Universität Stuttgart
IPVS – Institute for Parallel and Distributed Systems

Analytic Computing

UNIVERSITY OF Southampton

Interactive Intelligent Systems

Steffen Staab
https://www.ipvs.uni-stuttgart.de/departments/ac/
@ststaab

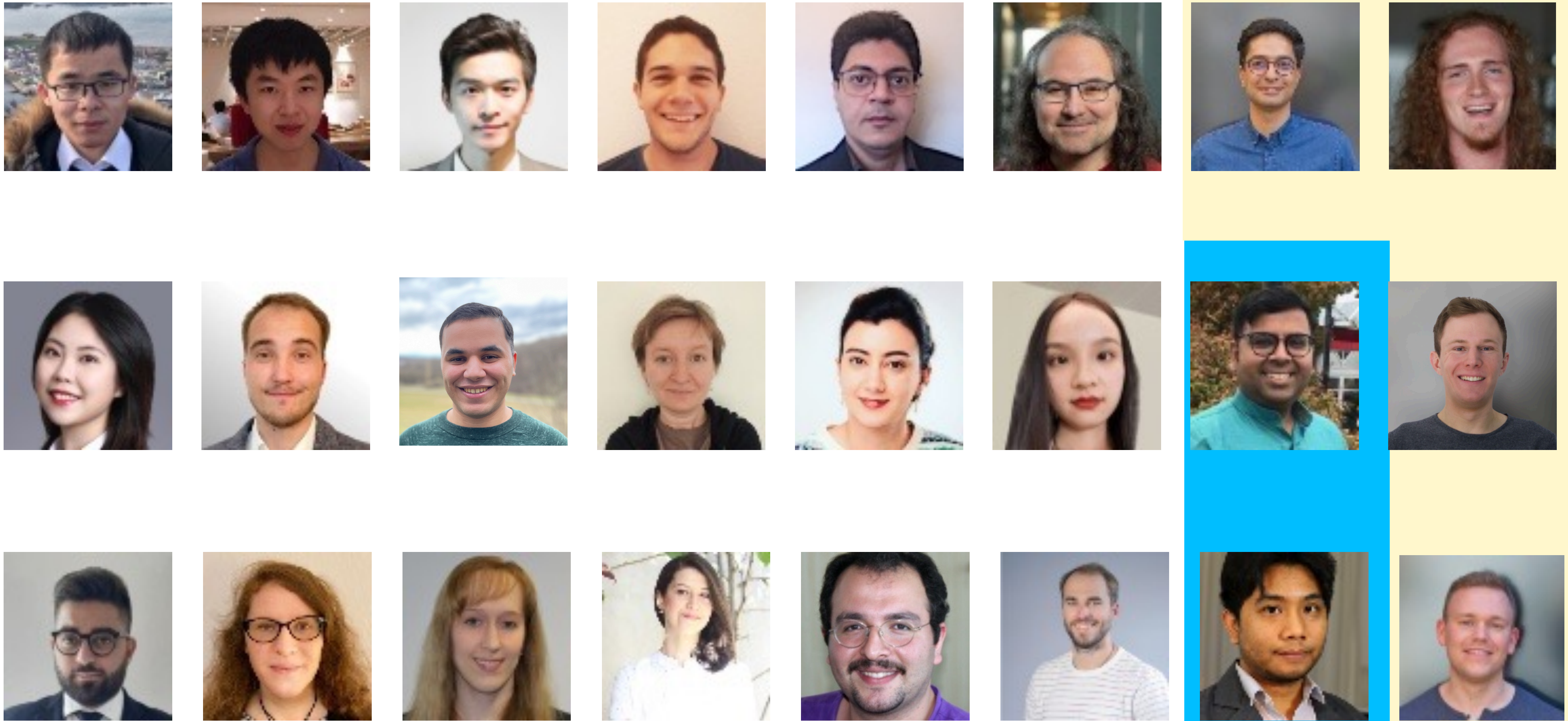
IRIS SimTech

ellis unit STUTTGART

Analytic Computing Research Group

SEMANUX

EXIST Research Transfer



Intelligent Interactive Systems

Examples for Research@ Analytic Computing (Staab)

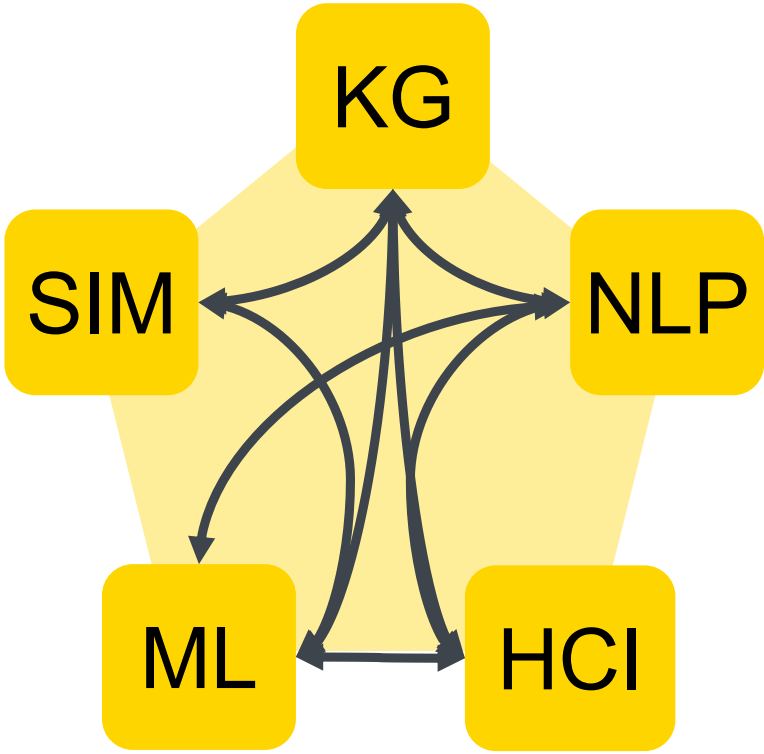
KG: Knowledge Graphs, Querying, Reasoning, Data integration.

Sim: Bridging simulation and ML, Knowledge-infused machine learning, discovery of scientific hypotheses

ML: ML on graphs, fairness

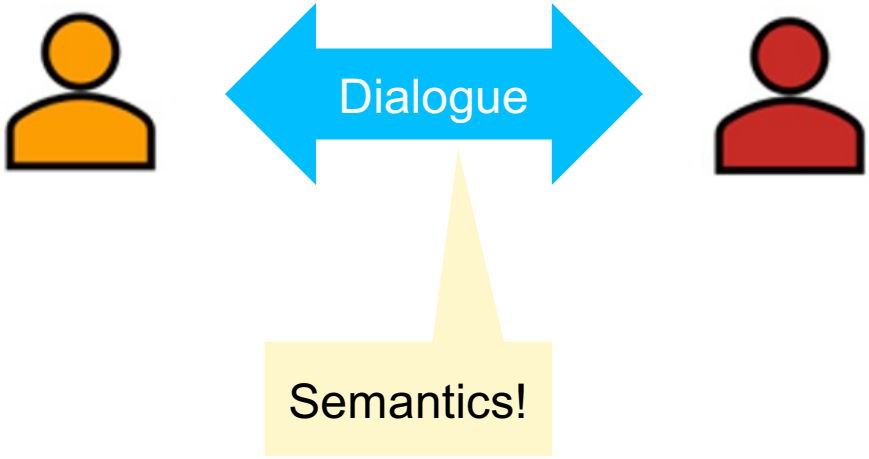
NLP: Entity linking, information extraction, clustering, explainable question answering

AI & HCI: This presentation today



Semantics and User Interaction

Semantics and Human-Computer-Interaction



Semantik ...is the theory of science of the meaning of signs.

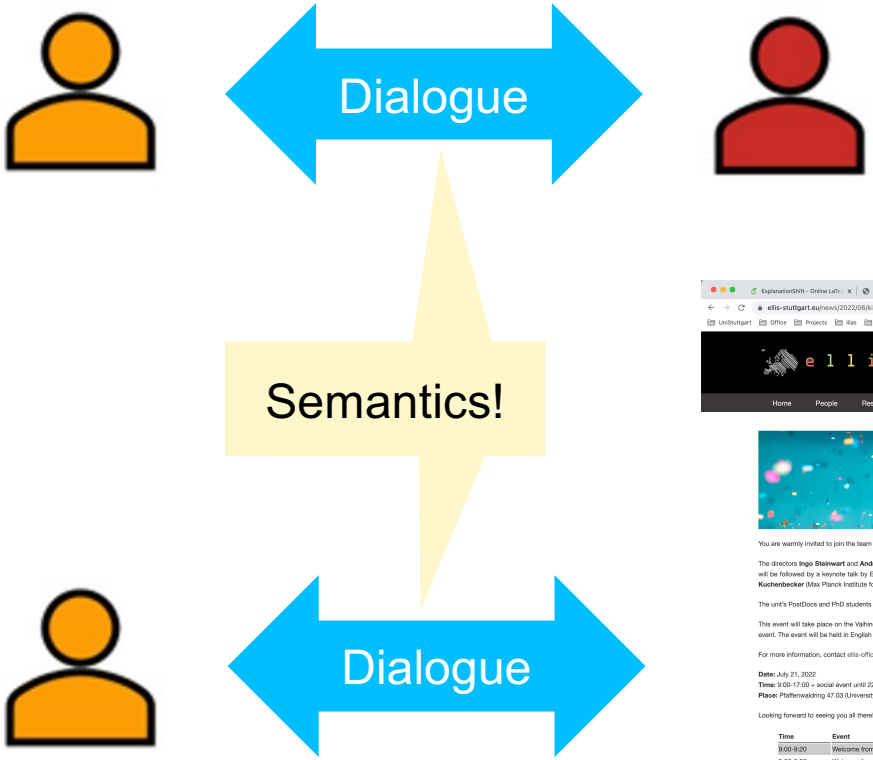
Signs may be any **symbols**,
but also sentences, parts of sentences, words or parts of words ....

As far as *linguistic signs* are concerned, semantics is a subdiscipline of *linguistics*.

Wikipedia

https://de.wikipedia.org/w/index.php?title=Semantik&oldid=214319081

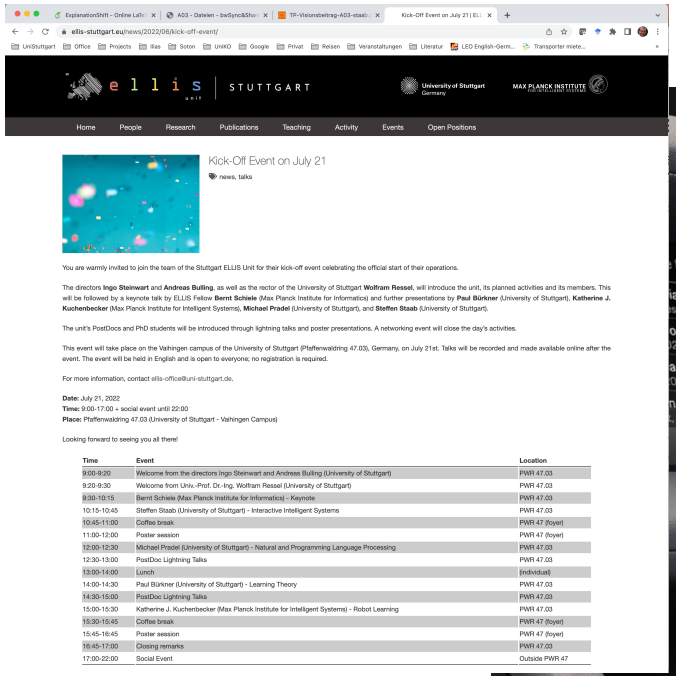
Semantics and Human-Computer-Interaction



Semantics ... as far as semantics is concerned with **signs of all kind**, it is a subdiscipline of **semiotics**

Wikipedia

https://de.wikipedia.org/w/index.php?title=Semantik&oldid=214319081



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Kick-Off Event on July 21

news, talks

You are warmly invited to join the team of the Stuttgart ELLIS Unit for their kick-off event celebrating the official start of their operations.

The directors **Ingo Steinwart** and **Andreas Bulling**, as well as the rector of the University of Stuttgart **Wolfram Ressel**, will introduce the unit, its planned activities and its members. This will be followed by a keynote talk by ELLIS Fellow **Bernt Schiele** (Max Planck Institute for Informatics) and further presentations by **Paul Bürkner** (University of Stuttgart), **Katherine J. Kuchenbecker** (Max Planck Institute for Intelligent Systems), **Michael Pradel** (University of Stuttgart), and **Steffen Staab** (University of Stuttgart).

The unit's PostDocs and PhD students will be introduced through lightning talks and poster presentations. A networking event will close the day's activities.

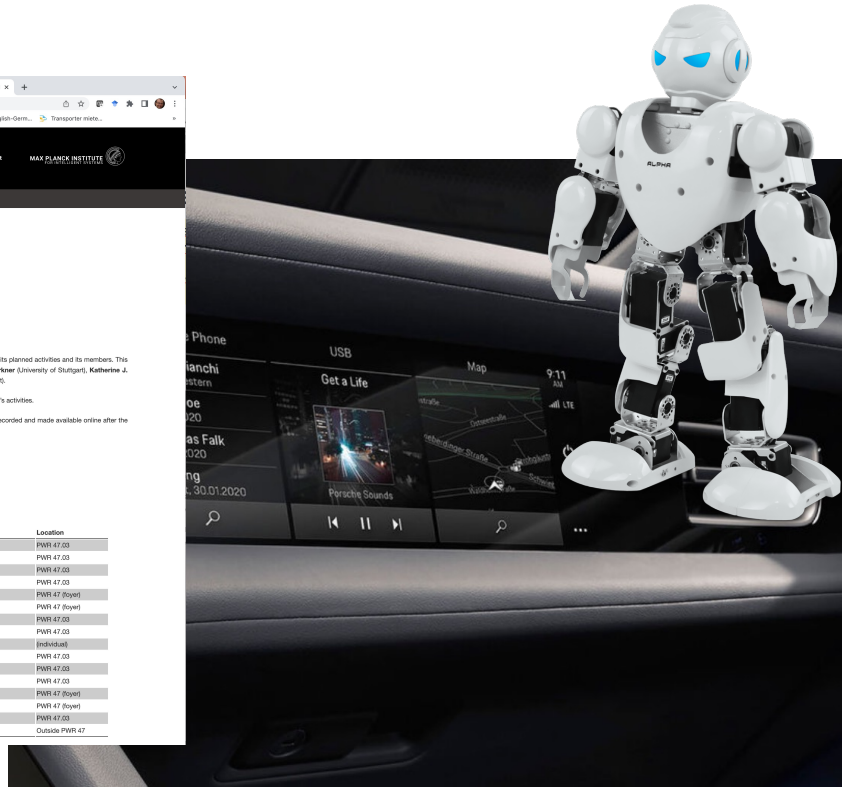
This event will take place on the Vaihingen campus of the University of Stuttgart (Pfaffenwaldring 47.03), Germany, on July 21st. Talks will be recorded and made available online after the event. The event will be held in English and is open to everyone; no registration is required.

For more information, contact ellis-office@uni-stuttgart.de.

Date: July 21, 2022
Time: 9:00-17:00 + social event until 22:00
Place: Pfaffenwaldring 47.03 (University of Stuttgart - Vaihingen Campus)

Looking forward to seeing you all there!

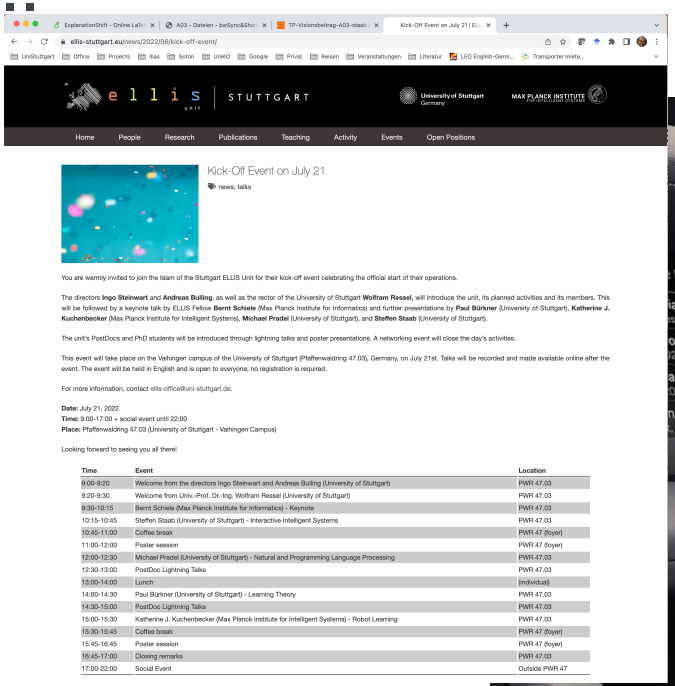
Time	Event	Location
9:00-9:20	Welcome from the directors Ingo Steinwart and Andreas Bulling (University of Stuttgart)	PWR 47.03
9:20-9:30	Welcome from Univ.-Prof. Dr.-Ing. Wolfram Ressel (University of Stuttgart)	PWR 47.03
9:30-10:15	Bernt Schiele (Max Planck Institute for Informatics) - Keynote	PWR 47.03
10:15-10:45	Steffen Staab (University of Stuttgart) - Interactive Intelligent Systems	PWR 47.03
10:45-11:00	Coffee break	PWR 47 (foyer)
11:00-12:00	Poster session	PWR 47 (foyer)
12:00-12:30	Michael Pradel (University of Stuttgart) - Natural and Programming Language Processing	PWR 47.03
12:30-13:00	PostDoc Lightning Talks	PWR 47.03
13:00-14:00	Lunch	(individual)
14:00-14:30	Paul Bürkner (University of Stuttgart) - Learning Theory	PWR 47.03
14:30-15:00	PostDoc Lightning Talks	PWR 47.03
15:00-15:30	Katherine J. Kuchenbecker (Max Planck Institute for Intelligent Systems) - Robot Learning	PWR 47.03
15:30-15:45	Coffee break	PWR 47 (foyer)
15:45-16:45	Poster session	PWR 47 (foyer)
16:45-17:00	Closing remarks	PWR 47.03
17:00-22:00	Social Event	Outside PWR 47

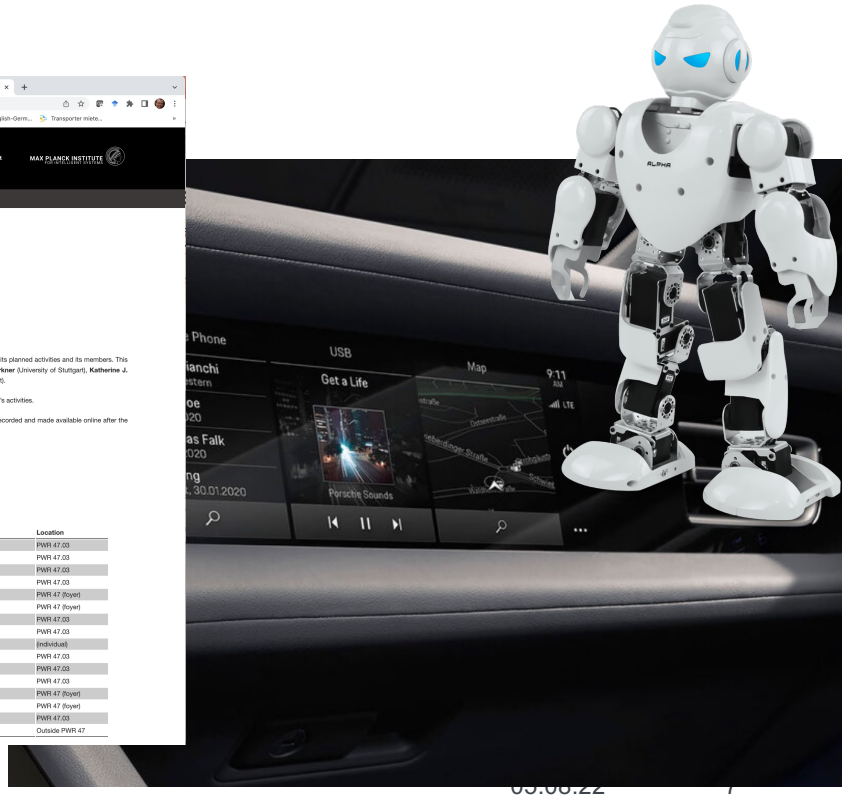


Natural Human-Computer-Interaction

- touch
- speak
- point
- nod
- hum
- frown....

Dialogue





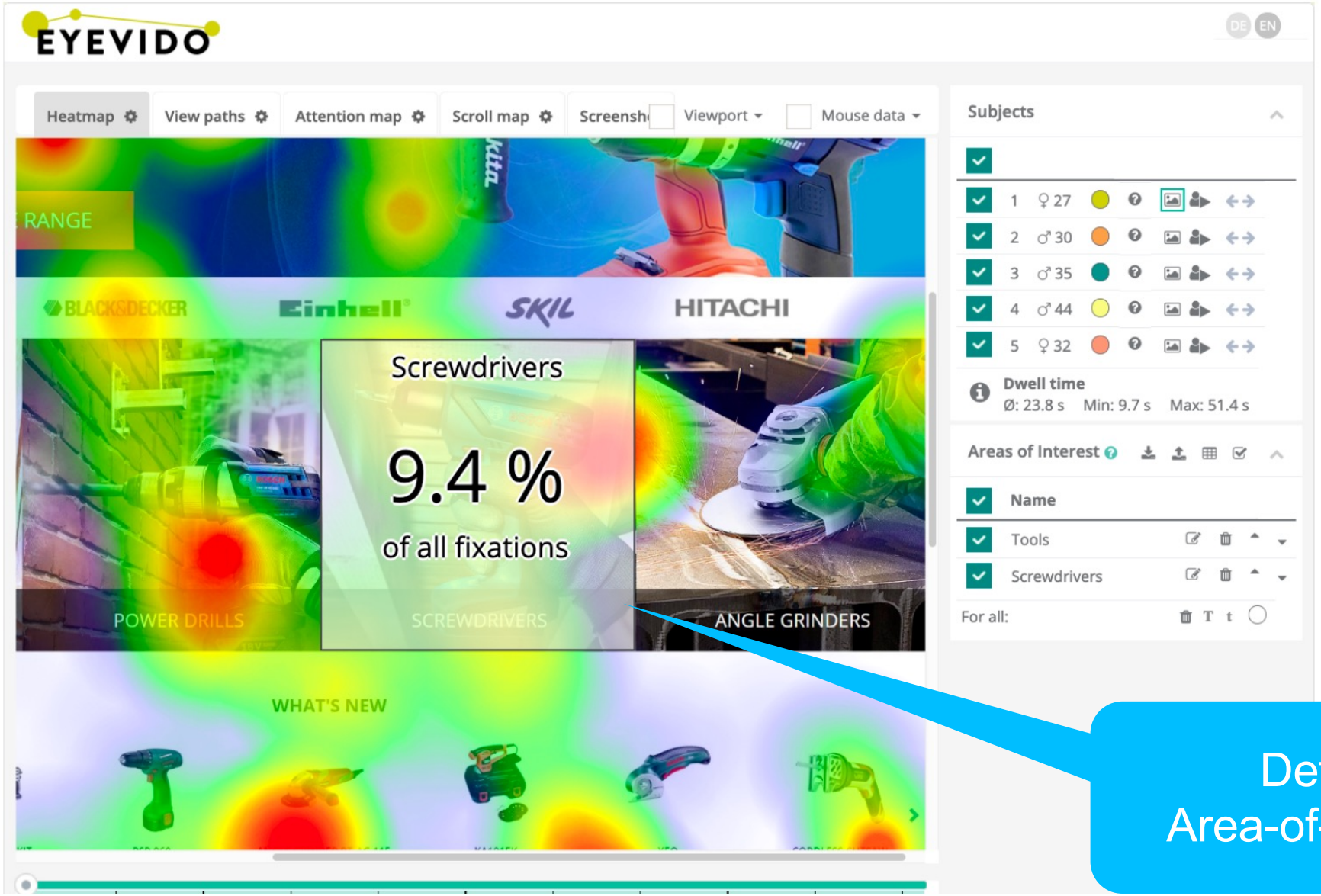
Core questions

- What is the semantics of a user interface and user action?
- How can I recognize the semantics?
- What do I need to understand it?
- What can I do better if I understand its semantics?
  1. Understand user
  2. Allow for new types of interactions
  3. Vision: Multimodal translation of interfaces

Usability Analysis with AI

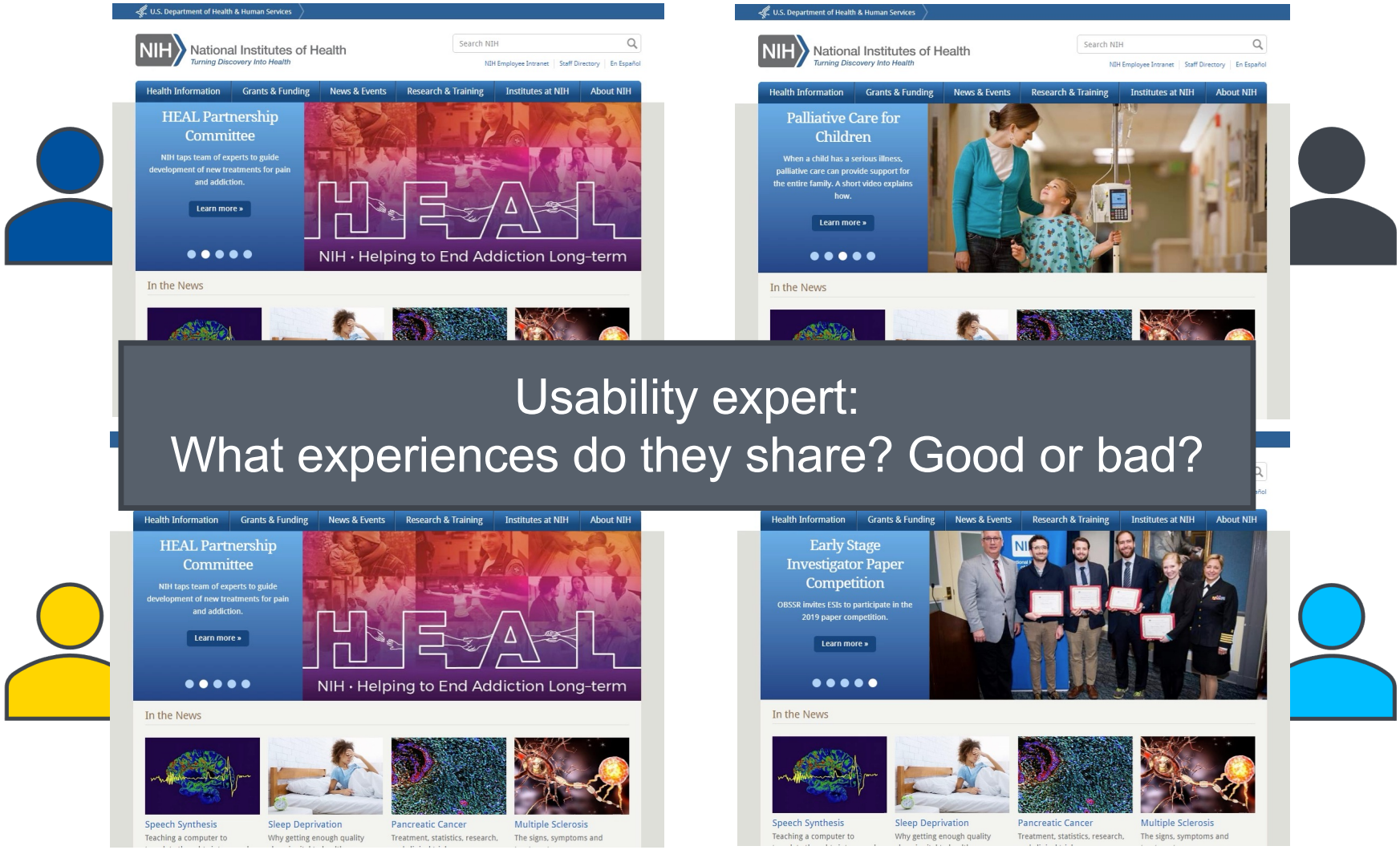
Understand your users

What do the users see? What do they not see?



Define
Area-of-Interest

Not every user experiences the same content!



Usability expert:
What experiences do they share? Good or bad?

Usability Analysis

Objective

- Mine data for correlations of stimuli and user activities
  - clicks
  - gaze
  - voice
  - emotion (Decky!)
  - *no activity*

→ Derive improved usability

Commonly

- Passive stimuli
  - static images

Required

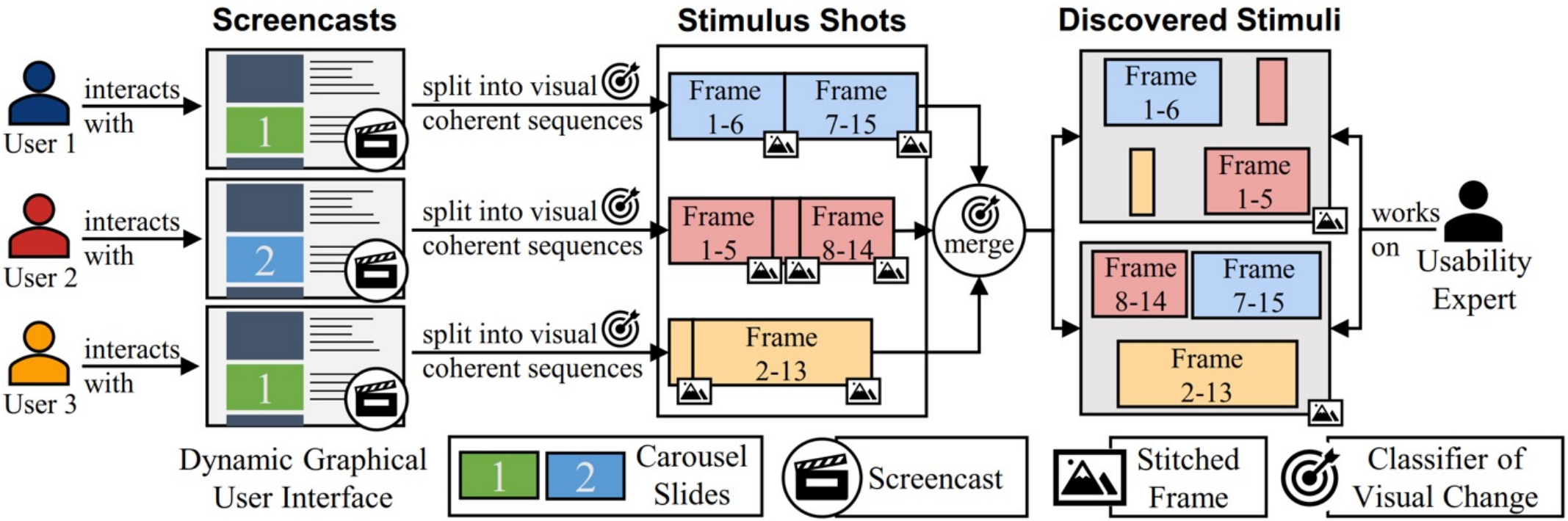
- Dynamic stimuli
  - scroll, activation,....
- Active stimuli
  - Web-caroussel, video, ...

Our methodology for discovering visual stimuli

Collect data

Recognize meaningful differences & similarities

Cluster likewise experiences



Learn from annotated data

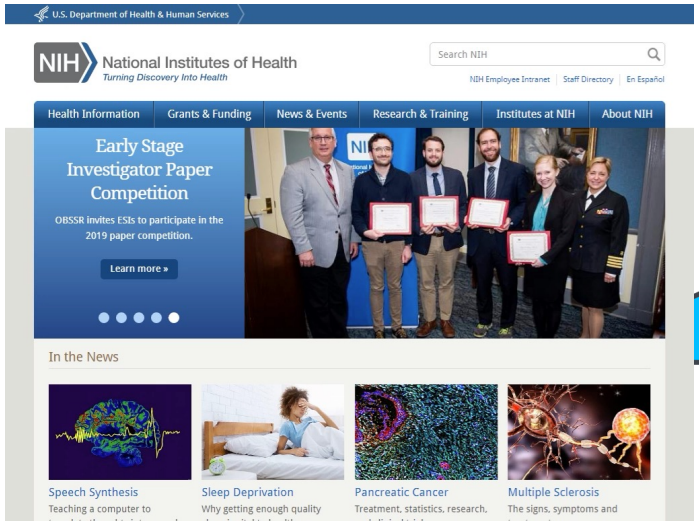
Computer Vision: edges, SIFT, colors
Machine Learning: Random Forest

Frame n

Frame n+1

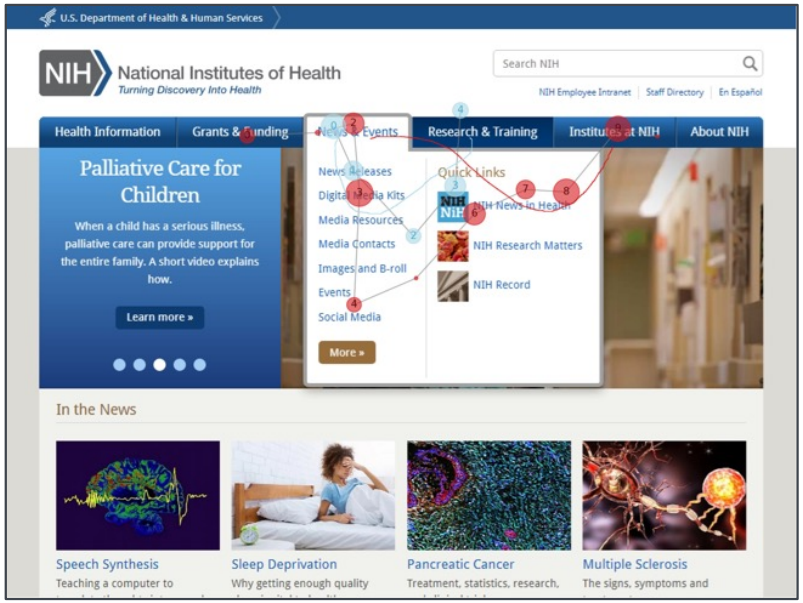
No ← Visual Change? → Yes

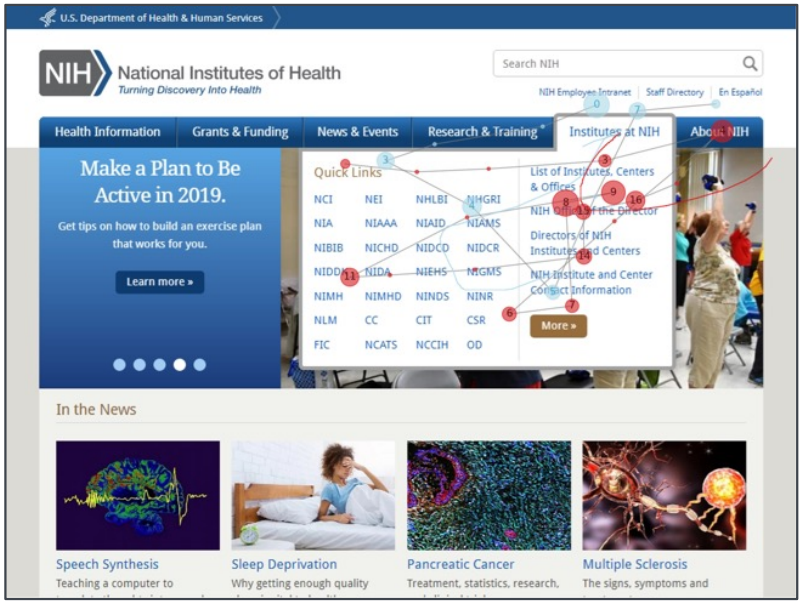
Input to the framework



Output of the framework

More Output of the framework





udeco
Usability Data Ecosystem

EYEVIDO

University of Stuttgart
Institute for Parallel and Distributed Systems

Application data

- user interface: Visual stimuli

User data

- „thinking aloud“ & questionaire: Deeply understanding issues
- Eye & mouse-Tracking: High spatial resolution
- Emotion: High temporal resolution

Inclusion by semantics-based adaptation

We are all disabled

Stroke

Parkinson's Disease

Injury

Spinal Cord Injury

Temporarily

Permanently

Busy Hands

Amyotrophic
Lateral Sclerosis

Rheumatism

EU Project MAMEM 2015-2018
https://youtu.be/42yGmr3NE0k

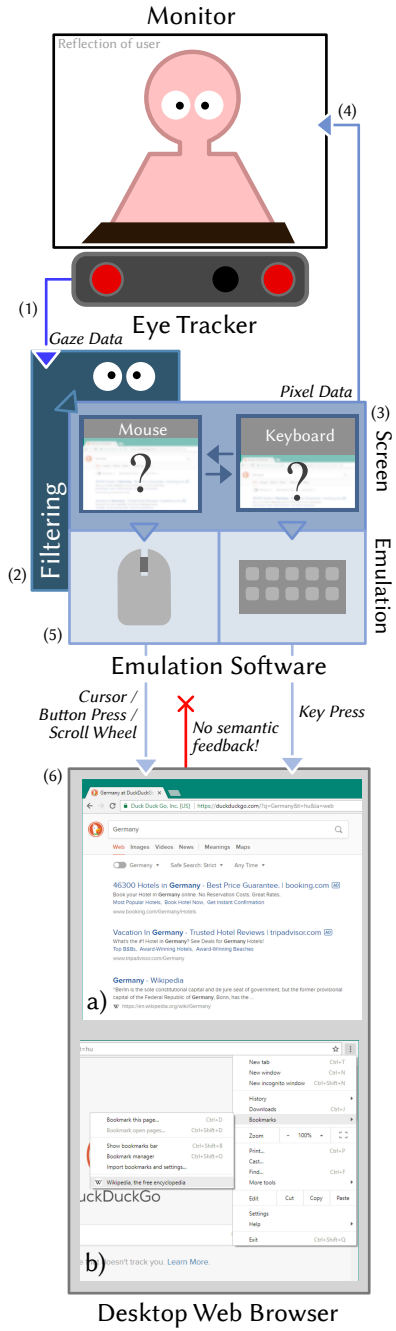
User Experience:
Emulation of manual user interaction

Bias, variance, Midas Touch

- filter, calibrate, size of user widgets, UI feedback
- simplify pointing and choosing (instead of mouse and keyboard)

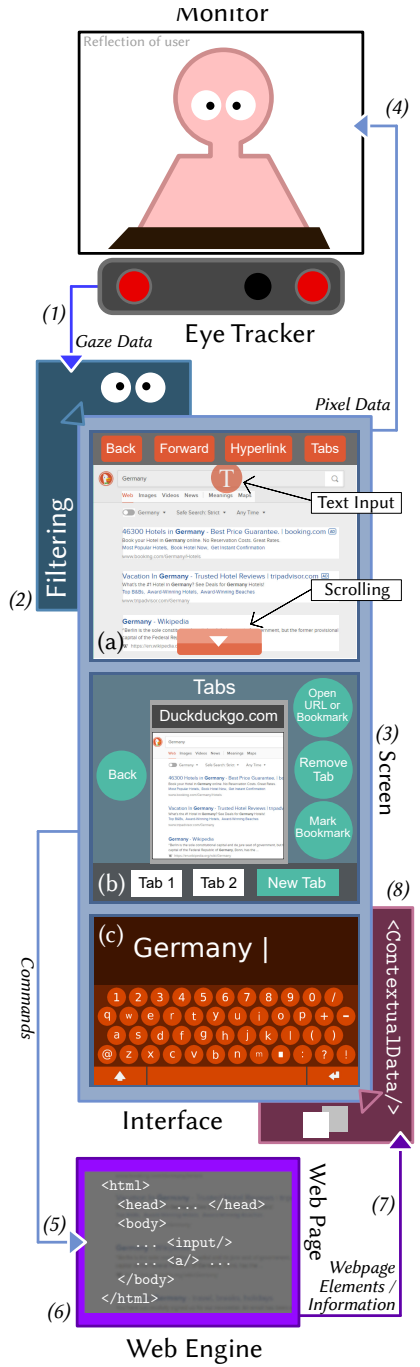
State-of-the-Art

Gaze Emulation



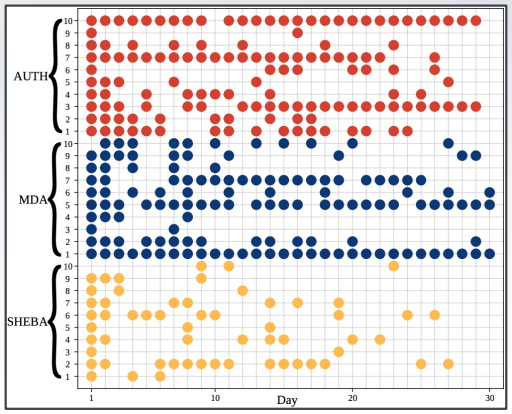
Contextualized gaze-based interaction: GazeTheWeb

- Determine semantics of user widgets
  - text input
  - hyperlink
  - video
  - …
- Optimize gaze-based user interaction
  - Fewer actions
  - Less overhead for monitoring
- Adapt type of interaction
  - “translate” input
  - visual feedback
  - contextualized feedback



GazeTheWeb – A gaze-controlled Web browser

- Horizon 2020 Project MAMEM from 2015 to 2018
- Remote-study with people with severe motor impairment
- Free-to use on laptop with GazeTheWeb at home
- 30 participants used our method for 30 days at home
  - 10 participants with spinal cord injury (Israel)
  - 10 participants with Parkinson's disease (Thessaloniki)
  - 10 participants with neuromuscular diseases (Athens)



MAMEM

Wednesday, April 7, 2021

Raphael, 15:40

I am happy that GazeTheWeb is still used!

Spiros, 15:41

There 4 to 5 people that are actively using it

Dr. Nikolopoulos
CERTH in Thessaloniki

From GazeTheWeb to Semanux: Head-based control

Wie kann ich meinen Computer
nur mit dem Kopf steuern?

Multi-modal input

Wie kann ich meinen Computer mit einem Fußschalter steuern?

Enhancing computer-based human collaboration with AI

Comparing physical and virtual meetings

Behavioral Impact

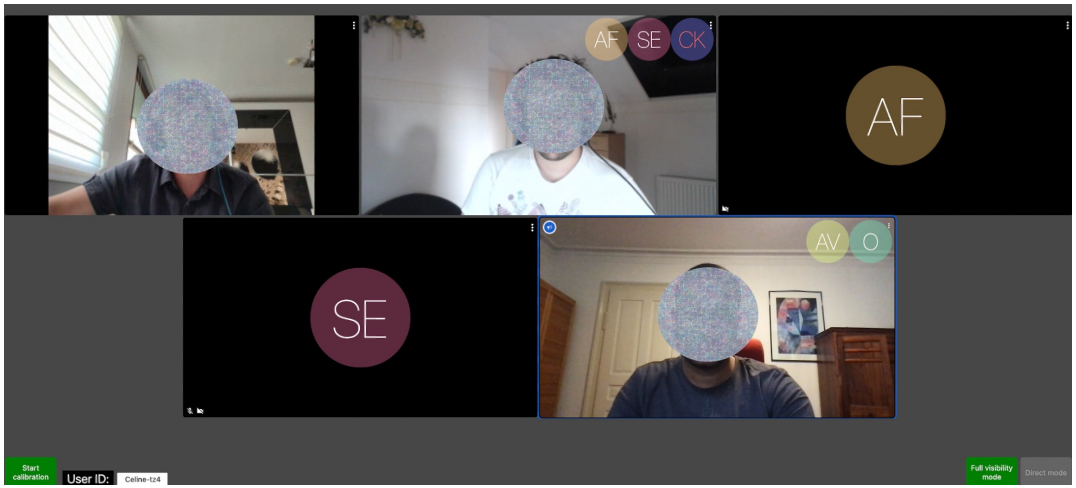
- Attention & motivation
- Non-verbal cues
- Intuitive organization
- Group dynamics
- Social connection
- …

“Eye contact is fundamental to human social interactions and, as such, a key non-verbal behavioural cue” Kleinke 1986

Intelligent virtual meeting platform

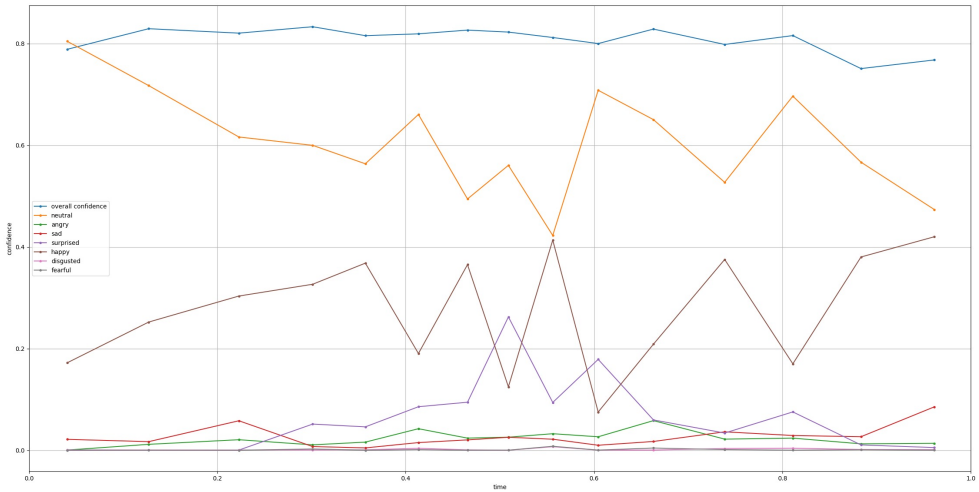
enabling non-verbal communication,

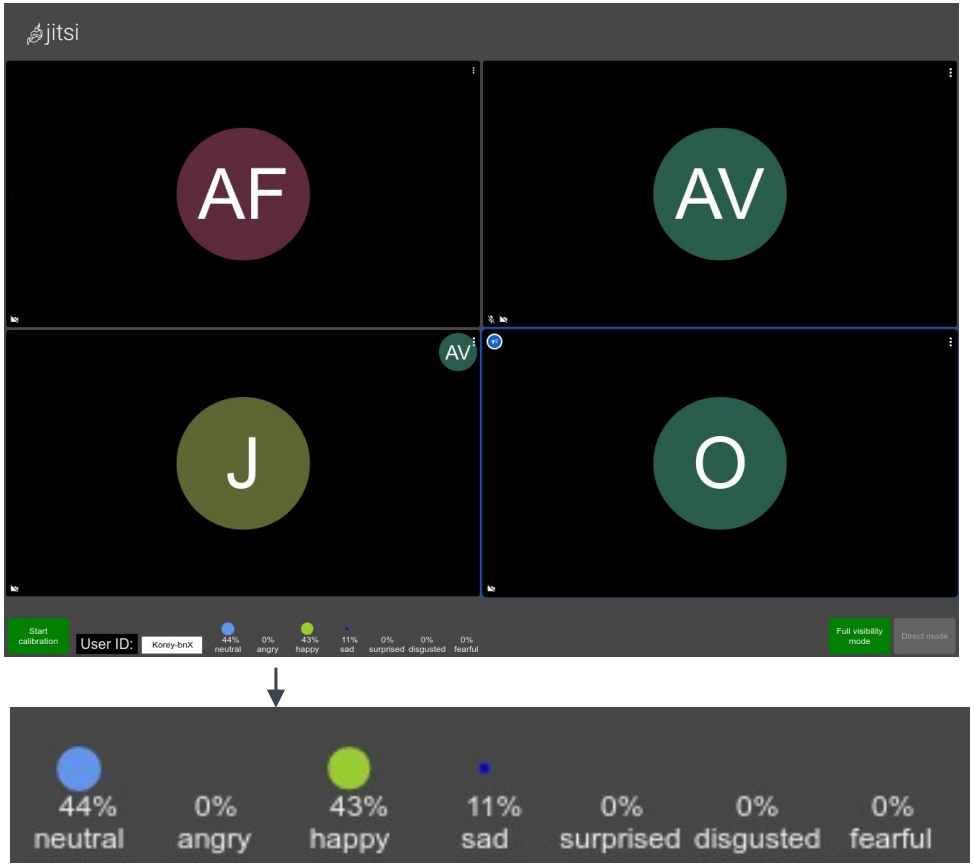
- Web-based virtual meeting extension that records and can share non-verbal behavioral information (gaze and emotion) of participants
  - Webcam-based eye tracking, Face expression-based emotion detection
  - Browser extension, server-based communication, Jitsi meet integration
- Analysis: feasibility and acceptance of enabling eye contact in virtual meetings, visualization schemes, emotion analysis and visualization



Attention and emotion

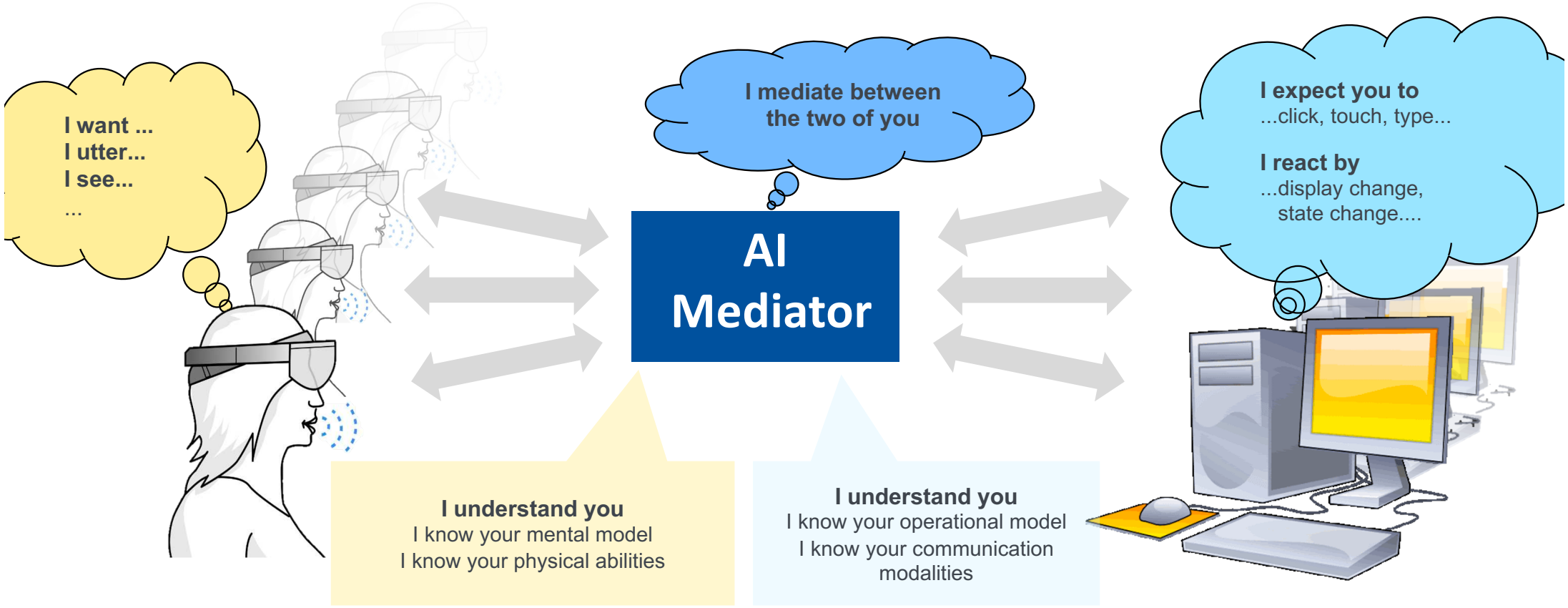
- Attention displayed via symbols
- The emotions are recognizable and change over time
  - feedback for speaker about the status of meeting, and cognitive status of participants
- We incorporated live emotion visualization into the meeting platform





Conclusion

Our Vision: Semantic Human-Computer Mediation



Universität Stuttgart
IPVS

UNIVERSITY OF Southampton

Danke schön!

Steffen Staab

E-Mail Steffen.staab@ipvs.uni-stuttgart.de
Telefon +49 (0) 711 685-88100
www. ipvs.uni-stuttgart.de/departments/ac/

Universität Stuttgart
Analytic Computing, IPVS
Universitätsstraße 32, 50569 Stuttgart

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