

A photograph showing a dark silhouette of a person's head and shoulders against a background of numerous small, glowing blue circular lights, likely from a Christmas tree. The lights are out of focus, creating a bokeh effect.

Augmenting Humans

Kai Kunze
Professor
Keio Media Design
Keio University, Tokyo, Japan
<http://kaikunze.de/>

My Background

Professor

Graduate School of Media Design, Keio University

Research Assistant Professor

Osaka Prefecture University

Visiting Researcher at MIT Media Lab

MIT, Cambridge, USA

phD in Ubiquitous/Wearable Computing (2011)

University Passau, Germany

Collaborations with PARC, SUN, Deutsche Börse ...

Palo Alto, Grenoble, Frankfurt, Innsbruck



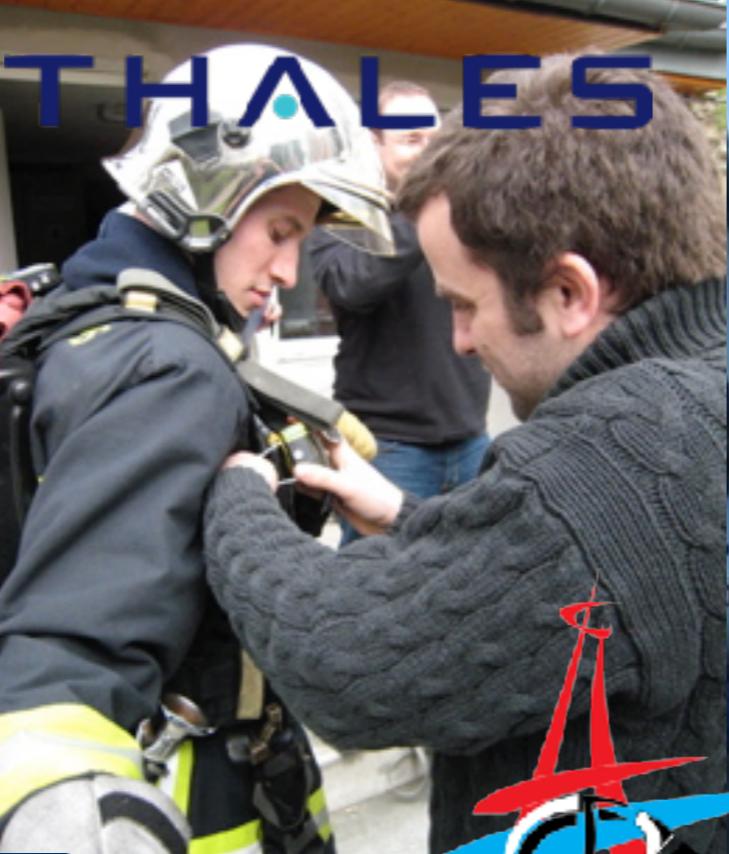
WEARABLE COMPUTING ~2000



ZEISS



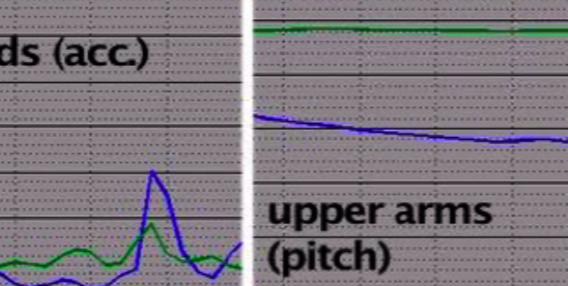
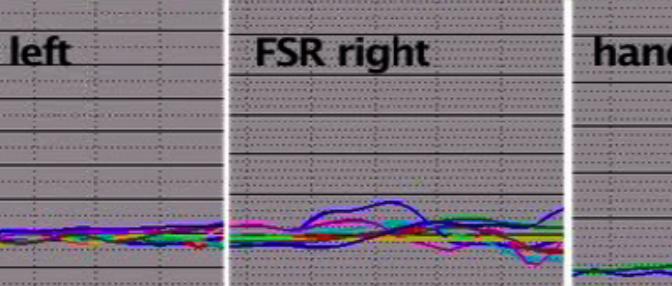
THALES



SAP



WEMBLEY
inspiring • memories



Allianz **Arena**



My Research Group (and Friends)



My Workplaces

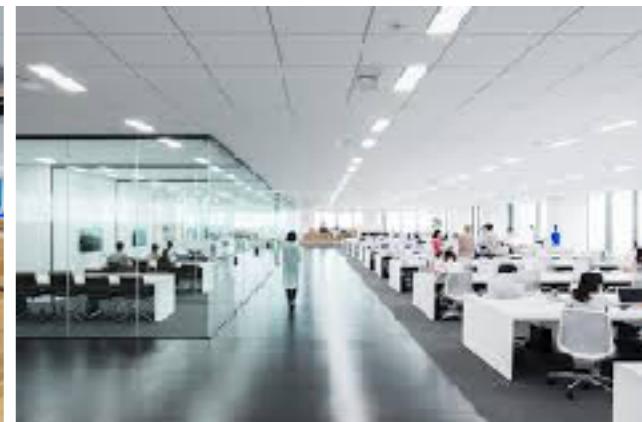
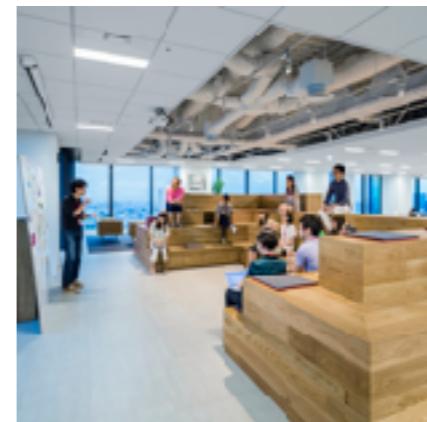
Shibuya Lab, Keio Media Design
Workspace, Workshops with
Companies etc.



Hiyoshi Campus, Keio University
Teaching, Mentoring etc.



J!NS Office
Research and Development for J!NS



Living Lab, Miraikan, Japanese Science Museum
Public Outreach, Workshops, Talks, Prototyping



Physical



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

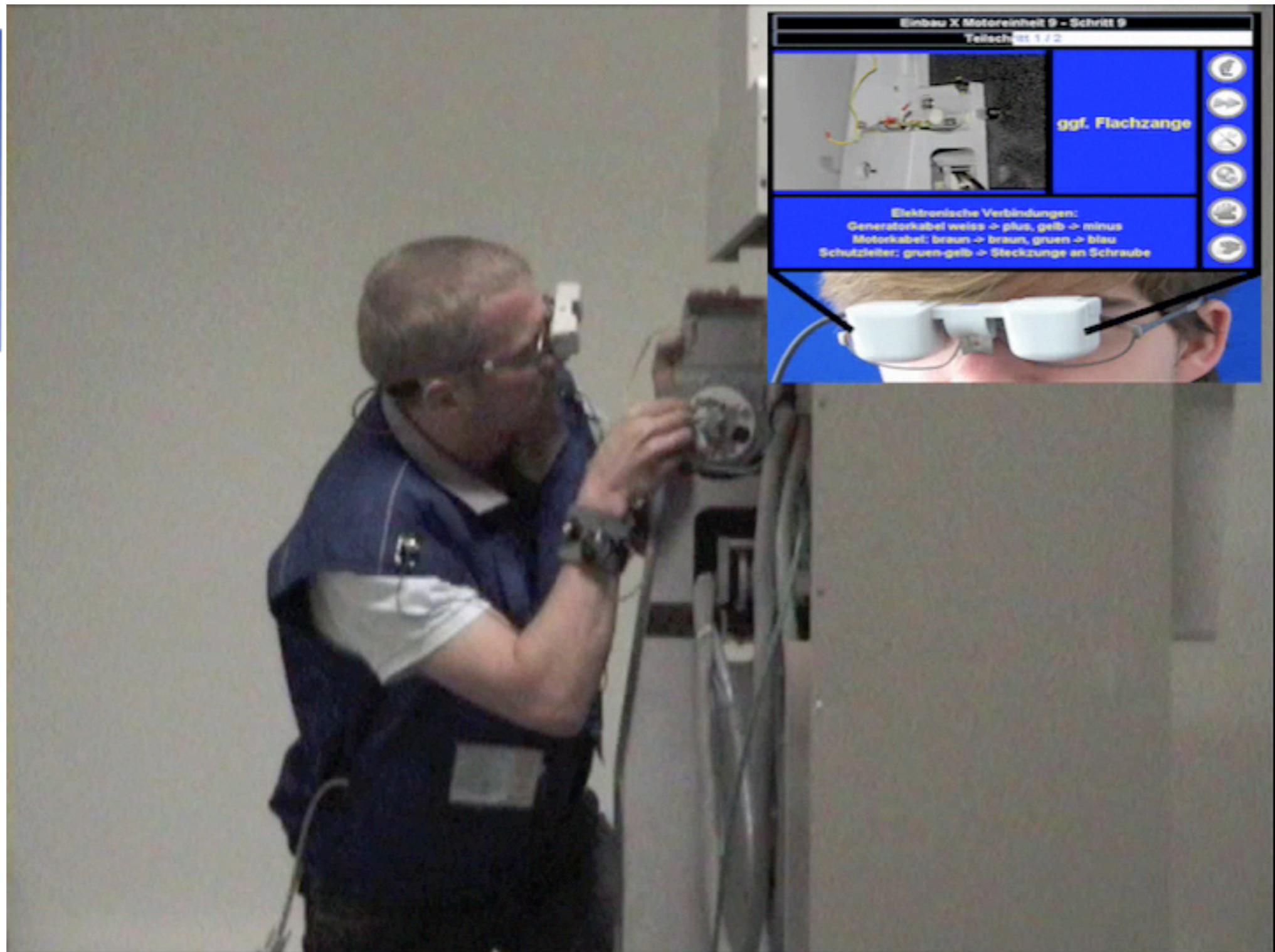
Key challenge: intuitive cooperation between humans and computers

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

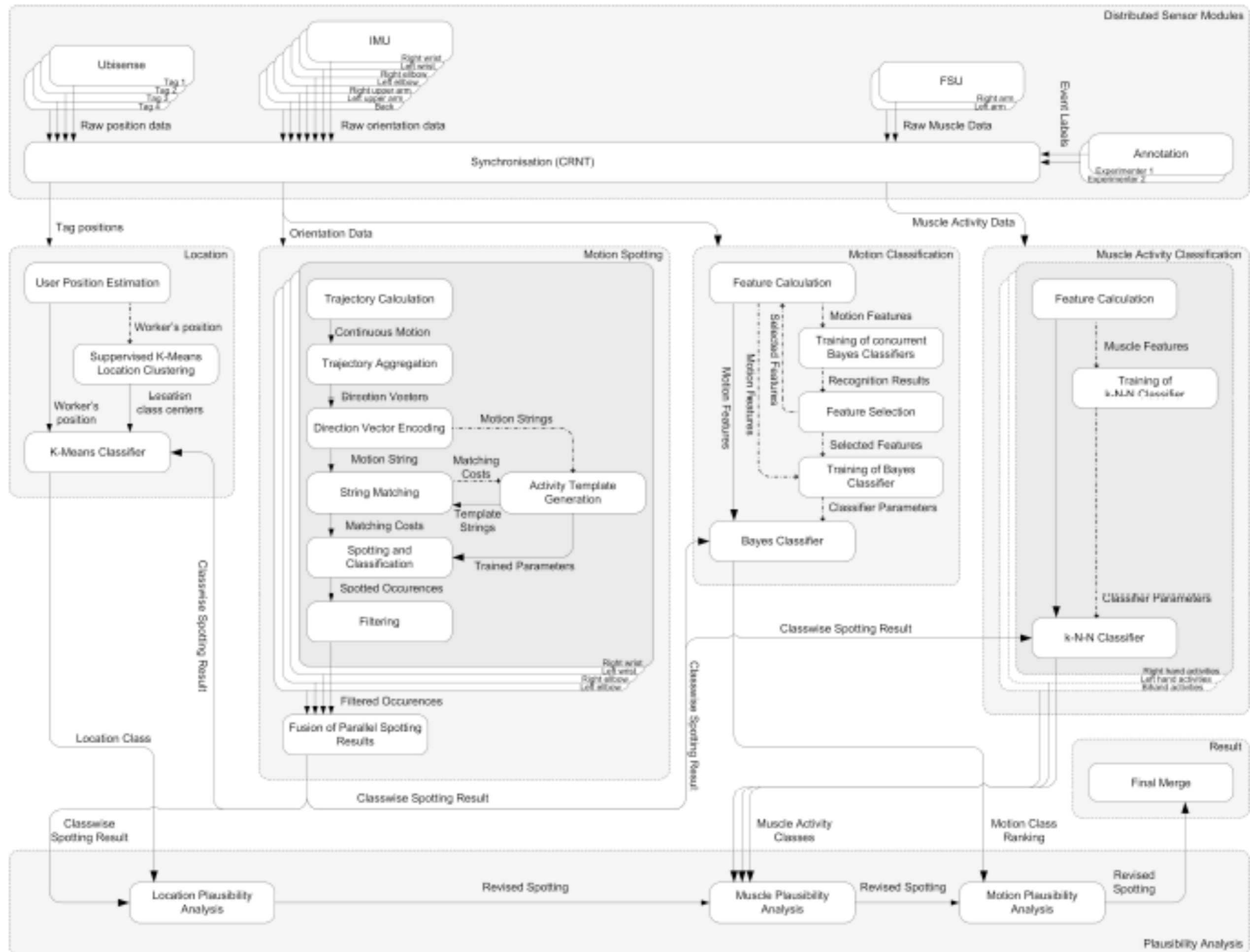


Wearable Computing around 2005

Maintenance Scenario Collaboration with Zeiss, Oberkochen.



Kunze, Kai, et al. "Does context matter?-a quantitative evaluation in a real world maintenance scenario." International Conference on Pervasive Computing. Springer, Berlin, Heidelberg, 2009.



Wearable Computing – Activity Recognition becomes Mainstream



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

Cognitive

Tracking Cognitive Tasks— Reading Habits



Where to start?

Ubiquitous learning activity: reading



How much are you reading?

Kai Kunze et al. Quantifying Reading Habits — Counting How Many Words You Read. UbiComp 2015.

What are you reading?

Kai Kunze et al. I know what you are reading – Recognition of document types using mobile eye tracking, ISWC 2013, Zurich.



How much do you understand?

K. Kunze, H. Kawaichi, K. Yoshimura, K. Kise. Towards inferring language expertise using eye tracking. WIP ACM SIGCHI Conference on Human Factors in Computing Systems, Paris, France 2013.

Kazuyo Yoshimura, Kai Kunze and Koichi Kise. The Eye as the Window of the Language Ability: Estimation of English Skills by Analyzing Eye Movement While Reading Documents, ICDAR, 2015

Cognitive

J!NS MEME: From Research to Product

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



Cognitive Activity Tracking in Everyday Life



Overview of J!NS MEME



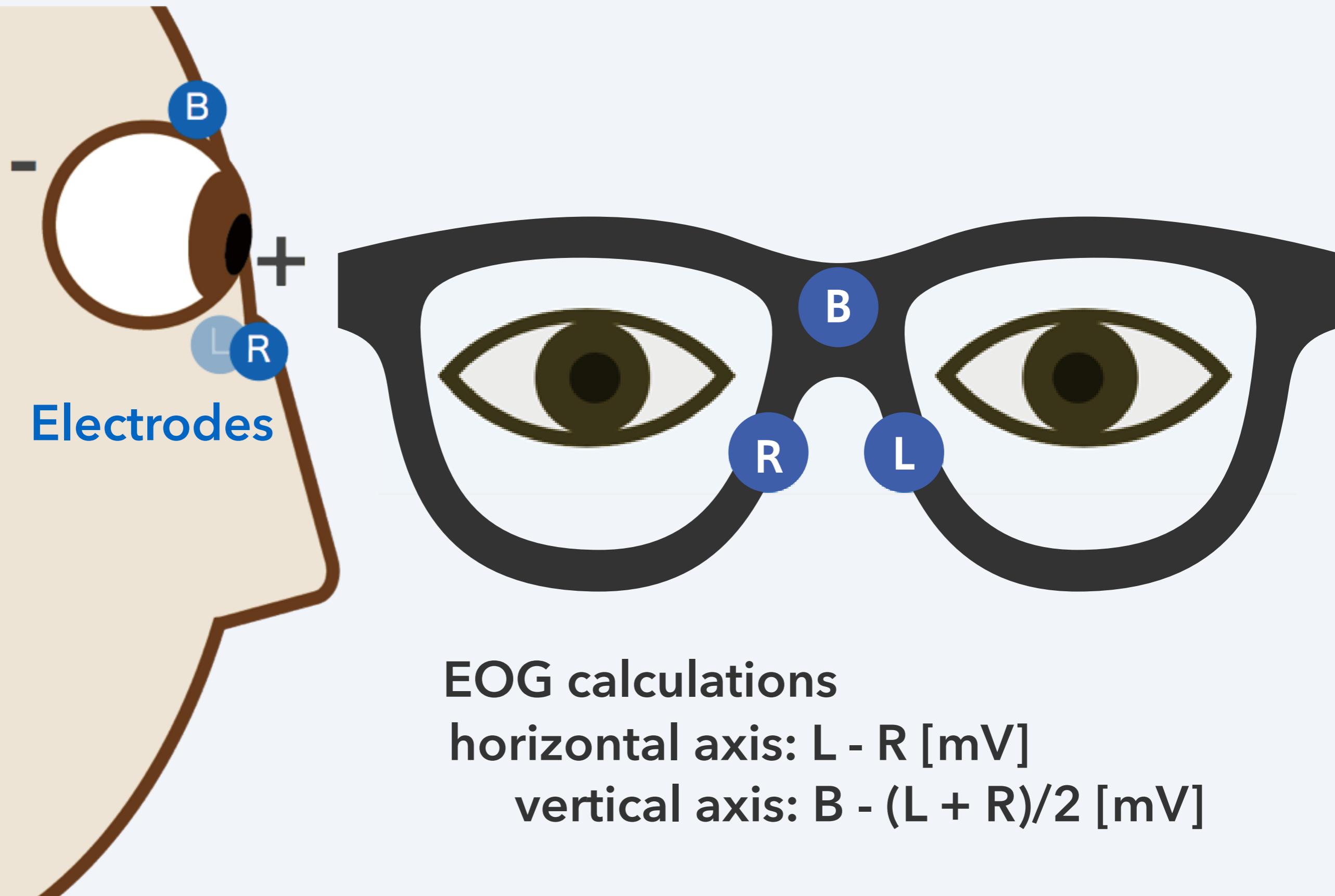
J!NS MEME

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



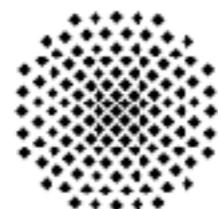
J!NS MEME, smart EOG glasses, can be easily confused with [normal glasses](#).

Overview of J!NS MEME



Meme Academic Collaborations

Used by over 30 research institutes (just the most prominent ones are highlighted with whom we publish)



Universität
Stuttgart



MAX-PLANCK-GESELLSCHAFT



University
of San Diego



University of
South Australia

KAIST





Long Term Fatigue Study



16 participants, 2 weeks

At least 10 hours a day: Electrooculography + Motion Sensors

“Groundtruth” every 2 hours:

Standard Cognitive Tests on the Smart Phone

Karolinska Sleepiness Scale

Psychomotor vigilance task (PVT)

Stroop Test

Log Caffeine intake and Naps

Sessions in the lab with fNIRS

Tag, Benjamin, et al. "Continuous Alertness Assessments: Using EOG Glasses to Unobtrusively Monitor Fatigue Levels In-The-Wild." *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, 2019.

Project with J!NS for MEME 2.0

The longest, continuous, external
research and development member of the team (over 3 years now)

J!NS



UbiComp/ISWC Student Competition on Eyewear

Co-organizer Yuji Uema

Sponsored by J!NS

(you will get 2 J!NS MEME Academic if accepted)

Interactions beyond the Individual

Website in the works

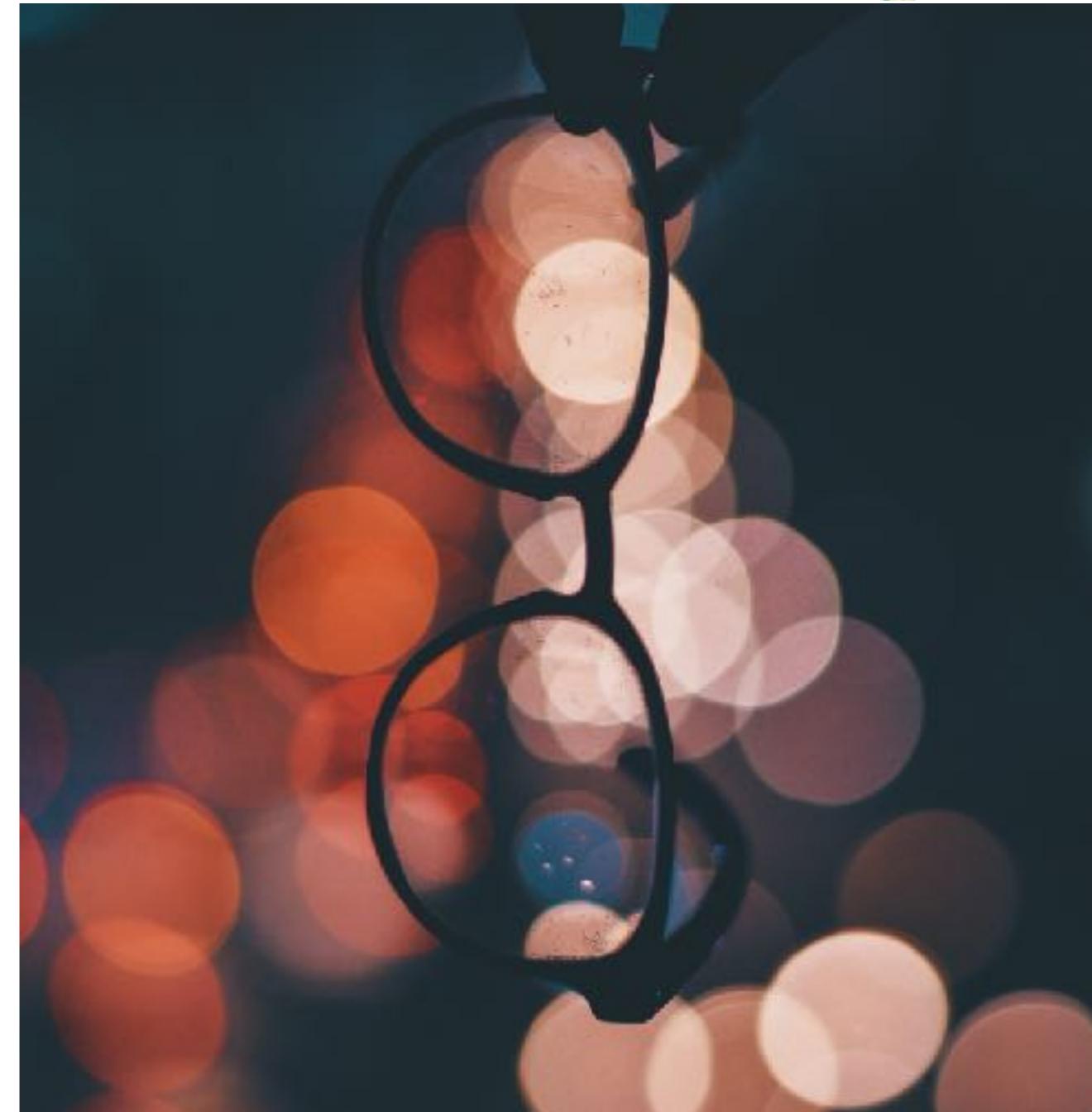
Concept Submission Deadline
sometime in April/May

Ping me ...

Try to put abstracts into the ACM DL

Demo at the Conference in Sept.

September 2021.





Katsutoshi Masai, Yuta Sugiura, Masa Ogata, Kai Kunze, Masahiko Inami, Maki Sugimoto: Facial Expression Recognition in Daily Life by Embedded Photo Reflective Sensors on Smart Eyewear. IUI 2016:

Affective Wear

Photoreflective Sensors to detect facial expressions

12 users, over 40 hours of data recording

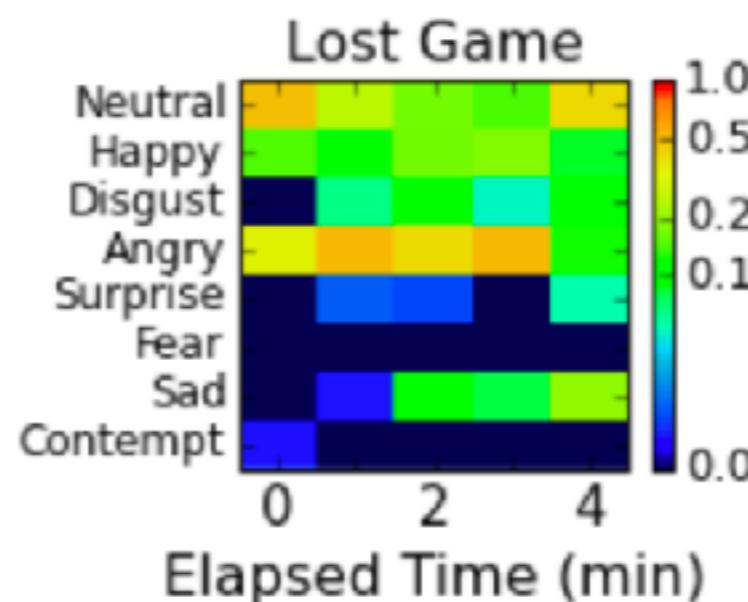
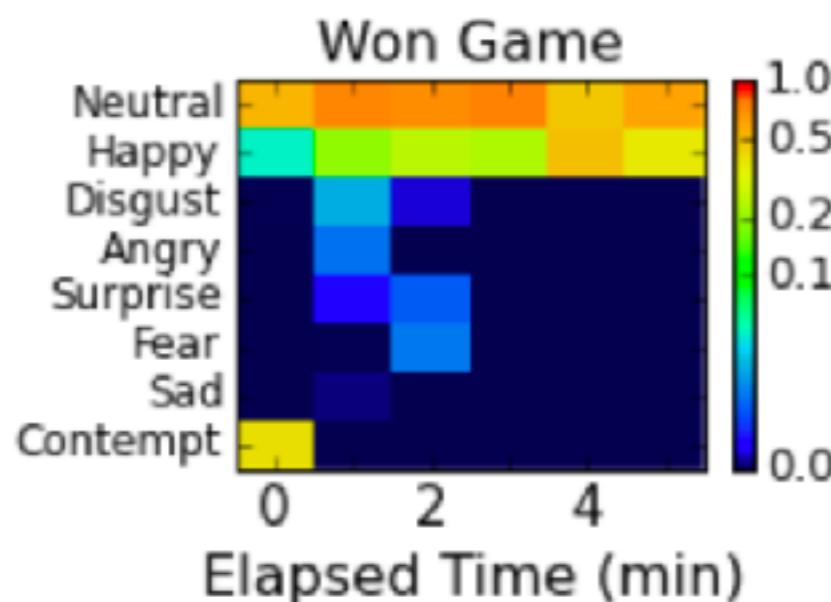
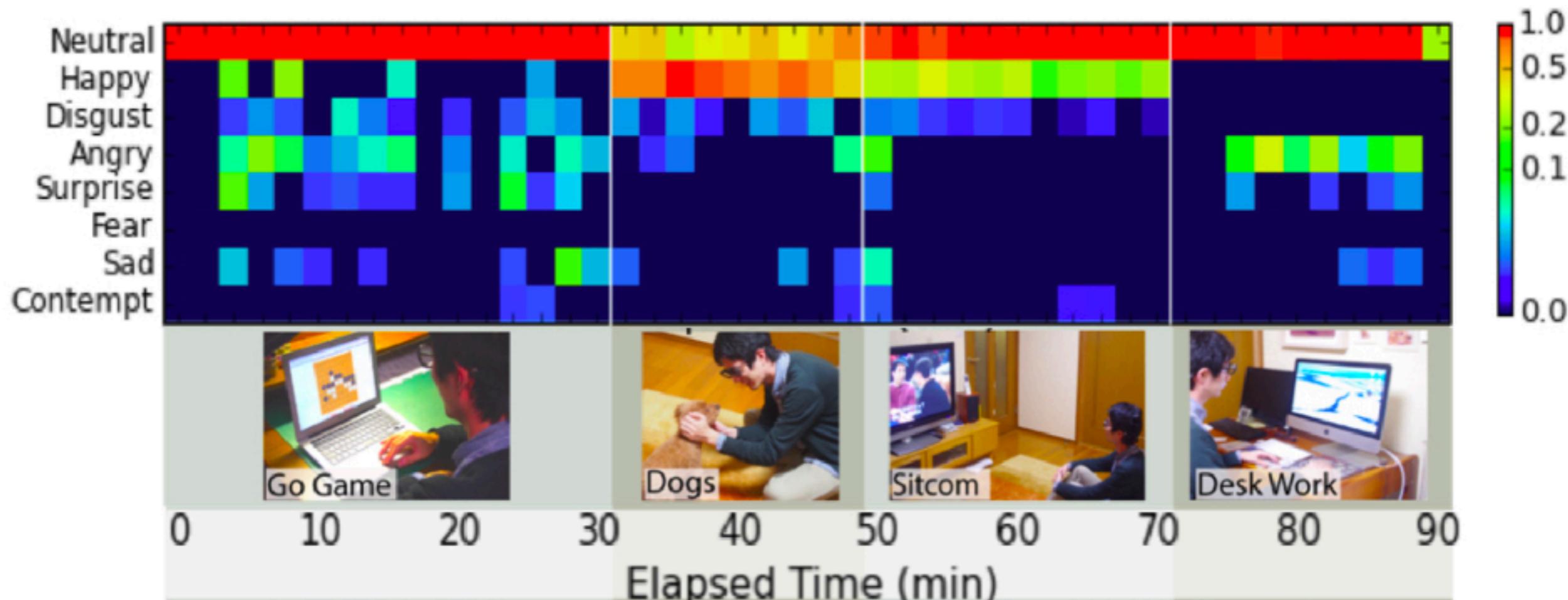
Sensor placement: 24 \rightarrow 8



		Classified Results								
		N	H	D	A	Su	F	Sa	C	
Actual Value	Neutral(N)	96.8%	0.7%	0.2%	0%	1.2%	1.0%	0.2%	0%	
	Happiness(H)	0.3%	98.3%	0.5%	0%	0%	0%	0%	0.8%	
	Disgust(D)	1.7%	0.2%	84.3%	3.2%	0%	5.5%	3.7%	1.5%	
	Anger(A)	0.3%	0%	0.7%	96.5%	0.8%	0.3%	1.3%	0%	
	Surprise(Su)	2.0%	0%	1.2%	0.2%	91.2%	4.7%	0.8%	0%	
	Fear(F)	1.5%	0%	4.2%	0.8%	4.7%	87.5%	0%	1.3%	
	Sadness (Sa)	4.5%	0%	2.5%	1.8%	0.8%	4.7%	85.7%	0%	
	contempt(C)	1.5%	0.3%	0%	0%	0%	0.3%	0%	97.8%	

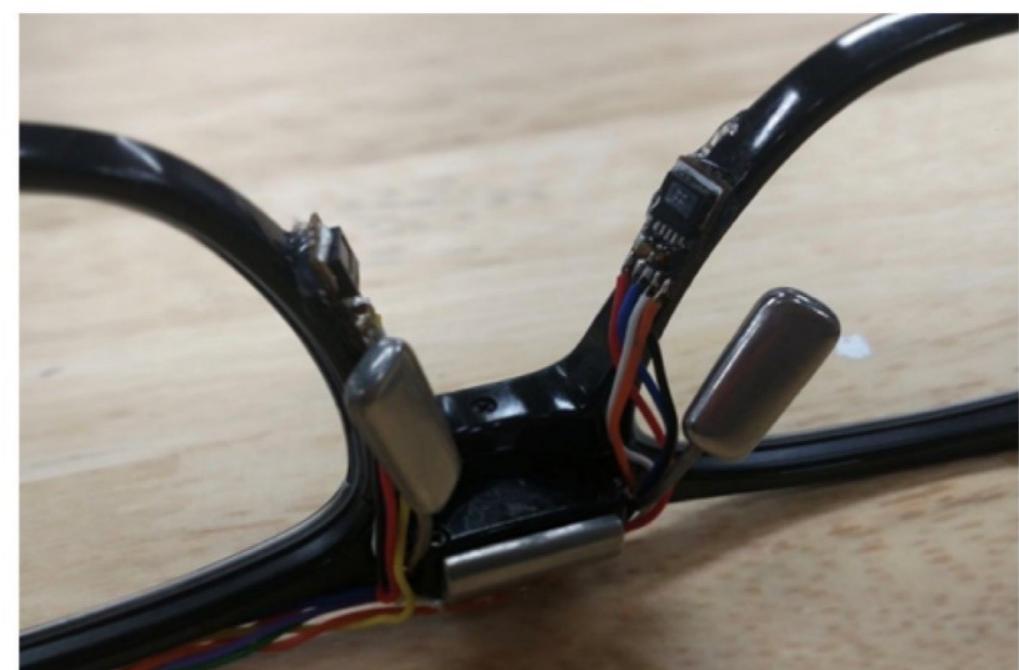
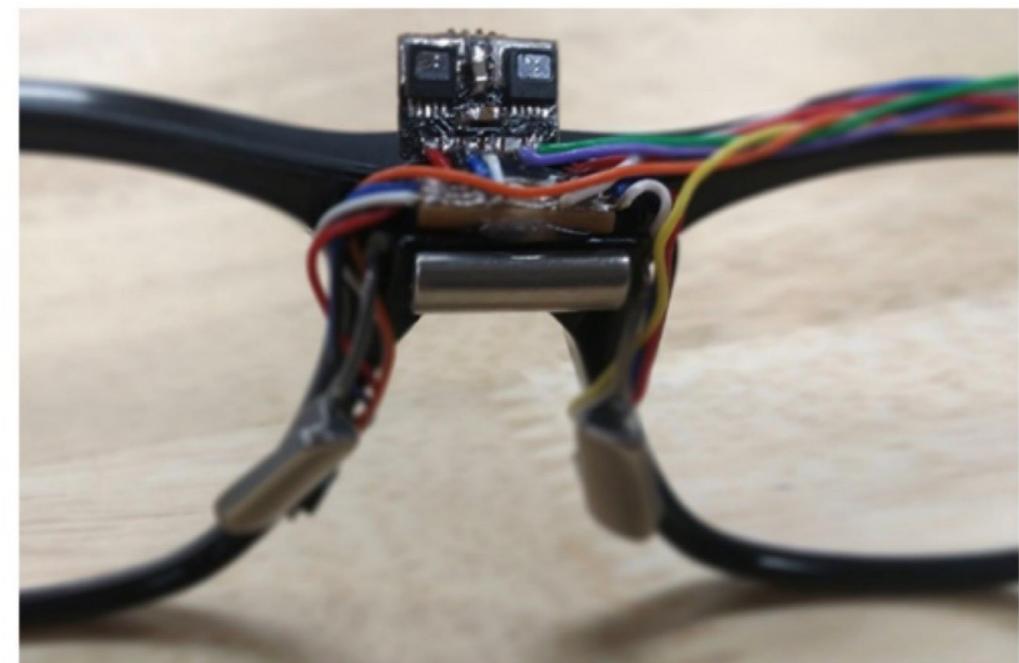
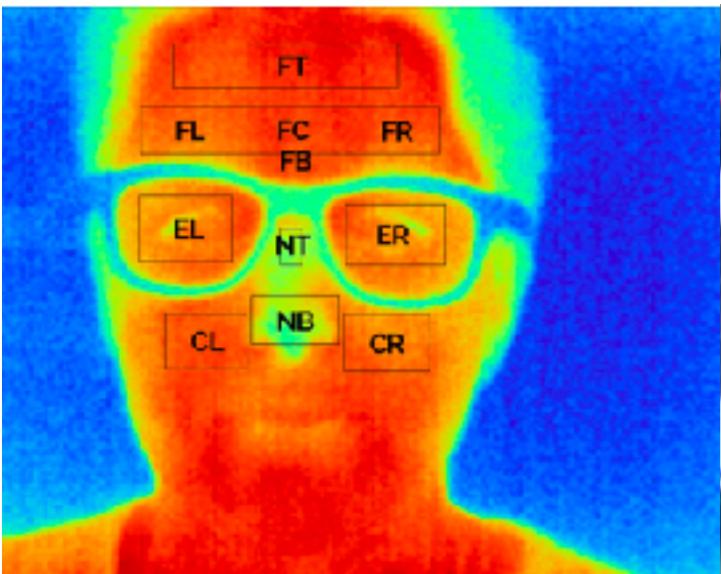
Evaluation of Facial Expression Recognition by A Smart Eyewear, accepted at ACM Transactions on Interactive Intelligent Systems

Facial Expressions Change Depending on Activities

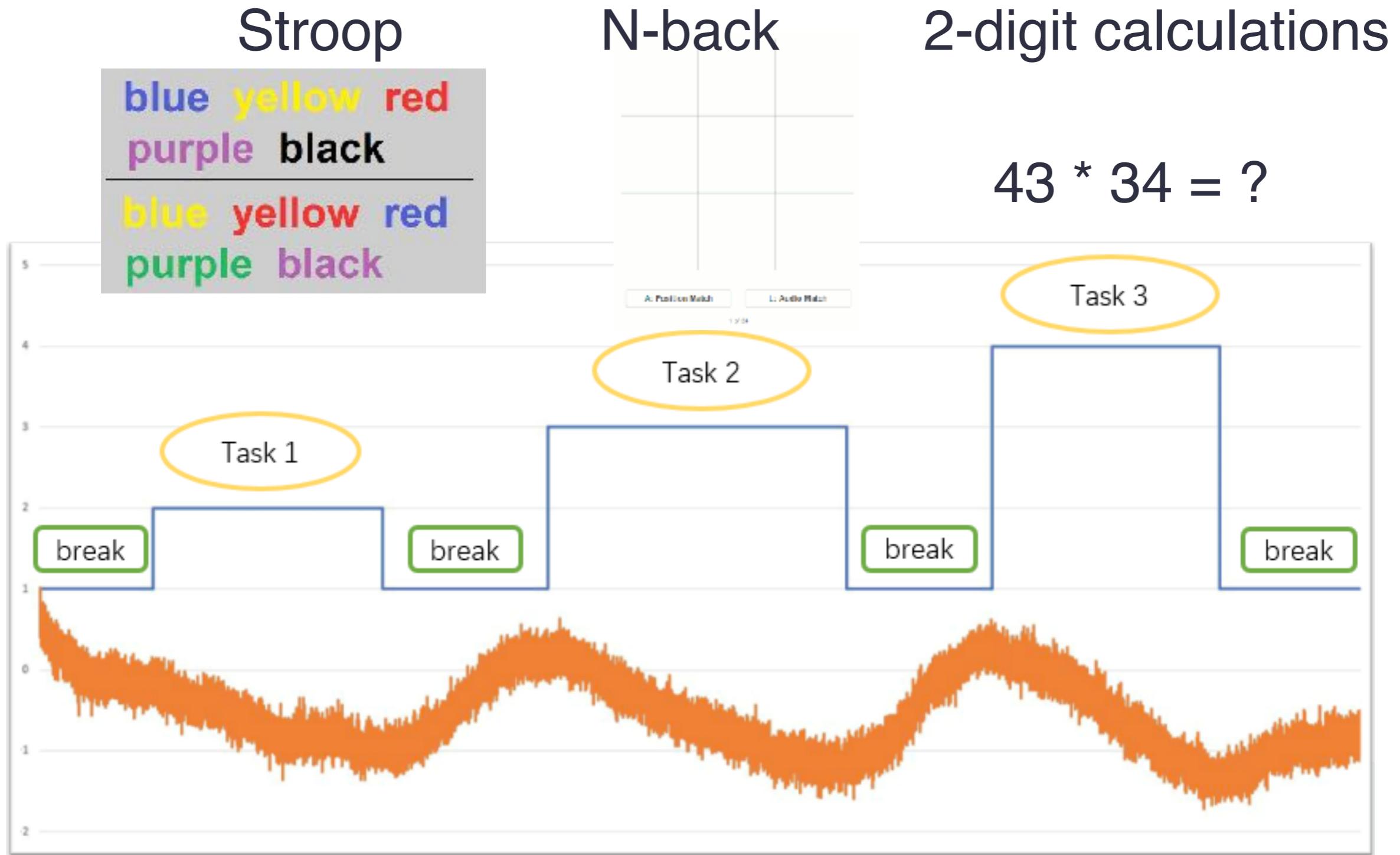


Working on Cognitive Load / Stress

Contactless Thermal Sensing Prototype



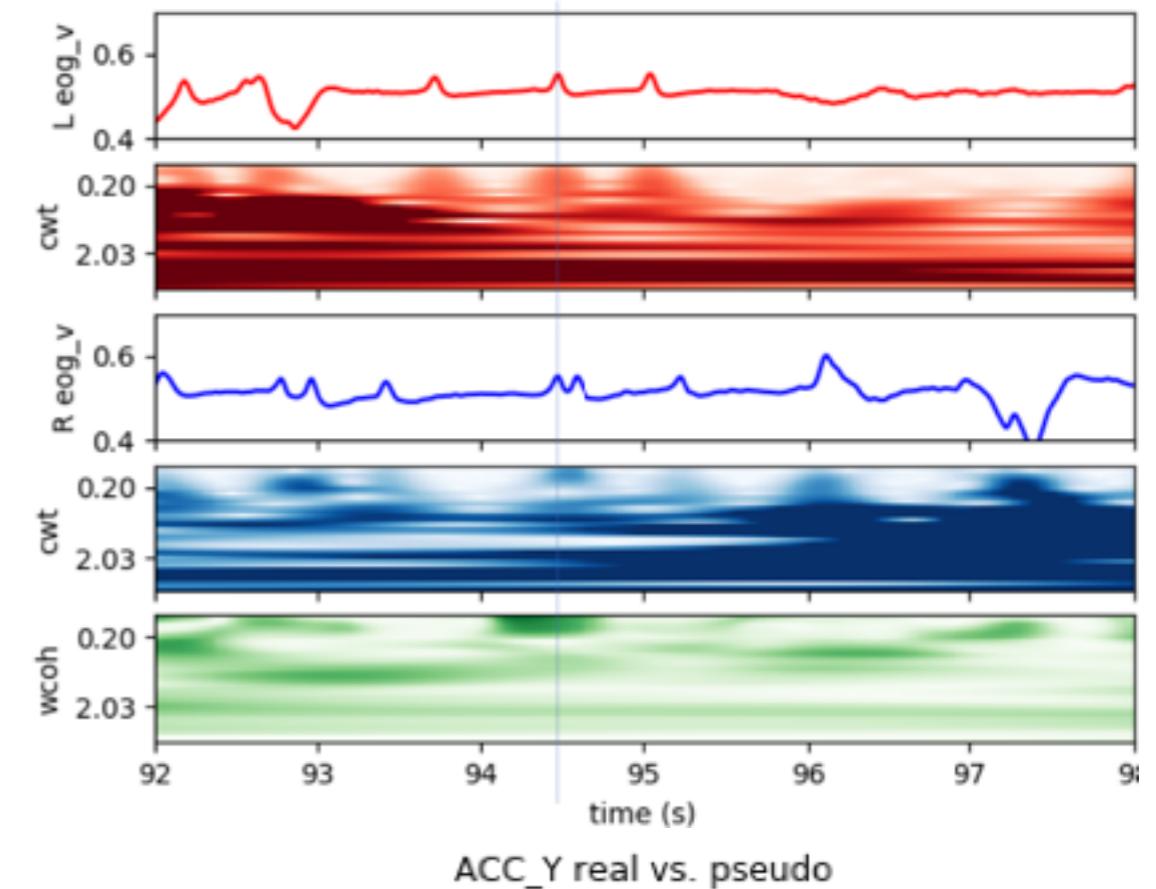
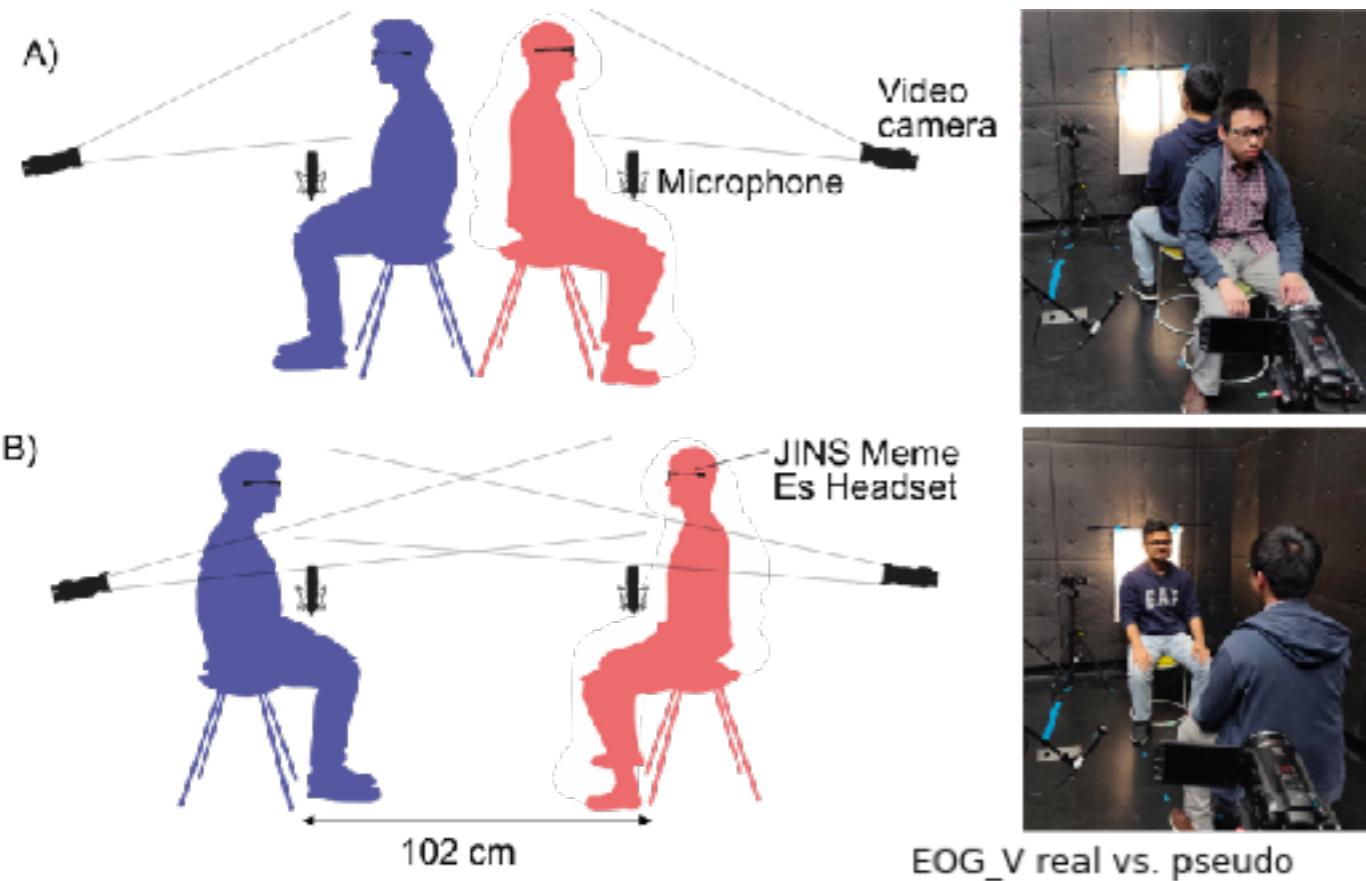
Thermal difference between nose and forehead



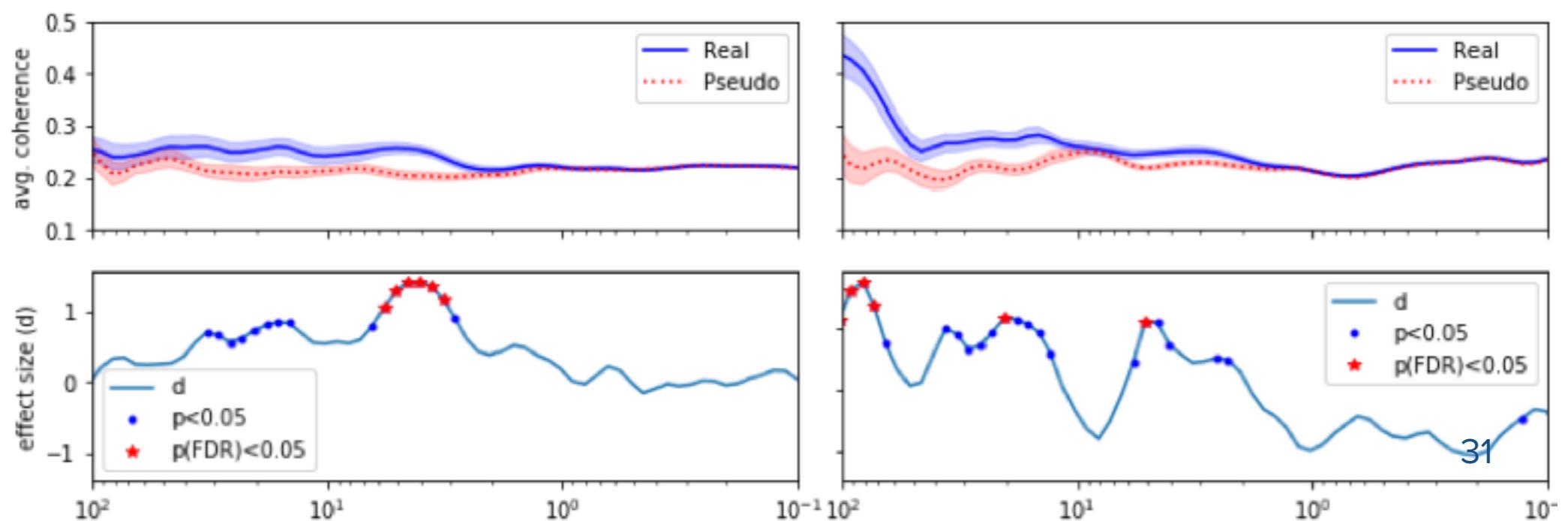
Confidential



UbiComp/ISWC: Blink as You Sync: Uncovering Eye and Nod Synchrony in Conversation using Wearable Sensing



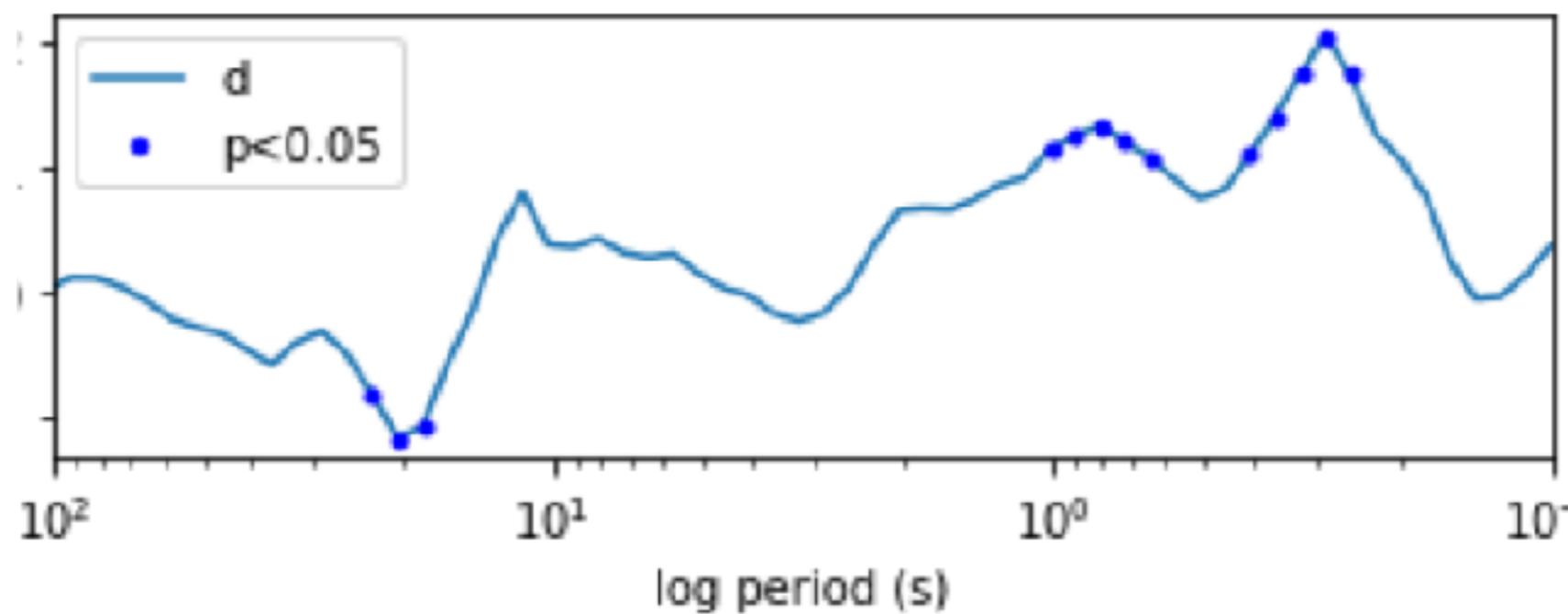
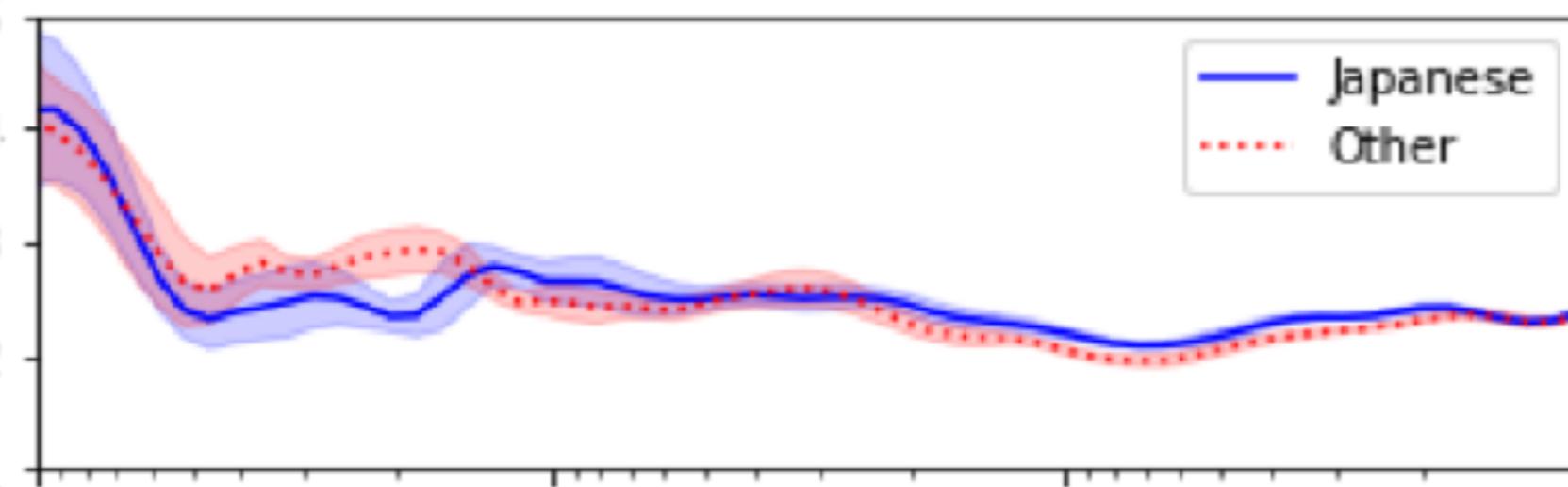
Gupta, Aman, et al. "Blink as you sync: uncovering eye and nod synchrony in conversation using wearable sensing." *Proceedings of the 23rd International Symposium on Wearable Computers*. ACM, 2019.



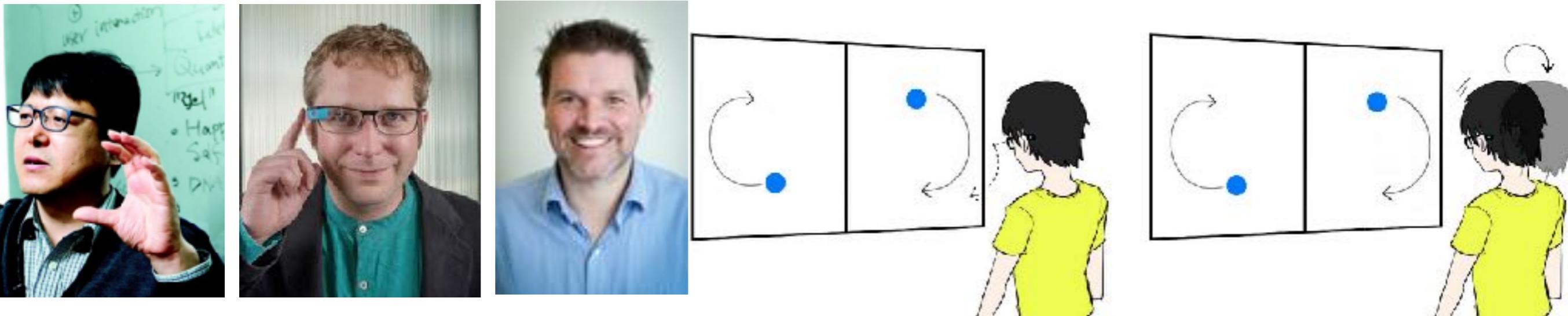
Not published:

Different Nodding Behavior for Japanese Speakers

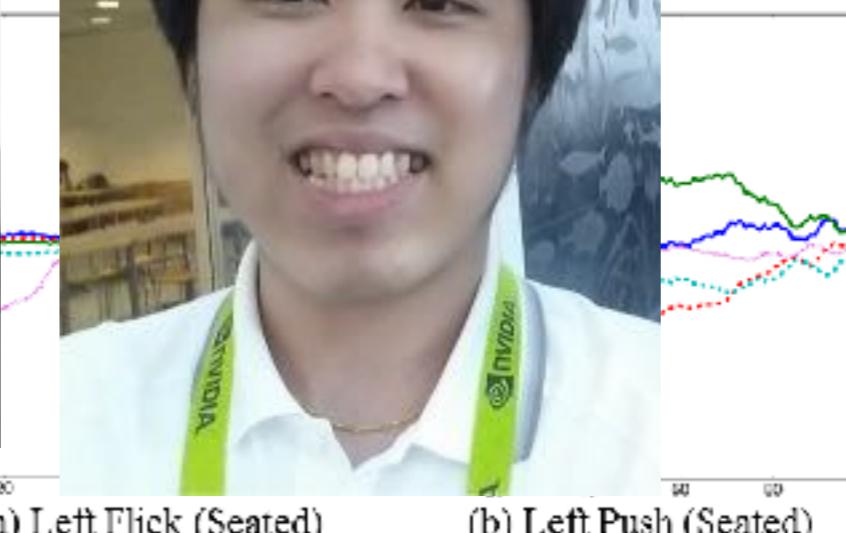
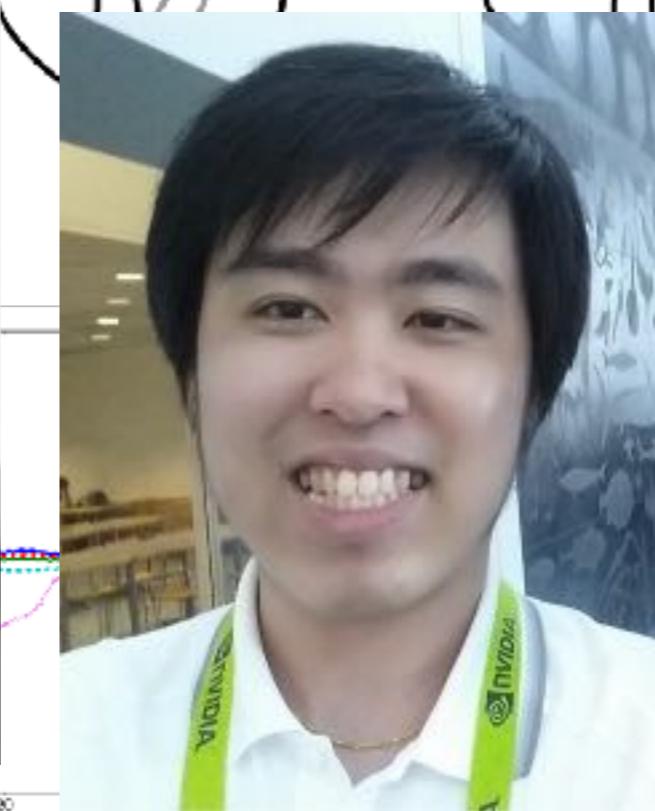
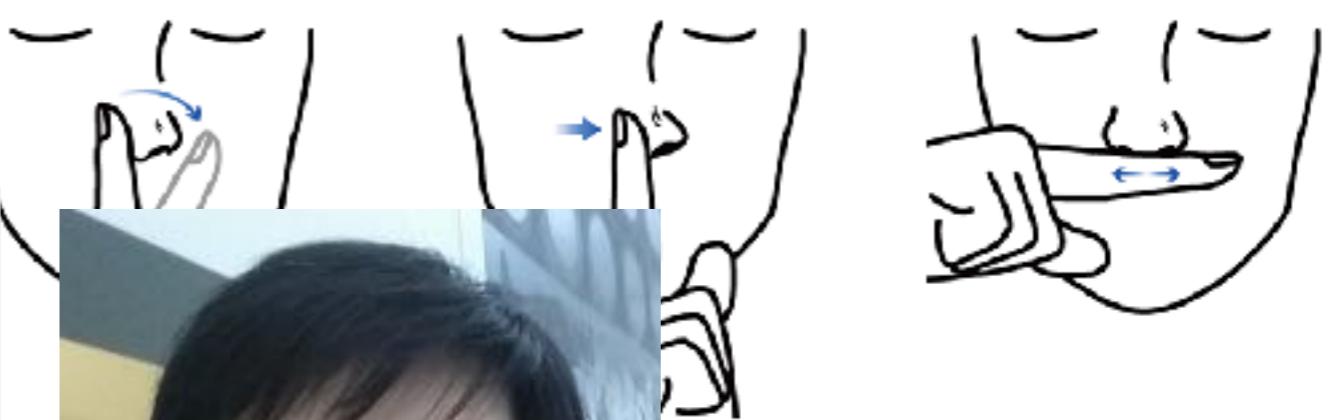
japanese vs. Other (ACC_Y)



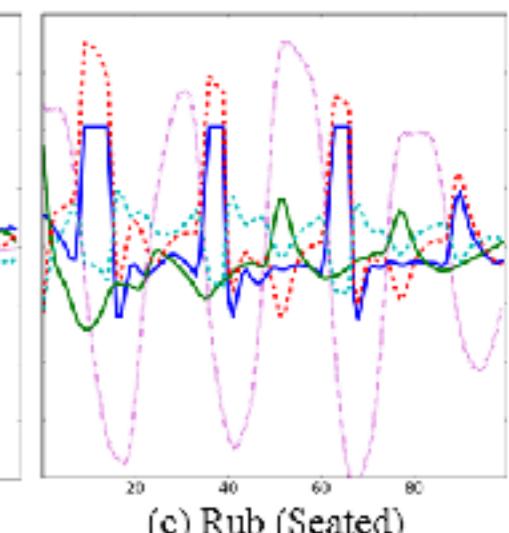
Subtle Interactions with Smart Eyewear



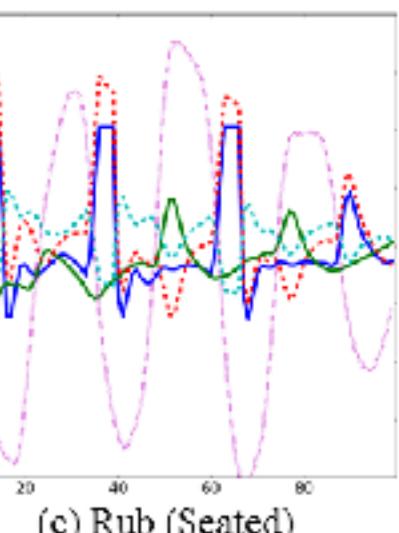
Collaboration with Woontack Woo, Thad Starner, Aaron Quigley



(a) Left Flick (Seated)



(b) Left Push (Seated)



(c) Rub (Seated)



Itchy Nose

Discreet Gesture Interaction using EOG Sensors in Smart Eyewear

Juyoung Lee¹, Hui-Shyong Yeo², Murtaza Dhuliawala³, Jедидия Акано³, Junichi Shimizu⁴, Thad Starner³, Aaron Quigley², Woontack Woo¹, Kai Kunze⁴

¹KAIST, ²University of St. Andrews, ³Georgia Institute of Technology, ⁴Keio University

"Royalty Free Music from Bensound"

Augmented

An Outlook on Future Work

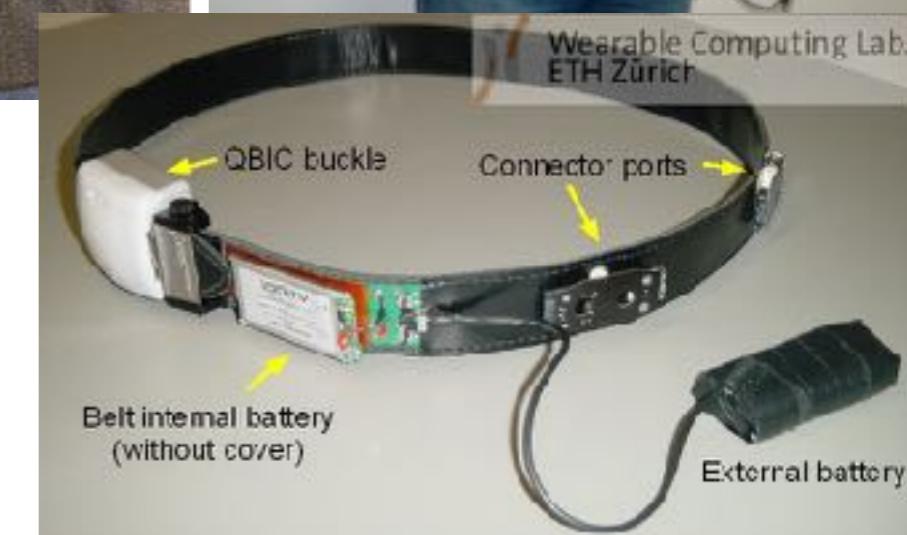
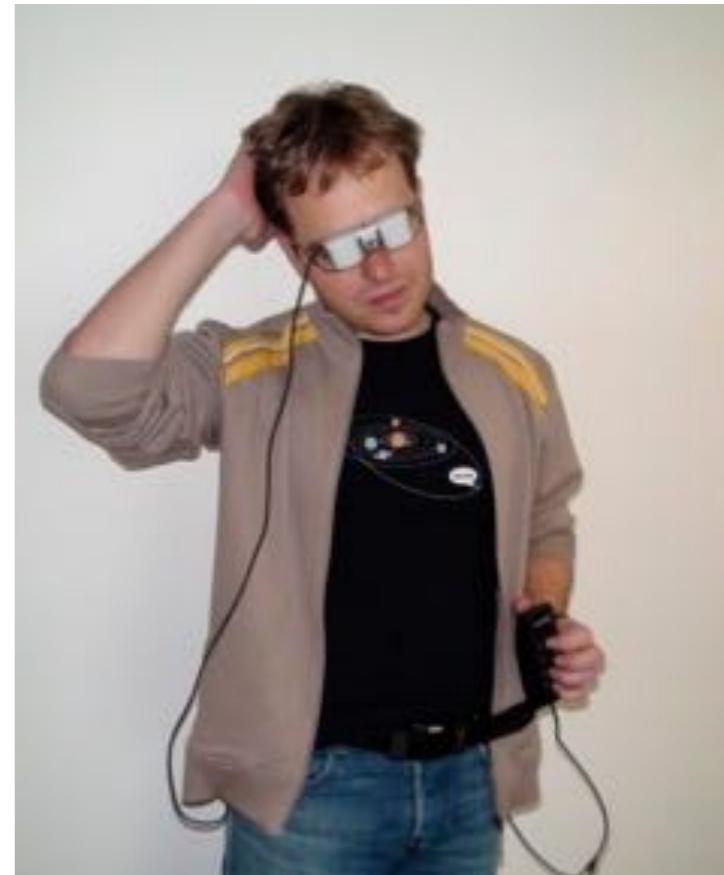
Can we overcome our limitations by bringing tech closer to our body?

Empathy / Agency / Ownership

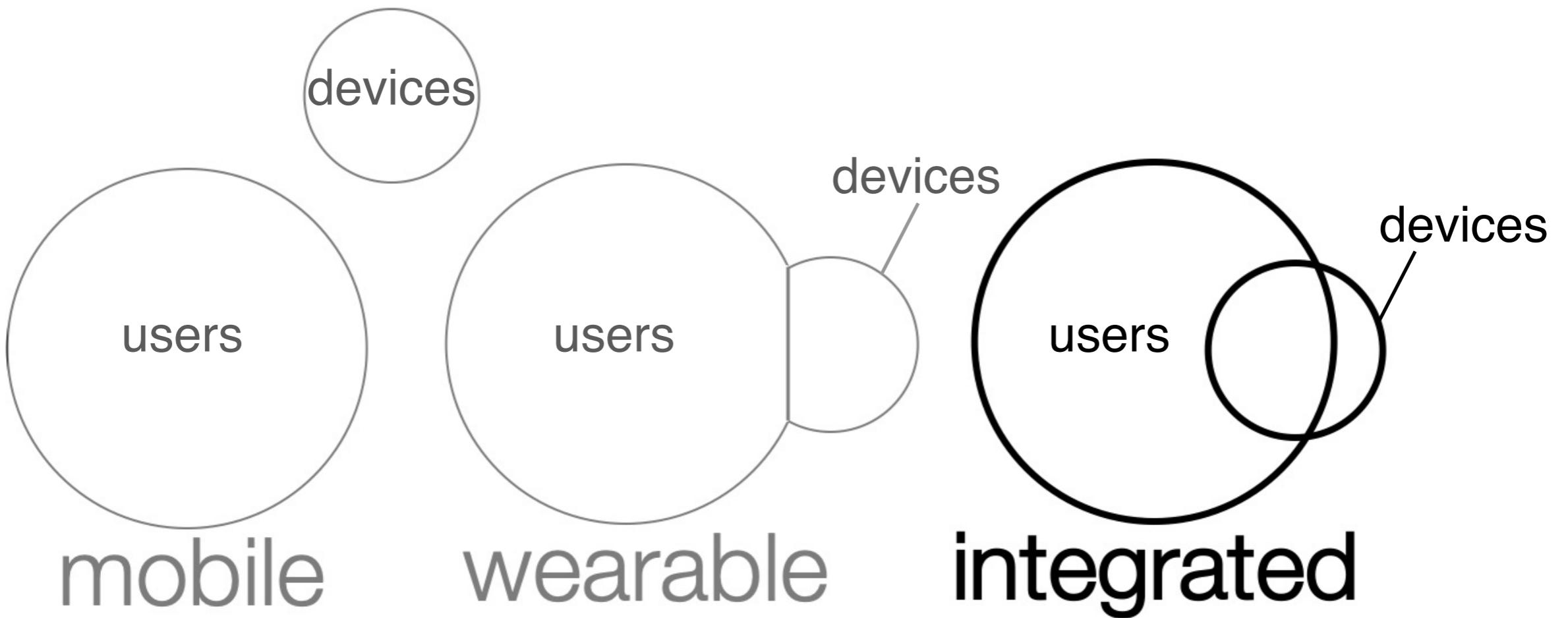
Extending our Body Schema

Making Wearable Tech overlap

With our body ...



“Next Steps in Human Computer Integration”



Novel paradigm moving away from Human Computer Interaction

Towards Human Computer Integration/Augmented Humans

Muscle Memory for Security



3D-AUTH

Two-Factor Authentication with
Personalized 3D-Printed Items

Karola Marky

Telecooperation Lab

TU Darmstadt

Keio University Japan

Martin Herbers

Telecooperation Lab

TU Darmstadt

Martin Schmitz

Telecooperation Lab

TU Darmstadt

Verena Zimmermann

FAI

TU Darmstadt

Max Mühlhäuser

Telecooperation Lab

TU Darmstadt

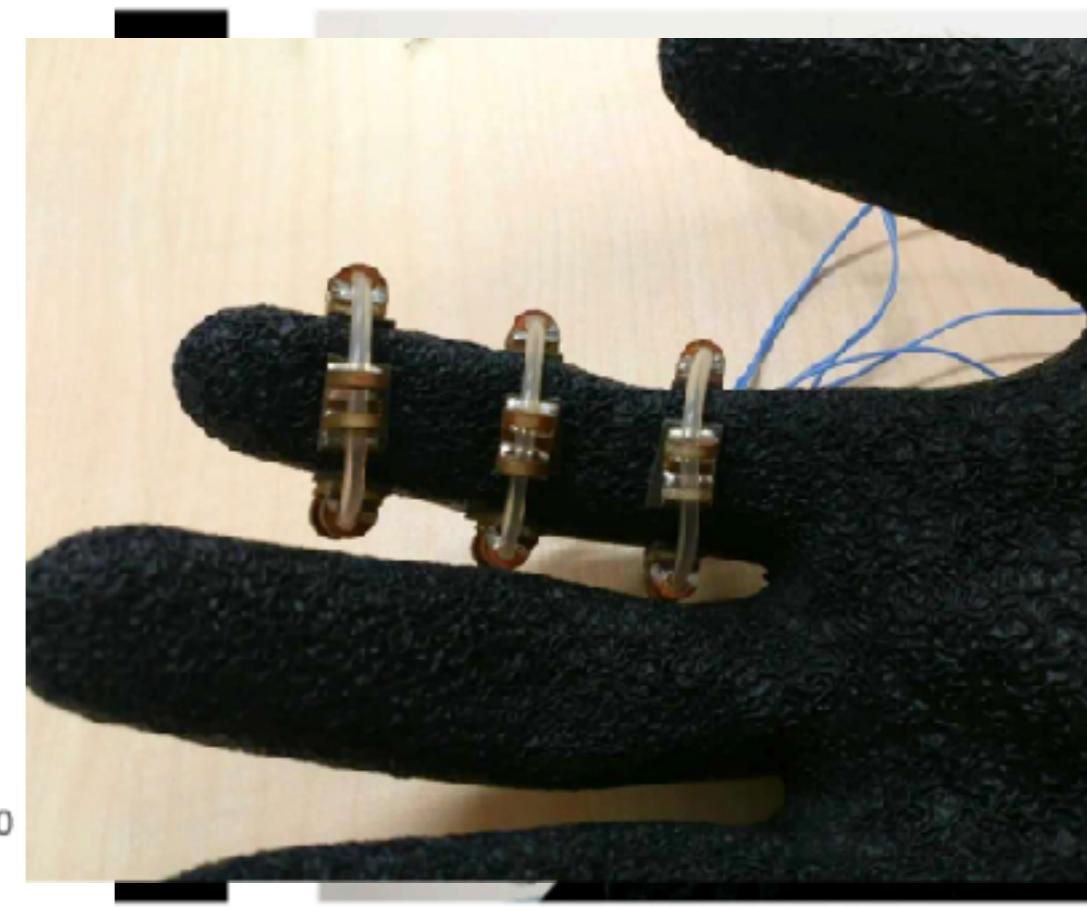
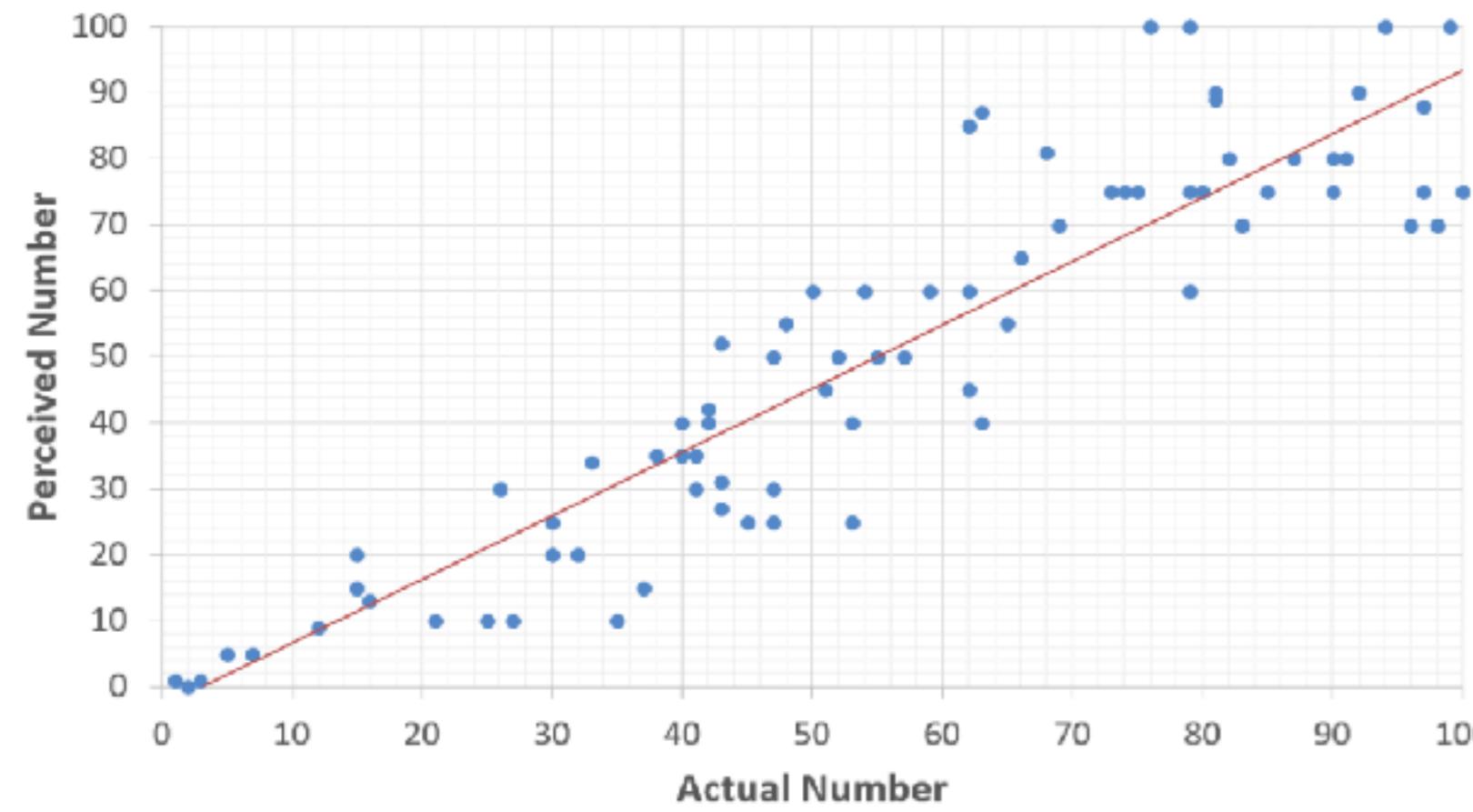


TECHNISCHE
UNIVERSITÄT
DARMSTADT



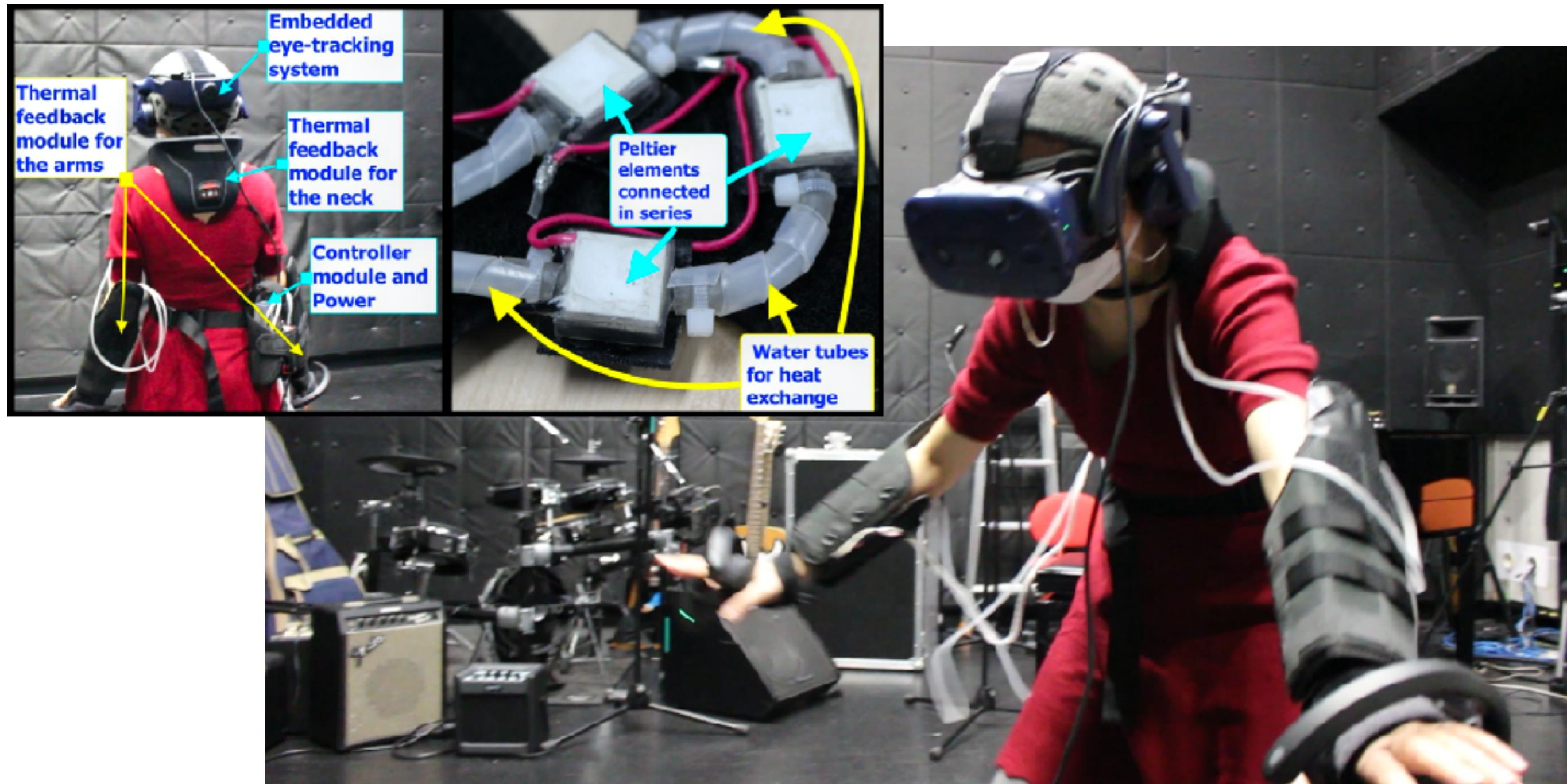


Feel a Progress Bar on Your Finger



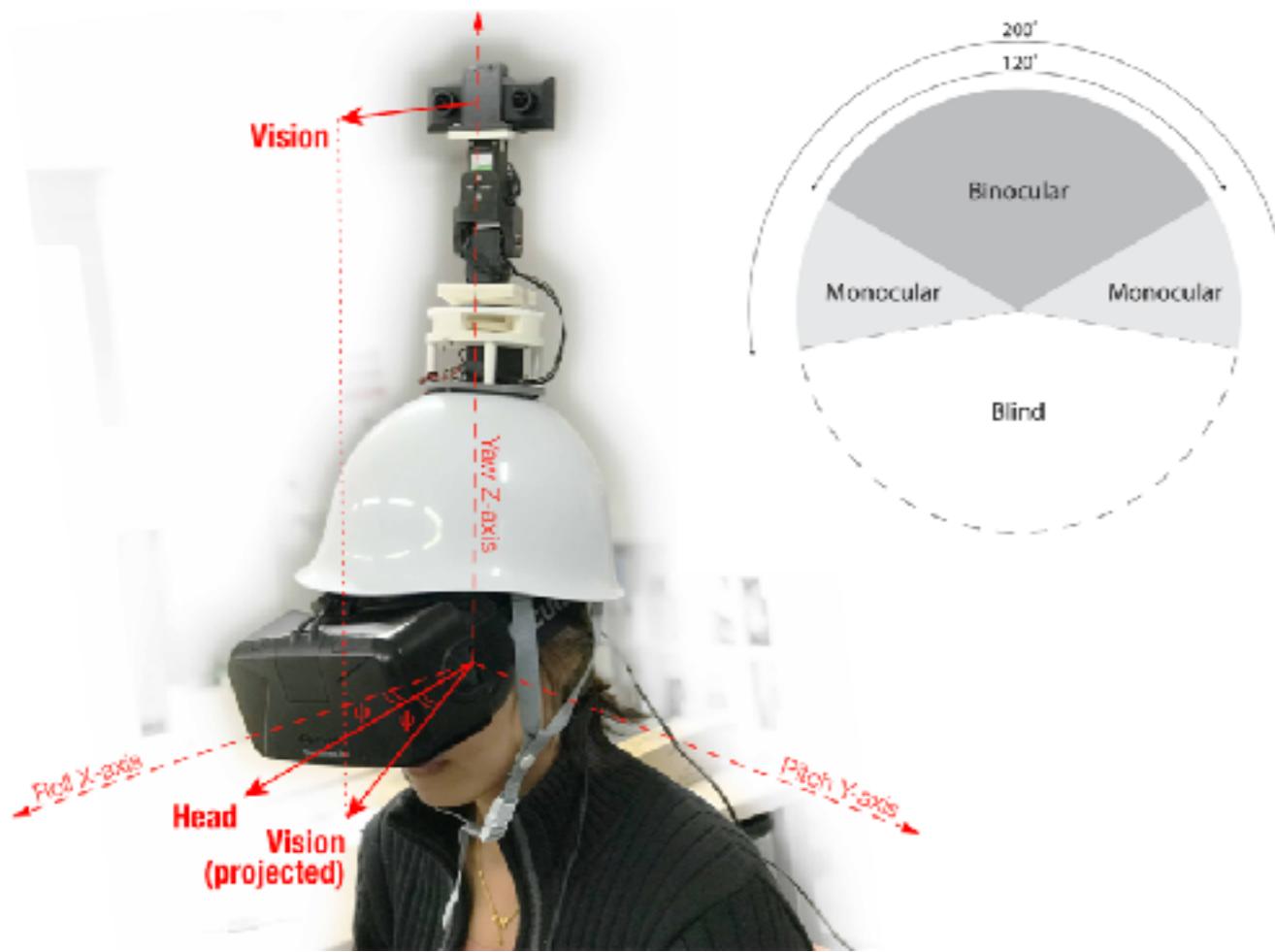
Chernyshov, George, et al. "Shape memory alloy wire actuators for soft, wearable haptic devices." *Proceedings of the 2018 ACM International Symposium on Wearable Computers*. ACM, 2018.

Enhancing a Horror Experience



Kirill Ragozin, George Chernyshov, Dingding Zheng, Danny Hynds, Jianing Zhao, Kouta Minamizawa, and Kai Kunze. 2020. Sophroneo: Fear not. A VR Horror Game with Thermal Feedback and Physiological Signal Loop. In ACM SIGGRAPH 2020 Immersive Pavilion (SIGGRAPH '20). Association for Computing Machinery, New York, NY, USA, Article 18, 1–2.

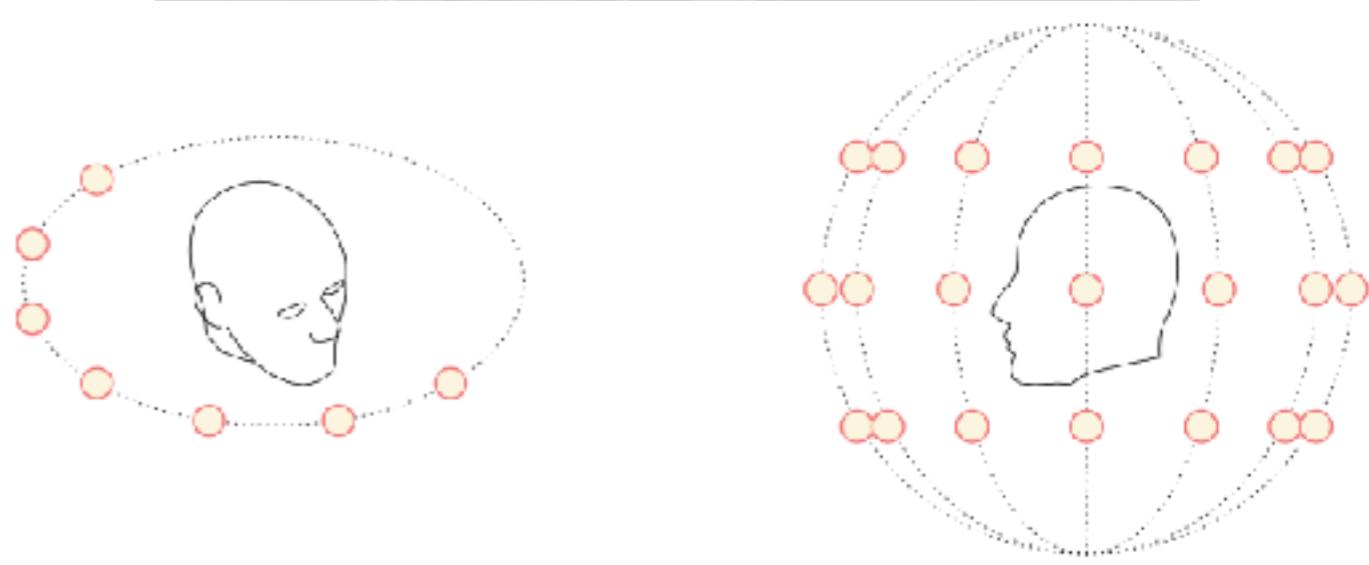
How to edit our body schema?



Unconstrained Neck: Omnidirectional Observation from an Extra Robotic Neck, Lichao Shen, Yamen Saraji, Kai Kunze, Kouta Minamizawa (Keio University)

Augmented Human 2018

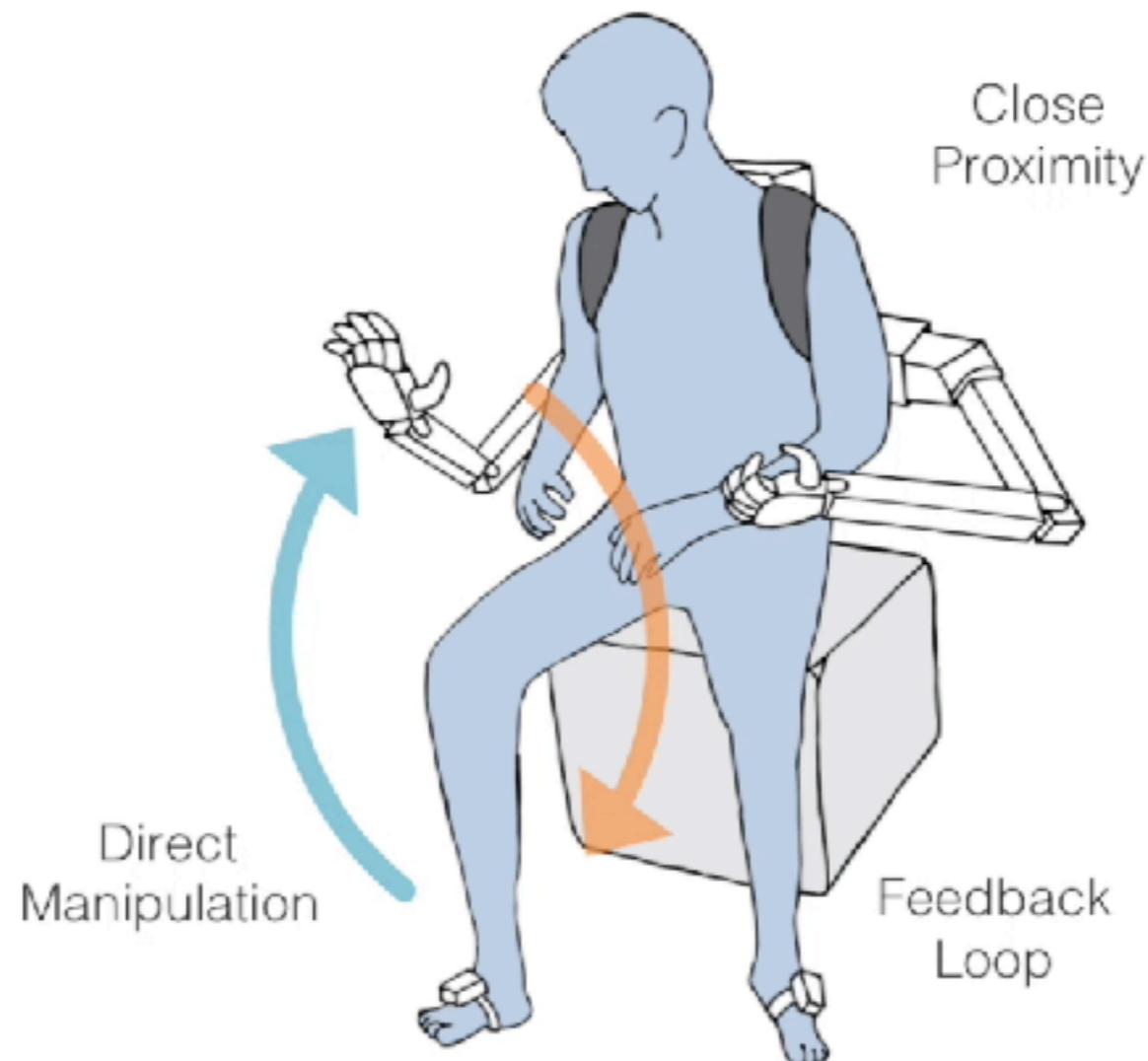
New Paper accepted at SUI 2020



Explore how can Tech overlap with our bodies

Collaboration with Inami Sensei, Minamizawa Sensei

Yamen Saraiji and Tomoya Sasaki



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.

Can we program ourselves? Collaboration with Kurita Sensei (Hiroshima) and Pedro Lopes (Chicago)



Takashi Goto, Swagata Das, Yuichi Kurita, and Kai Kunze. 2018. Artificial Motion Guidance: an Intuitive Device based on Pneumatic Gel Muscle (PGM). In The 31st Annual ACM Symposium on User Interface Software and Technology Adjunct Proceedings (UIST '18 Adjunct).

Improves Skill Acquisition in Percussions

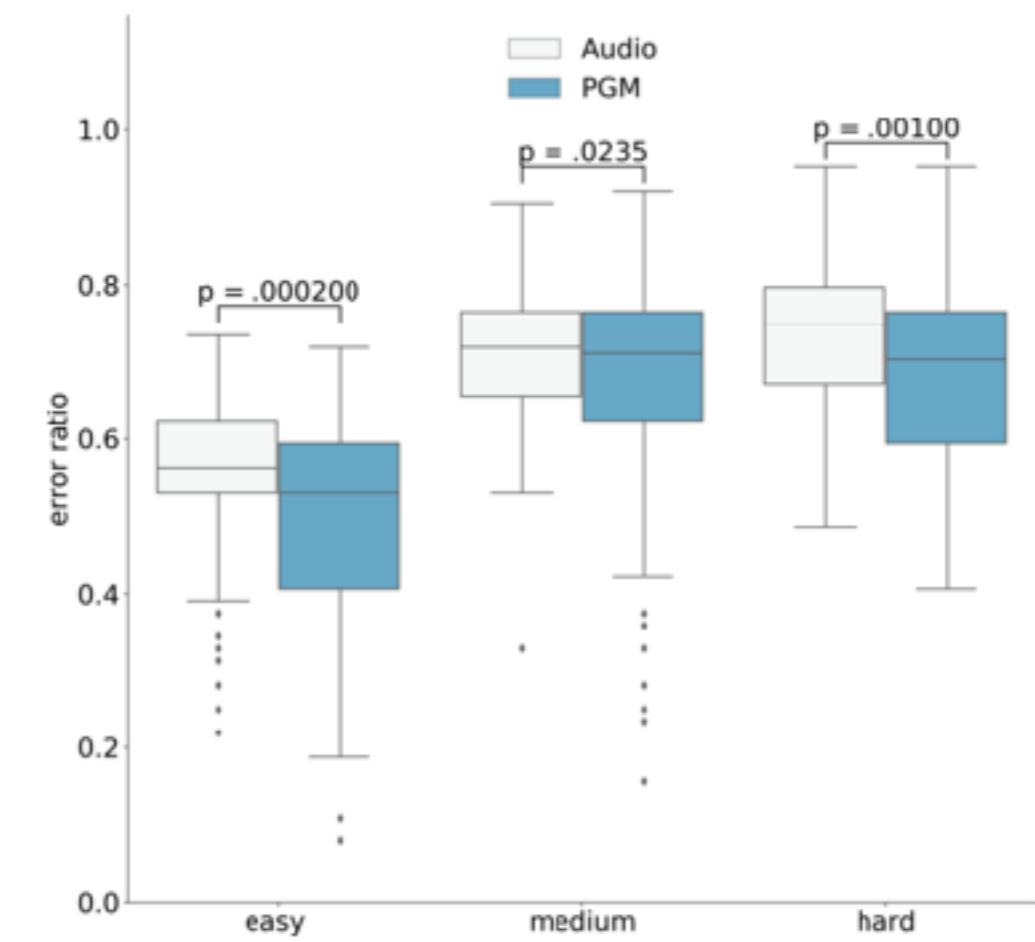


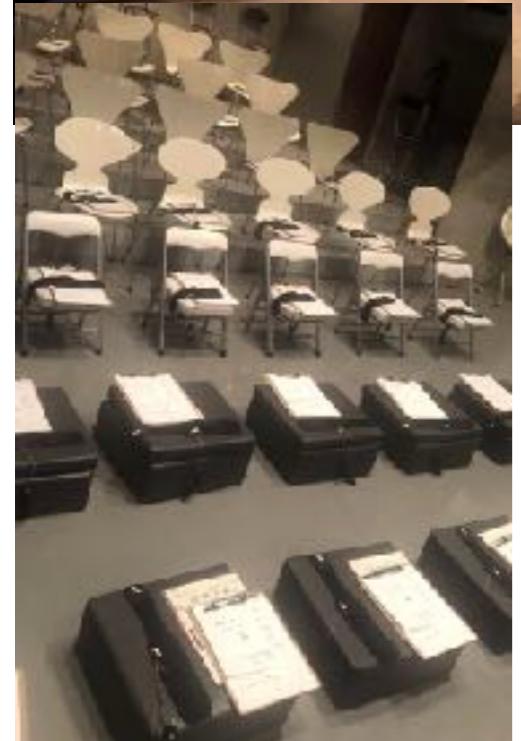
Figure 8. Results of error rate for each task.

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

Towards Enhancing the Collective Experience (collaboration with Mademoiselle Cinema and Kouta Minamizawa)



Make the Audience part of the stage



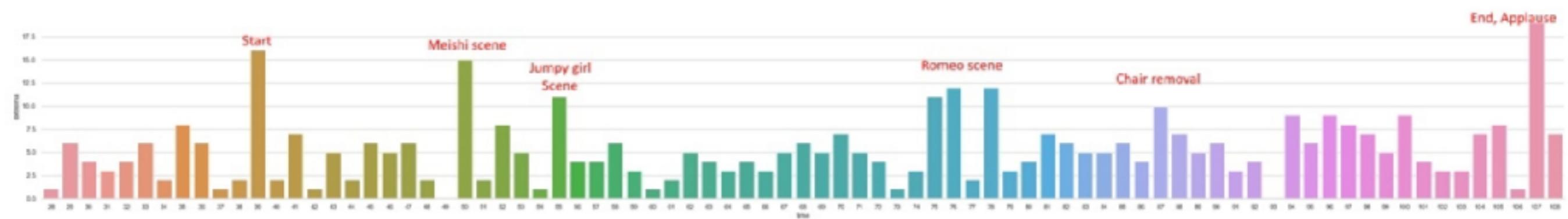
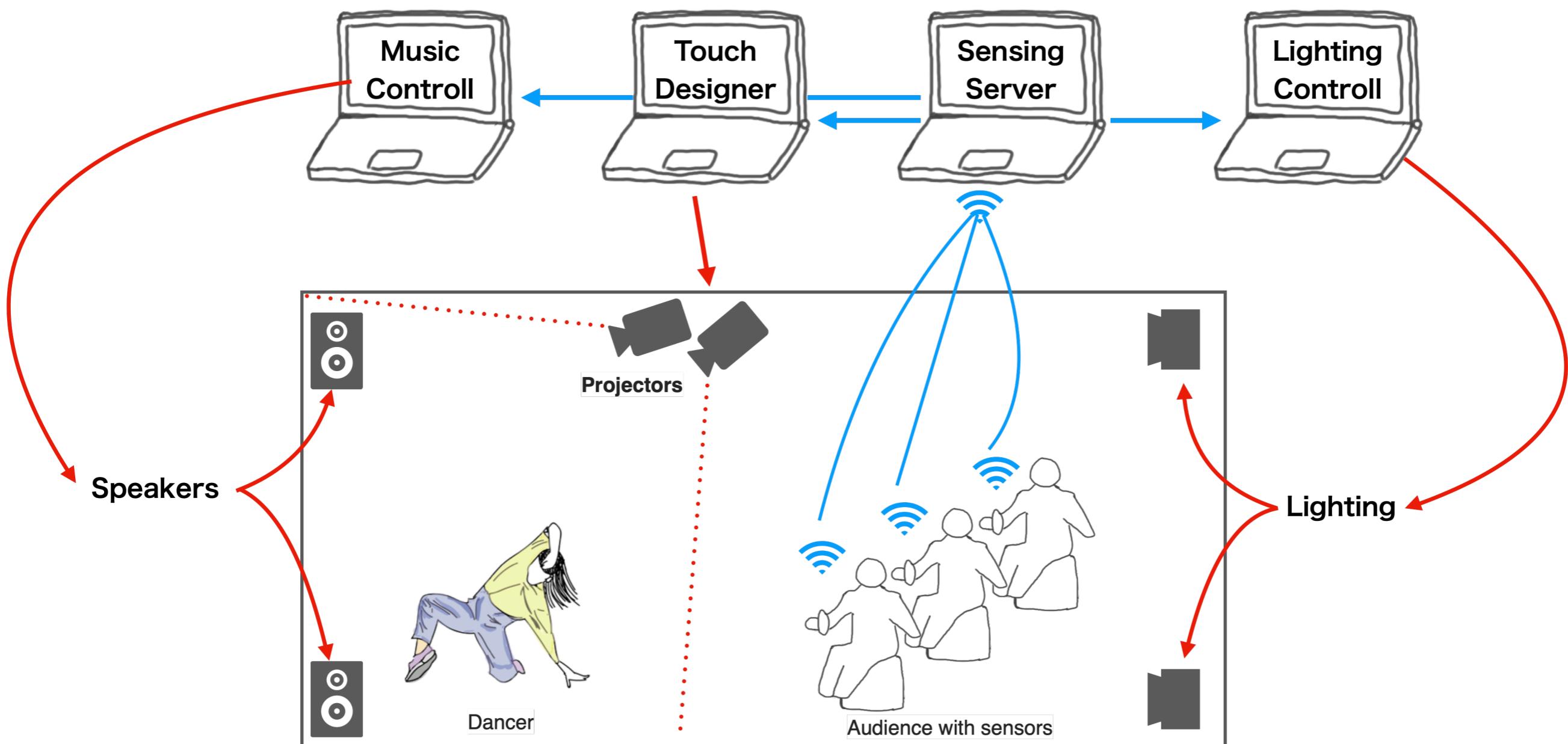
3 performances around 40 visitors
Heart, electrodermal activity and
Inertial motion streamed and recorded

We can share the data

(after the first publication is accepted)







Augmented Humans or Superhuman?

An Outlook on Future Work

Superhuman Sports Society



ABOUT

超人スポーツ協会について

GAMES

ゲームズ

SPORTS

競技一覧

CREATION

スポーツクリエーション

ACADEMY

超人スポーツアカデミー



「超人スポーツ」は、現代のテクノロジーでスポーツを再発明します。



Superhuman Sports is
a great testing ground to overcome individual
limitations and amplify human senses



The First Superhuman Sports Design Challenge

<https://dl.acm.org/citation.cfm?id=3210299>

Organised by

Stephan Lukosch TU Delft, S.G.Lukosch@tudelft.nl

Kai Kunze Keio University, kai@kmd.keio.ac.jp



Special Thanks to ...

to the people who actually did the work

Yun Suen Pai,
Jiawen Han,
Dinging Zheng,
George Chernyshov
Kirill Ragozin,
Junichi Shimizu,
Takuro Nakao,
Cedric Carêmel,
Benjamin Tag,
Shoya Ishimaru,
Taka Kazufumi.

Masai Katsutoshi,
Takashi Goto,
Kouta
Minamizawa,
Masashi Nakatani



Questions, Remarks, Violent Dissent?



<http://augmented-humans.org/> with an additional “s”

Deadline: Full Papers 17th December 2020

<http://kaikunze.de/>

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