

AI with psychology

A few words on affective adaptation
and personalisation of intelligent systems

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FAIS UJ, JAHCAI Lab UJ,
AfCAI Research Group, GEIST Research Group

AIRA Seminar, online, 18.05.2021

INTELLIGENT SYSTEMS

GET THE TASKS DONE RIGHT...



INTELLIGENT SYSTEMS

GET THE TASKS DONE RIGHT...

- Add Events to Calendar 
- Book Restaurants 
- Automate Customer Service 
- Book Tickets 
- Check Flight Status 
- Check Smart Home Devices 
- Give Recommendations 
- Hold a Natural Conversations 
- Make Phone Calls 
- Make Shopping Lists 

- Make "To Do" List 
- Make Travel Arrangements 
- Order Groceries 
- Organize Moving Arrangements 
- Play Media 
- Provide Facts and Information 
- Schedule Meetings 
- Send Text Messages 
- Set Alarms and Reminders 
- Shop Online (Conversational Commerce) 

INTELLIGENT SYSTEMS

... AND REACT TO EMOTIONS!

We verbally praise them when they do a good job for us or blame them when they refuse to perform as we had wished

[Donald Norman, Emotional Design, Basic Civitas Books, 2004]



AFFECTIVE COMPUTING (1997)



AFFECTIVE COMPUTING

► Emotion recognition



disgust



contempt



anger



fear



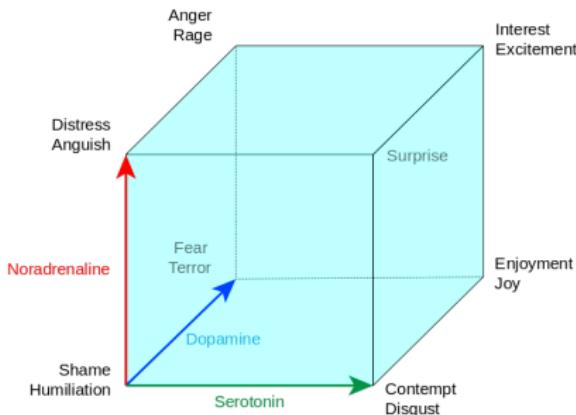
surprise



sadness

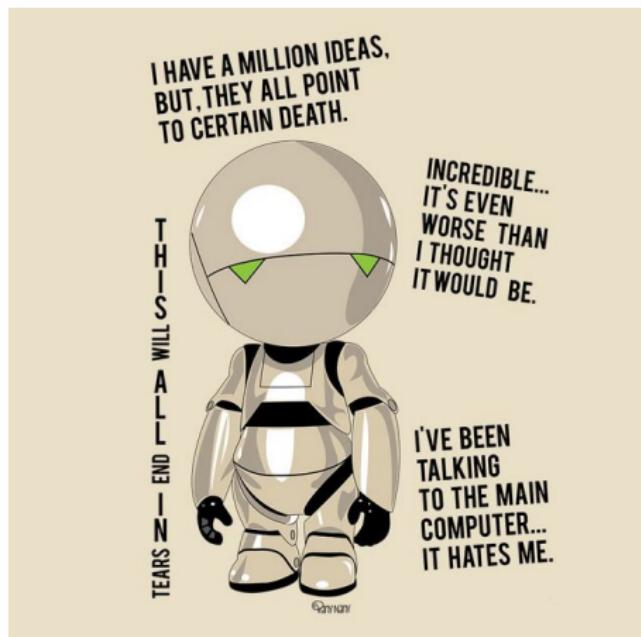
AFFECTIVE COMPUTING

- ▶ Emotion recognition
- ▶ Emotion representation



AFFECTIVE COMPUTING

- ▶ Emotion recognition
- ▶ Emotion representation
- ▶ Emotion simulation



AFFECTIVE COMPUTING

- ▶ Emotion recognition
- ▶ Emotion representation
- ▶ Emotion simulation

Many teams, papers,
datasets, models, ...



AFFECTIVE COMPUTING

- ▶ Emotion recognition
- ▶ Emotion representation
- ▶ Emotion simulation

Many teams, papers,
datasets, models, ...

...but it does not work!



**DON'T
PANIC**

MEDICAL/RESEARCH CLASS DEVICES ...



[Source of an image]

...ARE IMPRACTICAL (AND EXPENSIVE)



[Source of an image]

OUR ASSUMPTIONS

1. USE AFFORDABLE WEARABLES

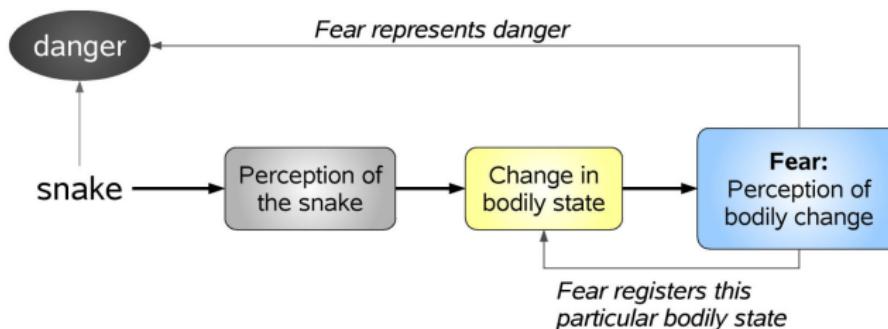


OUR ASSUMPTIONS

2. J. PRINZ THEORY AS A BASE

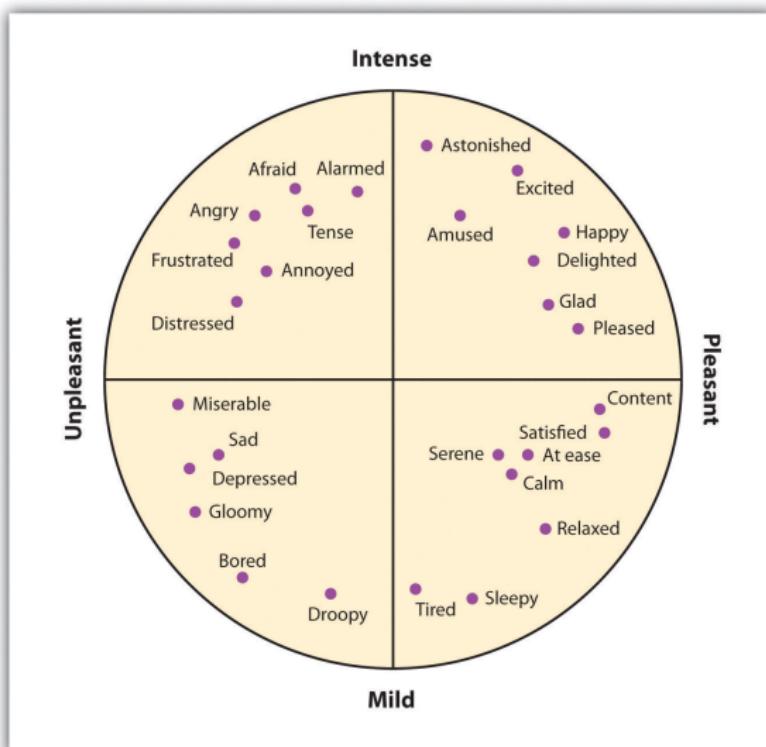
Emotions are build up by two parts:

- ▶ *form* – perception of **bodily changes** (as in the classical James-Lange theory),
- ▶ *content* – relationship between agent and environment



OUR ASSUMPTIONS

3. COMPUTATIONAL MODEL: RUSSELL'S CIRCUMPLEX MODEL

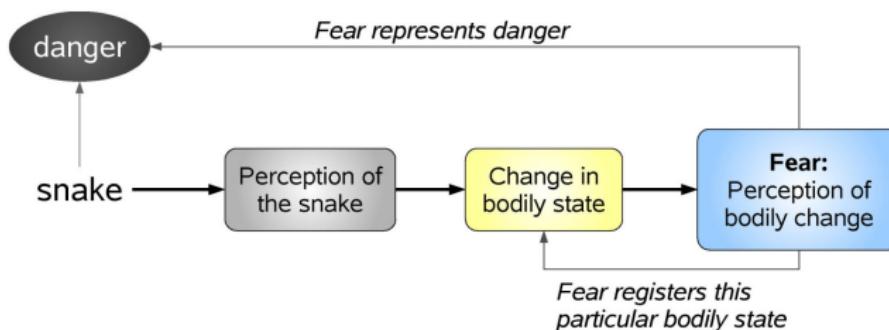


OUR ASSUMPTIONS

2. J. PRINZ THEORY AS A BASE

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- ▶ *content* – relationship between agent and environment



OUR ASSUMPTIONS

4. CONTEXT-AWARE SYSTEMS PARADIGM

Context

- Where you are, who you are with, what resources are nearby (Schillit)
- Any information that can be used to characterize the situation of an entity (Dey)
- Individuality, activity, location, time, relations (Zimmerman)
- Set of variables that may be of interest for an agent and that influence its actions (Bolchini)

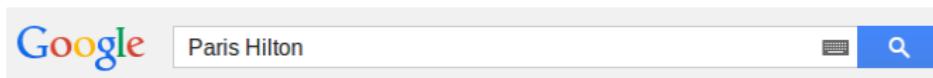
Aware

- Artificial intelligence methods

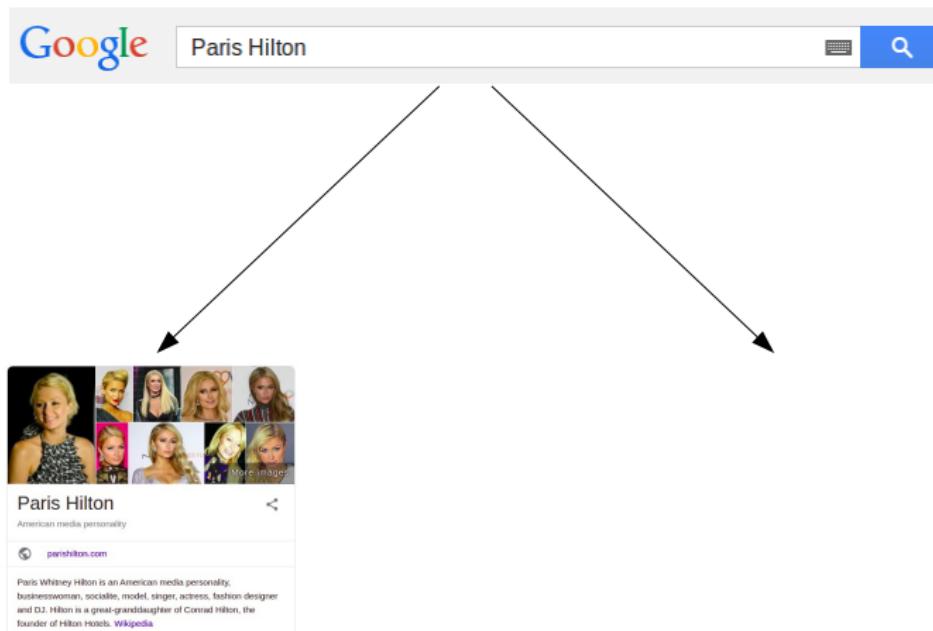
Systems

- Intelligent homes, intelligent cars, robotics
- Ambient intelligence, pervasive environments, ubiquitous computing
- Mobile computing (location aware mobile applications)
- Intelligent software (contextual advertising, etc.)

CONTEXT IN PRACTICE



CONTEXT IN PRACTICE



CONTEXT IN PRACTICE

Google

Paris Hilton

Paris Hilton

American media personality

paris.hilton.com

Paris Whitney Hilton is an American media personality. businesswoman, socialite, model, singer, actress, fashion designer and DJ. Hilton is a great-granddaughter of Conrad Hilton, the founder of Hilton Hotels. [Wikipedia](#)

Hilton Hotels & Resorts

Hotel company

Hilton HOTELS & RESORTS

Hilton Hotels & Resorts is a global brand of full-service hotels and resorts and the flagship brand of American multinational hospitality company Hilton. The original company was founded by Conrad Hilton. [Wikipedia](#)



CONTEXT IN PRACTICE

Google

Paris Hilton

Business Trip
pt, 17 styczeń 2014
Gdzie Paris, France mapa
Usuń na zawsze Edytuj wydarzenie +

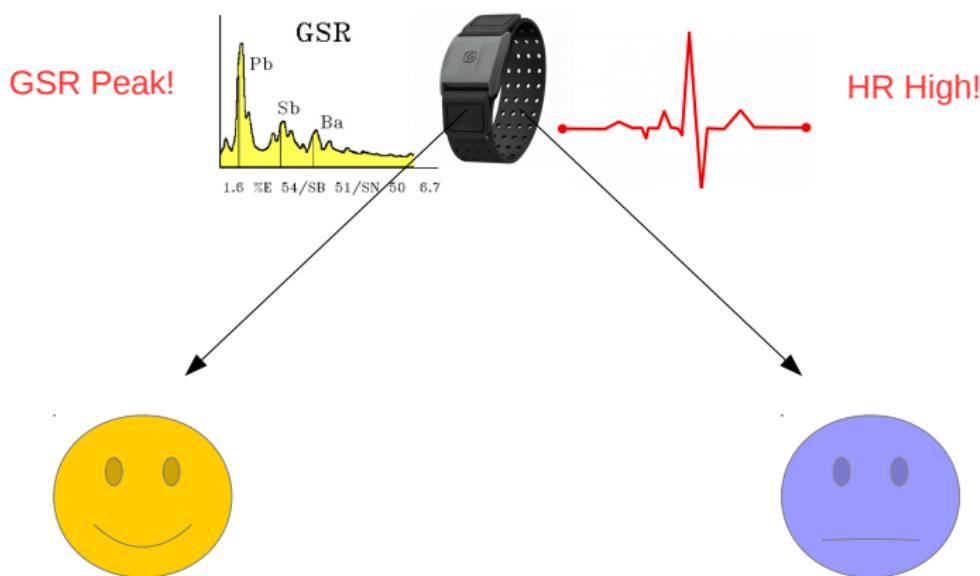
Paris Hilton
American media personality
paris-hilton.com
Paris Whitney Hilton is an American media personality. businesswoman, socialite, model, singer, actress, fashion designer and DJ. Hilton is a great-granddaughter of Conrad Hilton, the founder of Hilton Hotels. Wikipedia

Hilton Hotels & Resorts
Hotel company
Hilton HOTELS & RESORTS

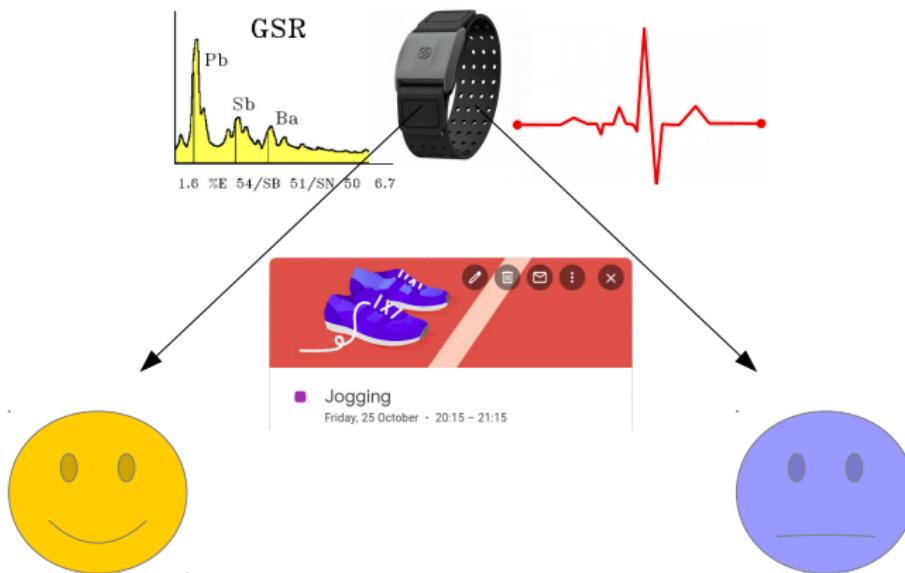
Hilton Hotels & Resorts is a global brand of full-service hotels and resorts and the flagship brand of American multinational hospitality company Hilton. The original company was founded by Conrad Hilton. Wikipedia



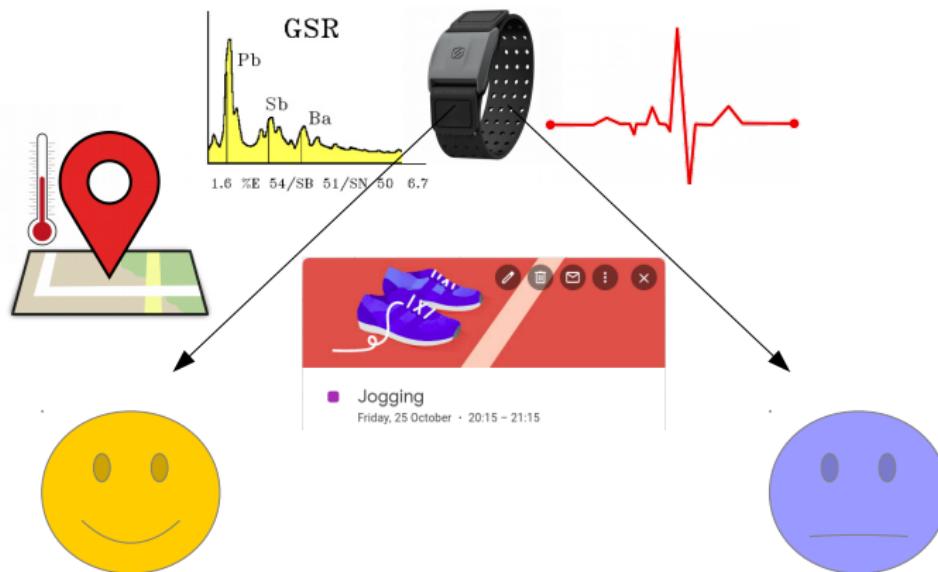
CONTEXT FOR AFFECTIVE COMPUTING



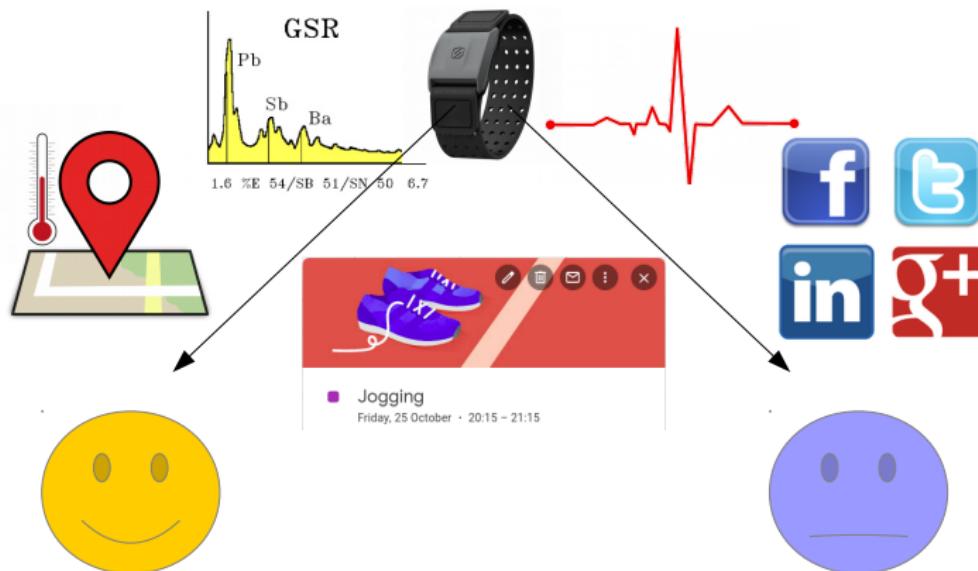
CONTEXT FOR AFFECTIVE COMPUTING



CONTEXT FOR AFFECTIVE COMPUTING



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CONTEXT FOR AFFECTIVE COMPUTING



AfCAI PARADIGM

Affective Computing with Context Awareness in Ambient Intelligence applications

Objectives: detection, interpretation and use of information on emotion for personalized decision support in ubiquitous / ambient computing

- ▶ AfCAI Team
- ▶ AfCAI Workshops:
Murcia, Spain (2016),
València, Spain (2018),
Cartagena, Spain (2019),
... (2022)!

AfCAI PARADIGM

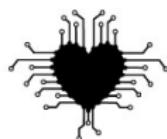
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AfCAI COMMUNITY

The screenshot shows a web browser window with the URL 'afcai.re/start' in the address bar. The page itself has a dark header with the text 'AfCAI Research Group' and navigation links for 'News', 'Research', 'Community', 'Workshops', and 'About us'. A 'Log In' button is also visible. The main content area features a large title 'AfCAI Research Group homepage' and a stylized heart icon composed of circuit board components. Below the title, there is text about the group's name, its members from Jagiellonian University and AGH University of Science and Technology in Krakow, Poland, and information about their international workshop.



The group name stands for **Affective Computing Context Awareness and Ambient Intelligence** as it identifies our most general research topics.

We are a group of researchers from the Jagiellonian University and AGH University of Science and Technology in Krakow, Poland.

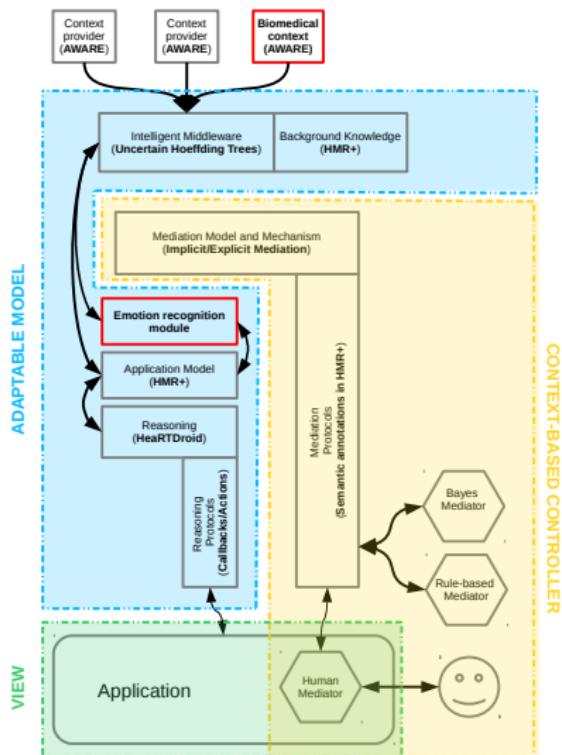
We created an international workshop related to these topics.

— Grzegorz J. Nalepa 2016/07/24 17:40

Go to the [Internal research page](#).

News

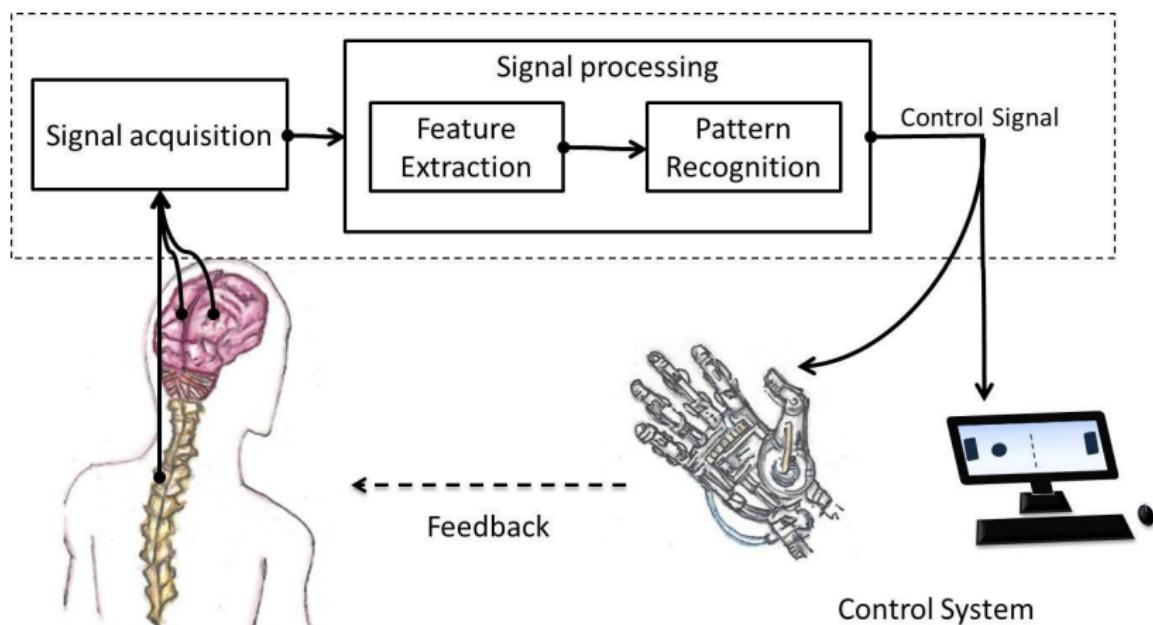
AfCAI PLATFORM



- ▶ affective computing methods with context-aware computing platforms
- ▶ big data from wearable sensors and **context** sources
- ▶ **reasoning layer**
- ▶ **human mediator**
- ▶ machine processable conceptualization of human emotions

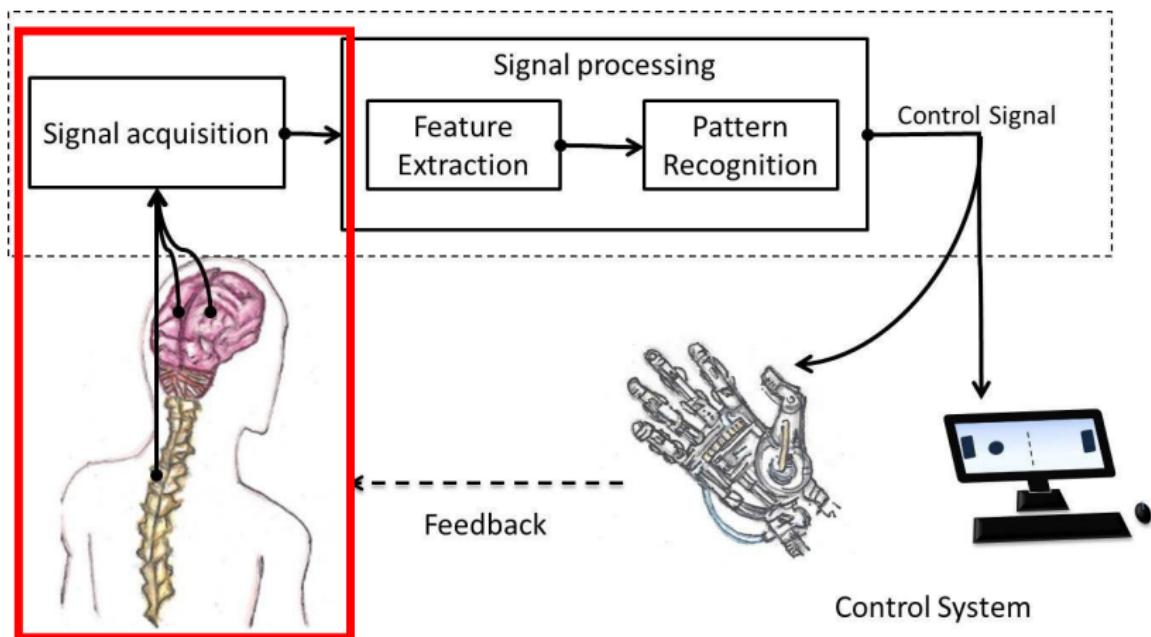
AFFECTIVE FEEDBACK LOOP

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM DESIGN



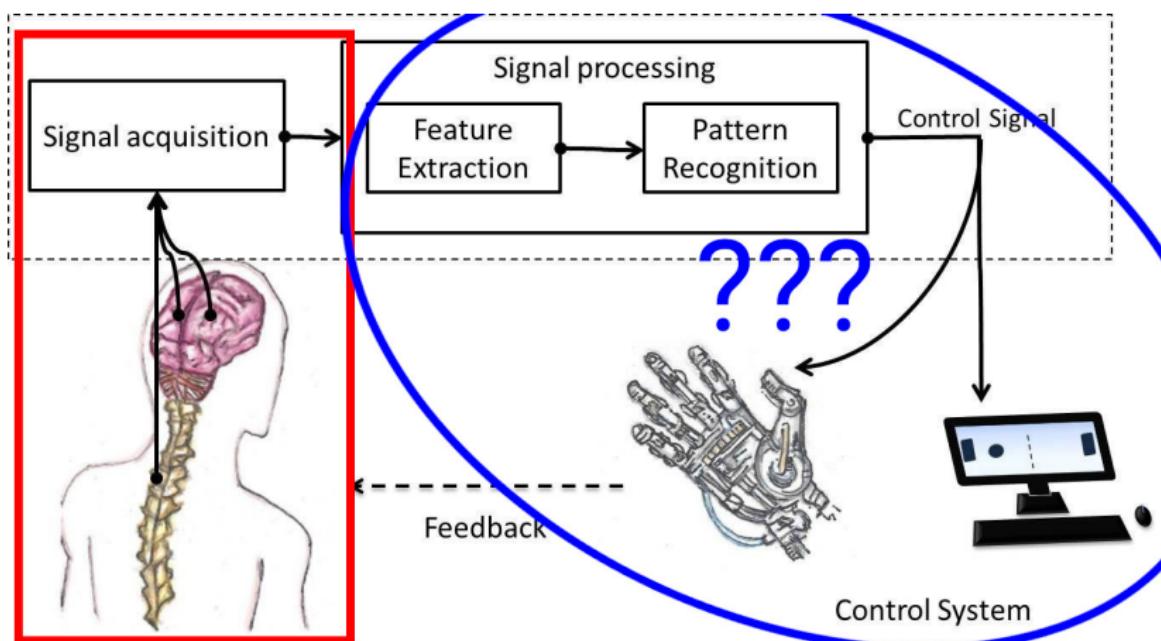
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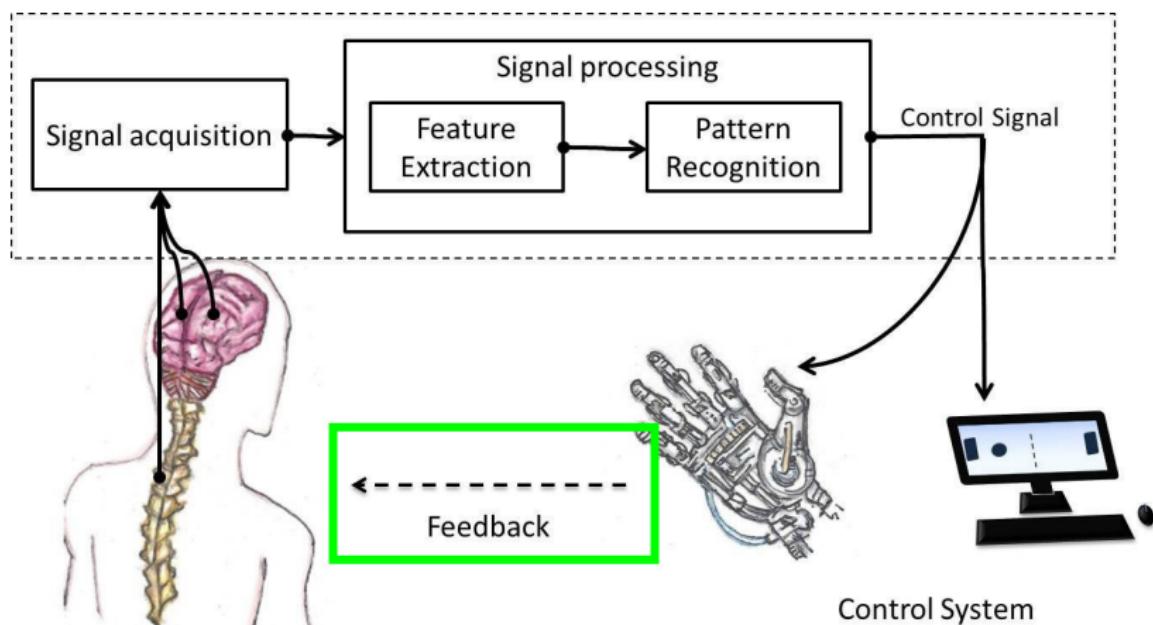
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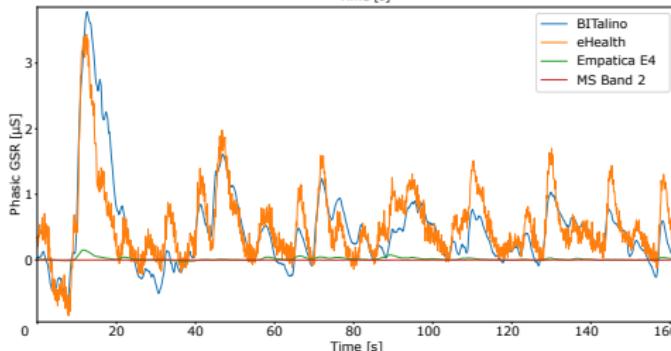
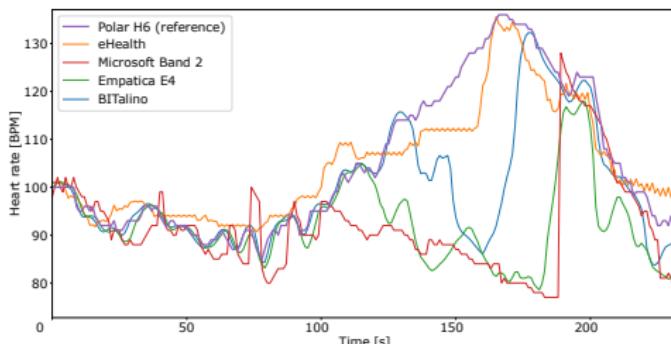
AFFECTIVE FEEDBACK LOOP

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM DESIGN



DEVICES COMPARISON

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM DESIGN



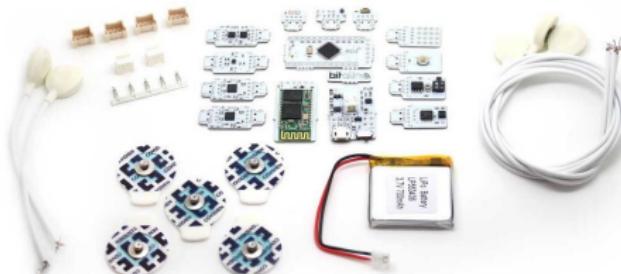
Critical comparison of ECG/PPG and GSR signals' quality

Results: focus on the **BITalino**, possibly combined with the **MS Band 2** in some cases

DEVICES COMPARISON

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM DESIGN

K. Knitt, W. Binek, P. Misiak, G. J. Nalepa, and S. Bobek, "Towards the Development of Sensor Platform for Processing Physiological Data from Wearable Sensors," in ICAIISC 2018, vol. 10842 LNAI, Springer, 2018, pp. 168–178

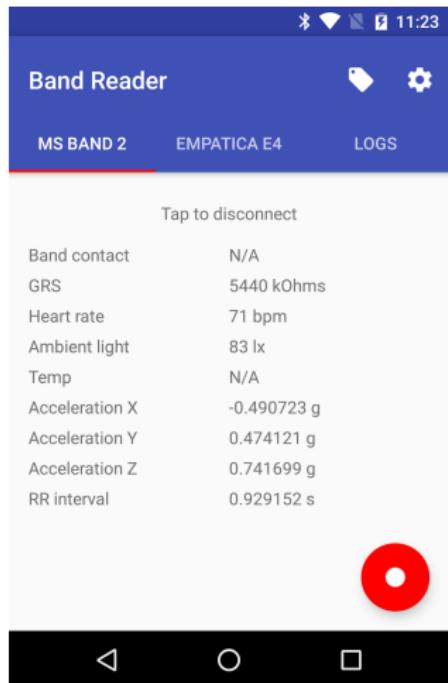
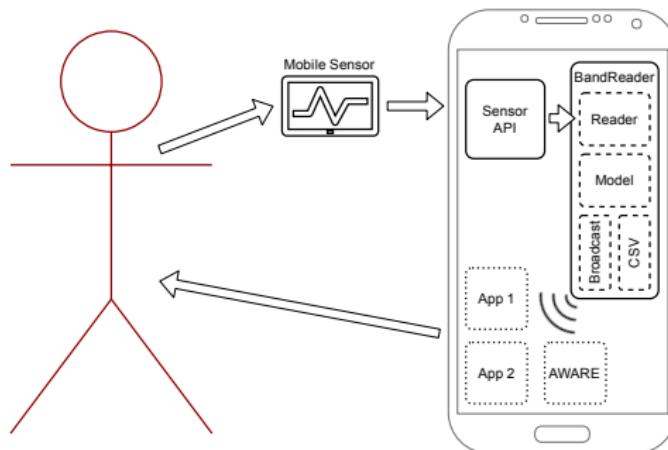


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BANDREADER

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM DESIGN



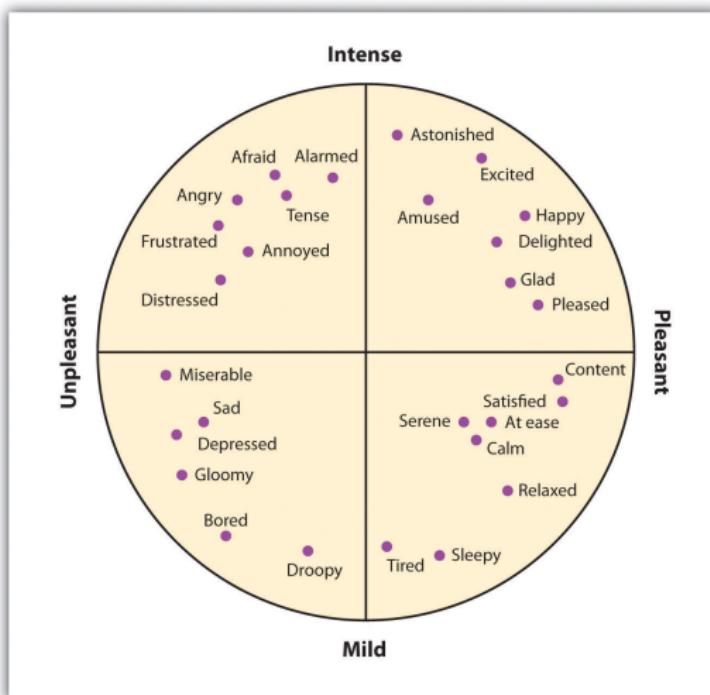
"CLASSICAL" EXPERIMENTAL METHODOLOGY

SIGNAL ACQUISITION ⇒ EMOTION MODELS ⇒ SYSTEM DESIGN



"CLASSICAL" EXPERIMENTAL METHODOLOGY

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM DESIGN



RICH ENVIRONMENT? (VR, MOVIES, REALITY, ...)

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM DESIGN

G. J. Nalepa, J. K. Argasiński, K. Kult, P. Węgrzyn, S. Bobek, and M. Z. Lepicki,
"Affective Computing Experiments in VR with Wearable Sensors. Methodological
considerations and preliminary results," in AfCAI 2016, CEUR, vol. 1794.



NEED FOR EXPERIMENTAL ENVIRONMENT

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM DESIGN

- ▶ Everyday life? **No!**
- ▶ Classical psychological methodology? **Real environment, but too much data and too much noise!**
- ▶ Games?

NEED FOR EXPERIMENTAL ENVIRONMENT

SIGNAL ACQUISITION ⇒ EMOTION MODELS ⇒ SYSTEM DESIGN

- ▶ Everyday life? **No!**
- ▶ Classical psychological methodology? Strict protocol, but lack of ecological validity!
- ▶ Games?

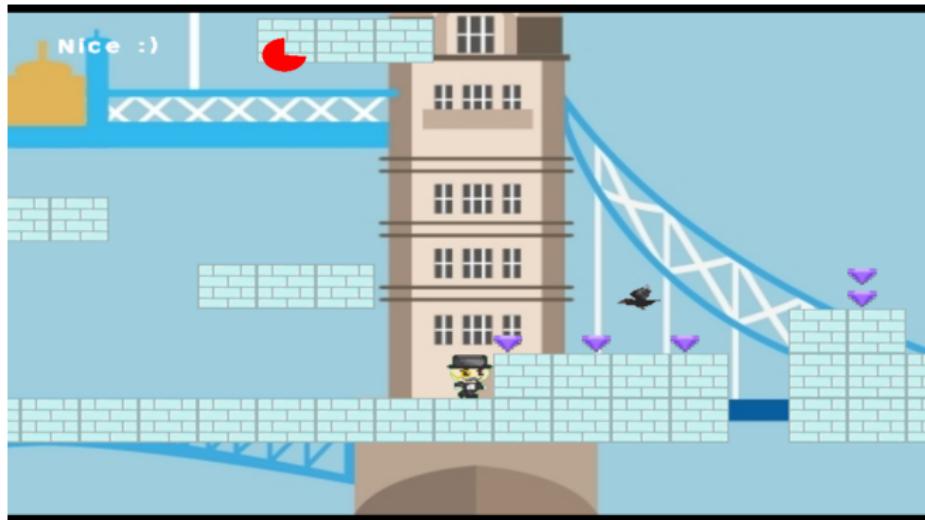
NEED FOR EXPERIMENTAL ENVIRONMENT

SIGNAL ACQUISITION ⇒ EMOTION MODELS ⇒ SYSTEM DESIGN

- ▶ Everyday life? **Yes!**
- ▶ Classical psychological methodology? **Rich & controllable environment!**
- ▶ Games?

LONDON BRIDGE

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM GAME DESIGN



Affective game design patterns,
Affective stimuli,
Affective vs neutral feedback

AFFECTIVE SPACESHOOTER

SIGNAL ACQUISITION ⇒ EMOTION MODELS ⇒ **SYSTEM GAME DESIGN**



- ▶ Colored asteroids
- ▶ Affective images in background

FREUD ME OUT

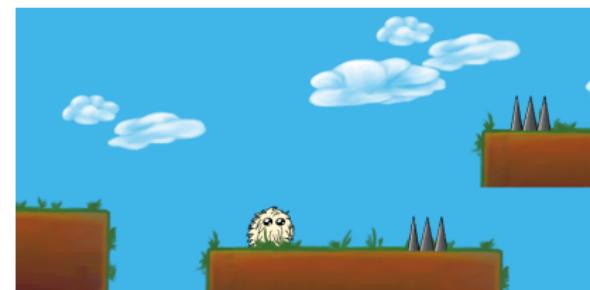
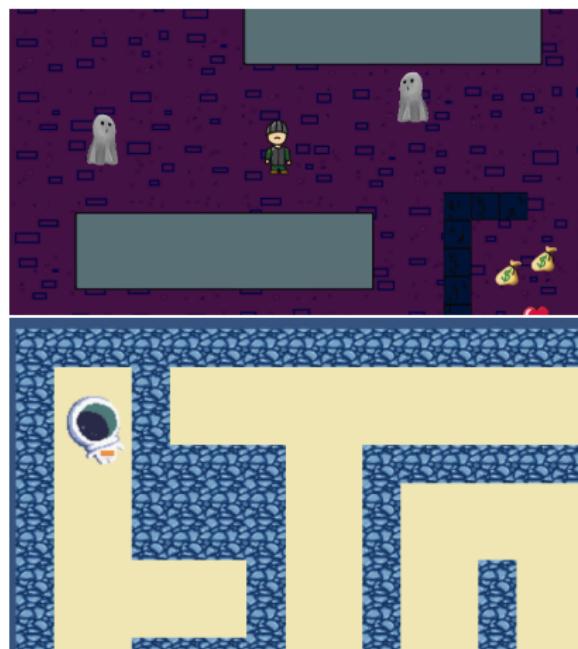
SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM GAME DESIGN



Two scenarios:
peaceful (collect stars) vs aggressive (kill them all!)

ROOM OF THE GHOSTS / JUMP! / LABYRINTH

SIGNAL ACQUISITION \Rightarrow EMOTION MODELS \Rightarrow SYSTEM GAME DESIGN



Short levels,
Restricted set of stimuli,
Aimed at specific emotions

MID-SUMMARY

Signal acquisition ⇒
Emotion models ⇒
System Game design

Too much games!

(They are only tools, not the ultimate goal!)

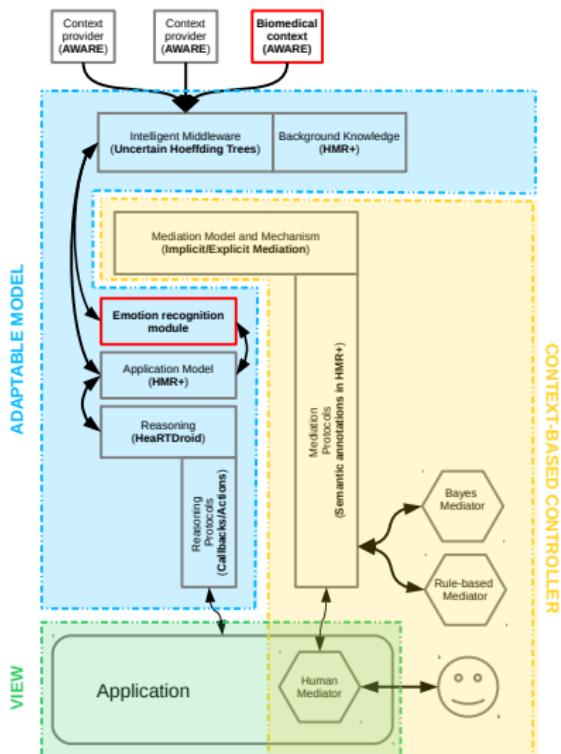
MID-SUMMARY

Signal acquisition ⇒
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(They are only tools, not the ultimate goal!)

ONE STEP BACK...



Goal:

- A universal framework as a basis for interaction design in intelligent systems

Tasks:

- to determine what a **particular user** feels
- to determine the reliability of this prediction
- to pass the information on to the intelligent system (to close the feedback loop)

To determine what **a particular user** feels

Why don't emotion prediction models work well "in the wild"?

- ▶ Trained on medical/research class devices
- ▶ Trained without contextual information
- ▶ Designed as **general models for everyone**

But, we need (a really big) data for personalised models...

To determine what **a particular user** feels

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But, we need (a really big) data for personalised models...

"BIG FIVE" PERSONALITY TRAITS



We want to know something about this particular user

- ▶ "Big Five" factors of personality as a base
- ▶ Personality assessment **is also a context**

BIRAFFE1

BIRAFFE: Bio-Reactions and Faces for Emotion-based Personalization

- ▶ 206 participants (31% female)
- ▶ Two parts:
 - ▶ “Classical” experiment (stimulus-reaction; affective pictures and sounds)
 - ▶ Games session
- ▶ “Big Five” personality traits (NEO-FFI questionnaire)
- ▶ approx. 60 minutes of physiological recordings (ECG, EDA, face images)

BIRAFFE2

[1] K. Kult et al., "The BIRAFFE2 Experiment – Study in Bio-Reactions and Faces for Emotion-based Personalization for AI Systems," arXiv:2007.15048
[2] K. Kult, L. Žuchowska, S. Bobek, and G. J. Nálepka, "People in the Context – an Analysis of Game-based Experimental Protocol," in MRC@IJCAI 2021

BIRAFFE2: the 2nd Study in Bio-Reactions and Faces for Emotion-based Personalization for AI Systems

- ▶ 103 participants (33% female)
- ▶ Two parts:
 - ▶ “Classical” experiment (stimulus-reaction; affective pictures and sounds)
 - ▶ Games session
- ▶ “Big Five” personality traits (NEO-FFI questionnaire)
- ▶ **Logs and GEQ (Game Experience Questionnaire)**
- ▶ approx. 60 minutes of physiological recordings (ECG, EDA, **gyroscope**, face images)

BIRAFFE1 AND BIRAFFE2

AVAILABLE UNDER CC LICENCE AT ZENODO

The screenshot shows a web browser displaying a Zenodo dataset page. The URL in the address bar is <https://zenodo.org/record/3865859>. The page has a blue header with the Zenodo logo. Below the header, the date "June 1, 2020" is shown, along with "Dataset" and "Open Access" buttons. The main title of the dataset is "BIRAFFE2: The 2nd Study in Bio-Reactions and Faces for Emotion-based Personalization for AI Systems". Below the title, there is a list of contributors under "Data collector(s)", "Editor(s)", and "Researcher(s)".

BIRAFFE2: The 2nd Study in Bio-Reactions and Faces for Emotion-based Personalization for AI Systems

Data collector(s)

Drażyk, Dominika; Kutt, Krzysztof; Bobek, Szymon; Nalepa, Grzegorz J.

Editor(s)

Drażyk, Dominika; Kutt, Krzysztof; Szelązek, Maciej; Żuchowska, Laura

Researcher(s)

Kutt, Krzysztof; Drażyk, Dominika; Bobek, Szymon; Nalepa, Grzegorz J.

- DOI: [10.5281/zenodo.3865859](https://doi.org/10.5281/zenodo.3865859)
- <https://afcai.re/pub:biraffe>

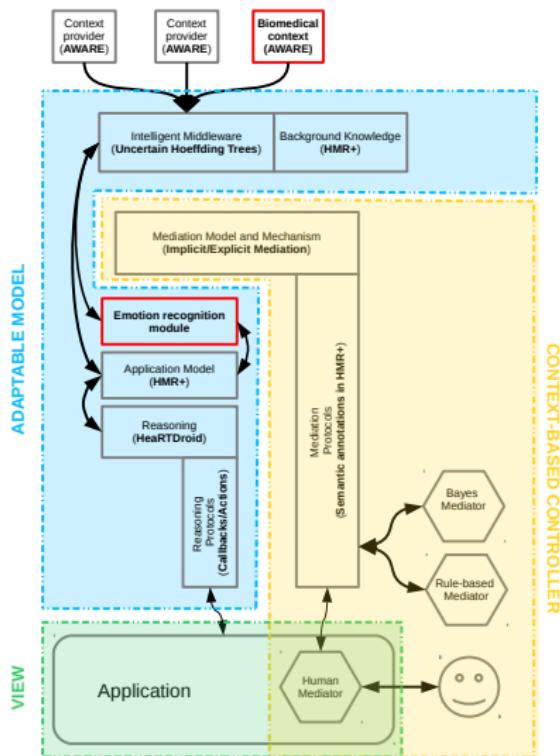
ADAPTATION AND PERSONALISATION



- ▶ Start by determining the user's personality
- ▶ Select one of pre-trained models for personality profiles
- ▶ The system is **pre-adapted** to the user
- ▶ Then get the data for more specific **personalisation**
- ▶ Federated learning?



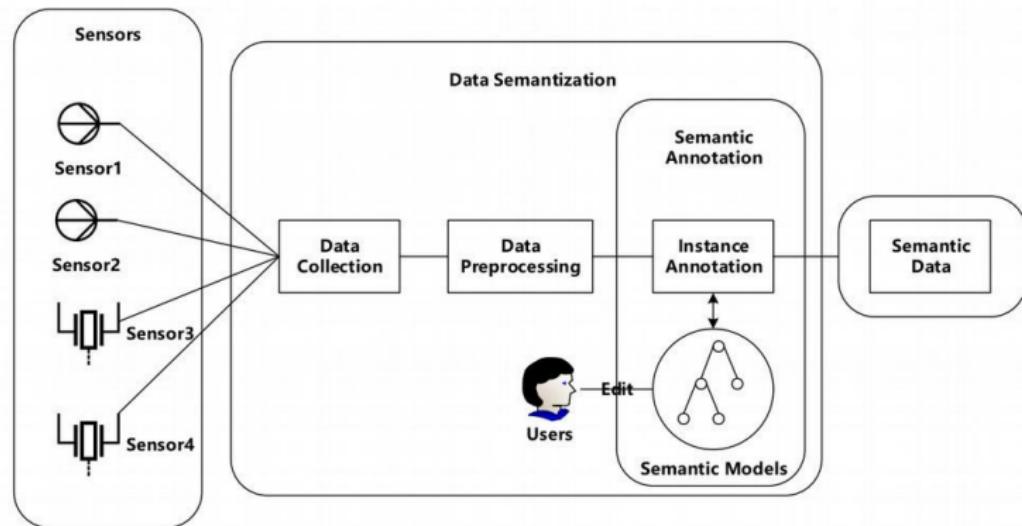
AfCAI FRAMEWORK IMPLEMENTATION



- ▶ Big Five-based pre-trained emotion recognition models
- ▶ Sensor fusion methods
- ▶ Emotion mediation methods (how to ask user if we do not know what s/he feels)

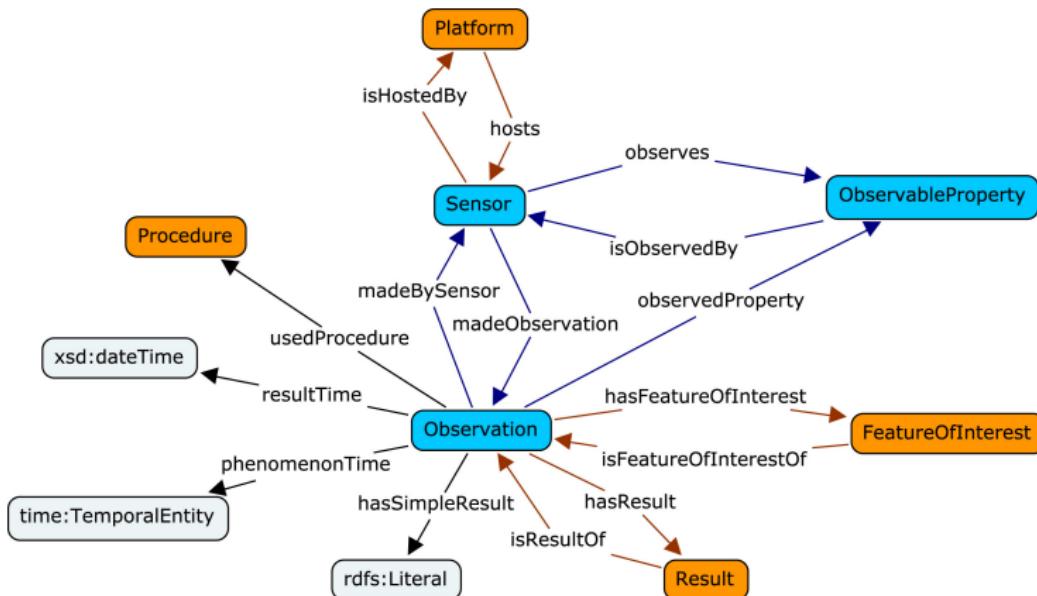
SENSORY AND EMOTION DATA SEMANTIZATION

A UNIVERSAL FRAMEWORK SHOULD HAVE IT



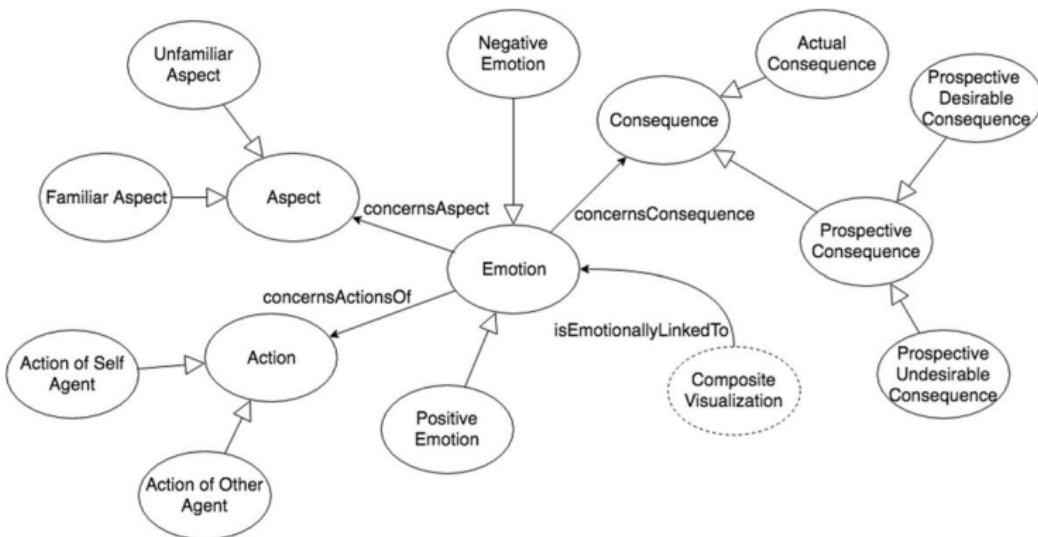
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A UNIVERSAL FRAMEWORK SHOULD HAVE IT



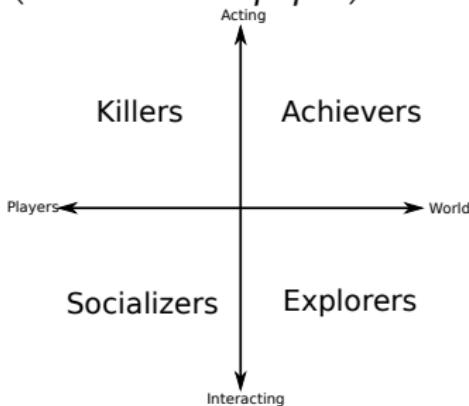
SENSORY AND EMOTION DATA SEMANTIZATION

A UNIVERSAL FRAMEWORK SHOULD HAVE IT



LOOKING BEYOND THE BIG FIVE...

- Bartle's taxonomy of player types for **BIRAFFE3**
(see the linked paper)



- Personality computing (mostly alternatives to psychological Big Five questionnaires)
- Dynamics of personality approach in psychology
- Non-personality related characteristics?

OTHER USE CASES?



[Source of an image]

SUMMARY

Ultimate goal:

- ▶ A universal framework for personalized intelligent assistants development
- ▶ Use of affective, contextual and subject-related information

How?

- ▶ BIRAFFE series of experiments
- ▶ Adaptation and personalisation instead of general models
- ▶ Use of games as a context-rich experimental environment

What's next?

- ▶ AfCAI framework implementation
- ▶ Sensory and emotion data semantization
- ▶ Human characteristics beyond Big Five
- ▶ Other use cases, e.g., in e-learning
- ▶ BIRAFFE3 experiment (in a few months)

Recommended papers:

- ▶ Personalisation and adaptation:
K. Kutt et al., "Personality-Based Affective Adaptation Methods for Intelligent Systems," Sensors, 21(1), p. 163, 2021
- ▶ Pre-BIRAFFE era summary:
G. J. Nalepa et al., "Analysis and Use of the Emotional Context with Wearable Devices for Games and Intelligent Assistants," Sensors, 19(11), p. 2509, 2019

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<https://krzysztof.kutt.pl/>
<https://afcai.re/>
<https://geist.re/>

*This presentation is available at
afcai.re/aira2021pres.pdf*