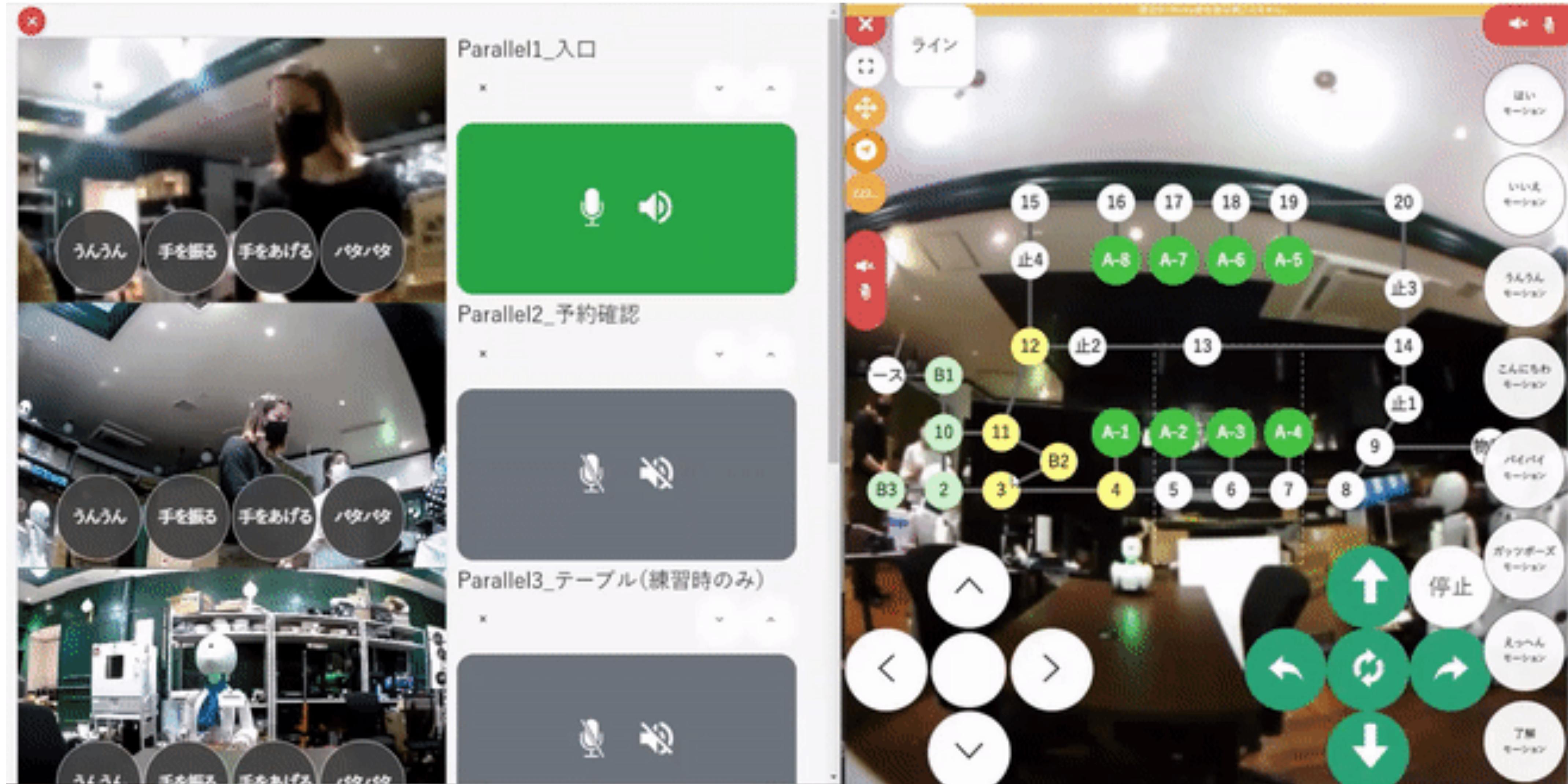
One to one interactions between pilots and customers

Parallel interactions (brief and sustained)

Hidden interactions to manage avatar control between pilots



Challenges, skills, and pride



Questions, Remarks, Violent Dissent?



<http://augmented-humans.org/>

Full/Short Paper/ Submission Deadline

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