Brain Robot Interface for Assessing the Emotions of Children with Special Educational Needs

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Talk Outline

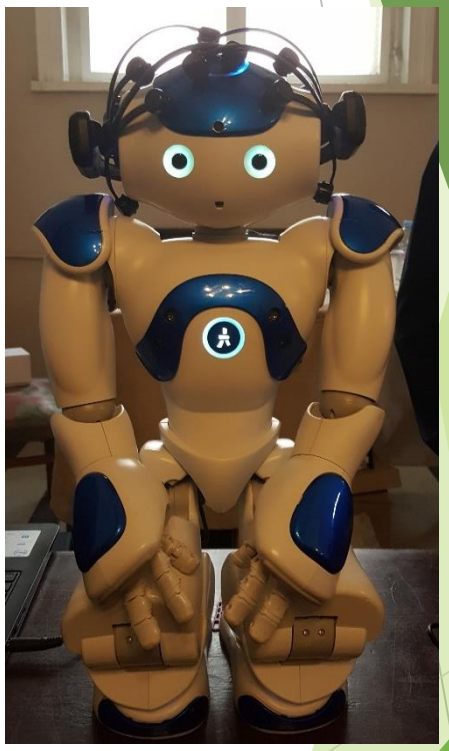
- Conclusions from previous studies - METEMS project
- Main idea - delivering physiological information in the loop of Cyber Physical Systems for pedagogical rehabilitation in special education
- Ongoing research in EEG based BCI for robot control and assessment of child socio-emotional states
- EMOTIV-NAO software framework
- New acquisition protocol and analysis of EEG data during eye blinking
- EMOTIV-BigFoot software framework
- Conclusions

Conclusions from previous studies - METEMSS Project

https://www.youtube.com/watch?v=qAI4cb6TWRI

Conclusions from previous studies - METEMSS Project (2)

- Children are attracted by robots spontaneously and this facilitates the assessment process by high-tech technologies of the work of teachers
- Nonverbal means - muscle patterns (EMG), brain patterns (EEG) and eye or hand motions
- New modalities in HRI - eye gaze, virtual touch, brain electrical potentials/oscillations and face recognition



ASSISTIVE TECHNOLOGIES

Conclusions from METEMSS Project (3)

Video observations helps to assess children satisfaction, listening, understanding of the verbal language and speaking skills.

Keep using MS Kinect v2 as an entertaining technology for children with SEN and for external sensor data for understanding child behavior based on body postures over time

Conclusions from METEMSS (4) – children with different profiles but special needs in common

- ✓ avoid eye contact, speech and language disorders, not asking questions, attention deficit, hyperactive

- ✓ New play like activities for training of listening, understanding and speaking through learning skills for orientation in space, shapes, colours and emotions (integration of BCI and a programmable robot).

Ongoing research

- Ideas:

- Enhance the child immersion and keep attention emotionally - extend the interaction with the robots by transmission of feelings, thoughts, intentions and emotions just for controlling robot scenarios or neurofeedback self-regularity training

- Assist special educators in assessment of socio-emotional states by Brain-Computer Interfaces (BCI) and computer vision-based 3D external observations of motions

- Solutions:

Innovative integration of EEG based BCI and programmable robots:

- New series of tasks and scenarios developed and deployed on humanoid robot NAO for training of listening, understanding and speaking in playful learning environment for orientation in space, shapes, colours and emotions

- New brain-robot game for "playing through emotions" for orientation in experiencing simple emotions by imitations

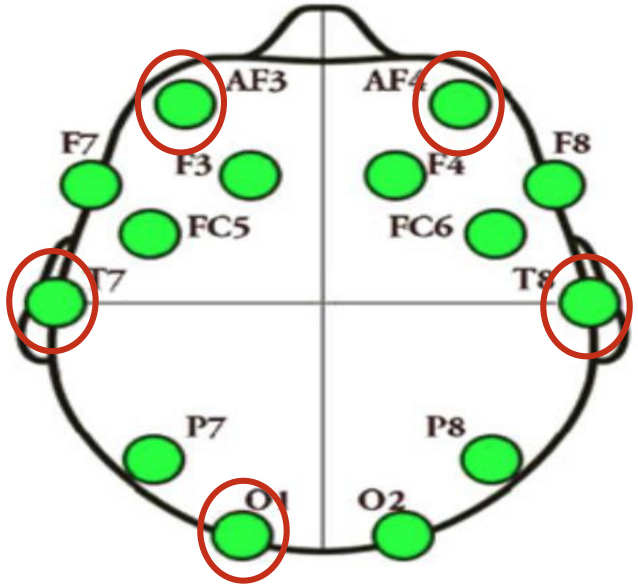
- Building an Emotiv-NAO/BigFoot/EmoSan software framework to translate brain signals into robot commands;

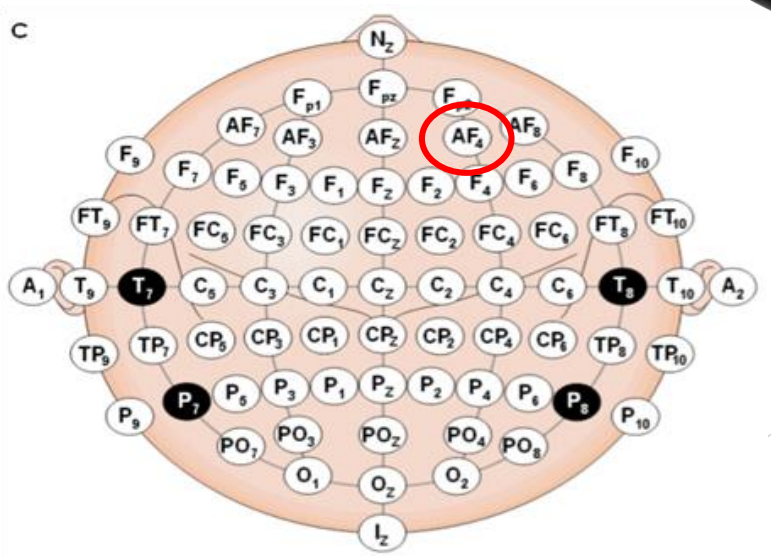
- New acquisition protocols to extract brain activity during eye blinking

EMOTIV EEG headsets

EEG-based BCI listens, records and transmits in real time the electrical activity of the brain

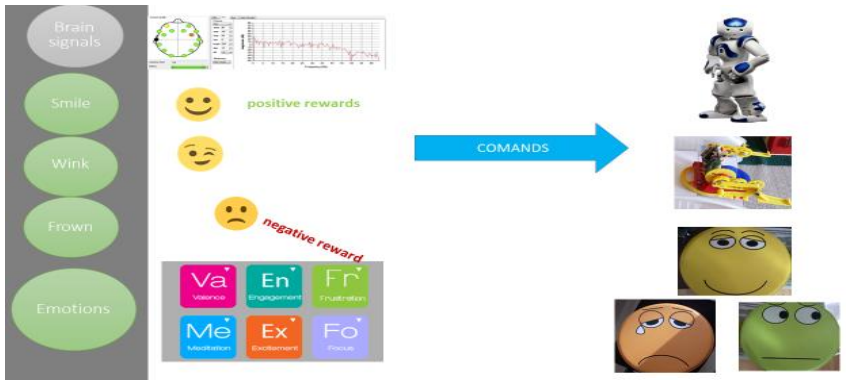
Emotiv Insight – 5 semi-dry polymer electrodes

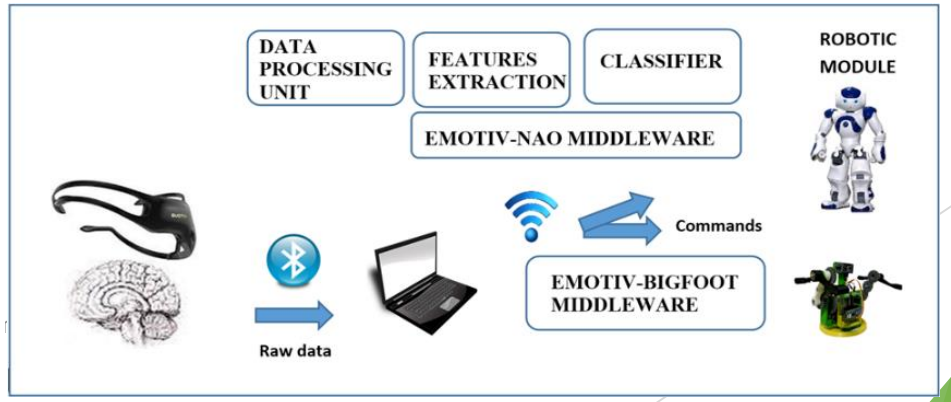




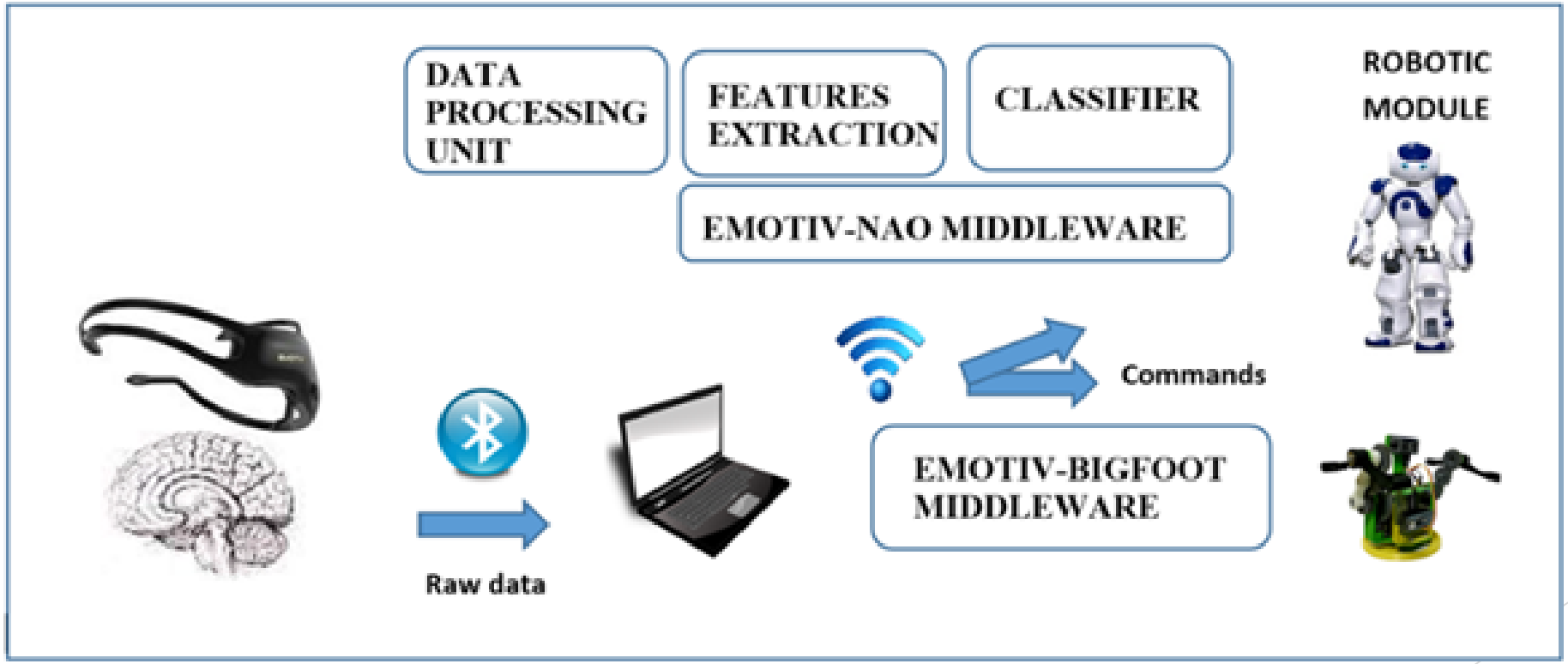
Innovative integration of EEG based BCI and programmable robot

- To assists therapists in eye-tracking and storing emotions experienced by the child
- Neurofeedback self-regulatory training of attention, stress, excitement, boredom
- Using of Emotiv software: emotional and sub-conscious dimensions in real time - 6 different output scores - to robot commands
- Assisting the recognition of possible cognitive failures to alert the special educators accordingly
- Assessing effectiveness of pedagogical rehabilitation. Measuring the pleasure in play

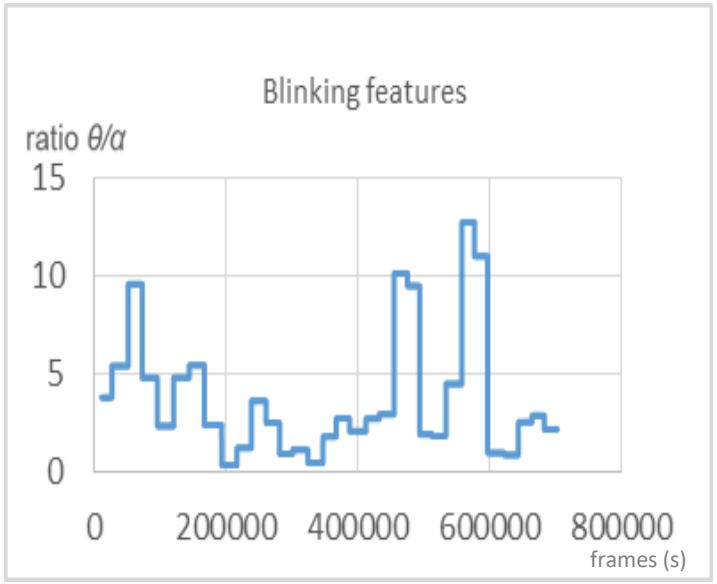


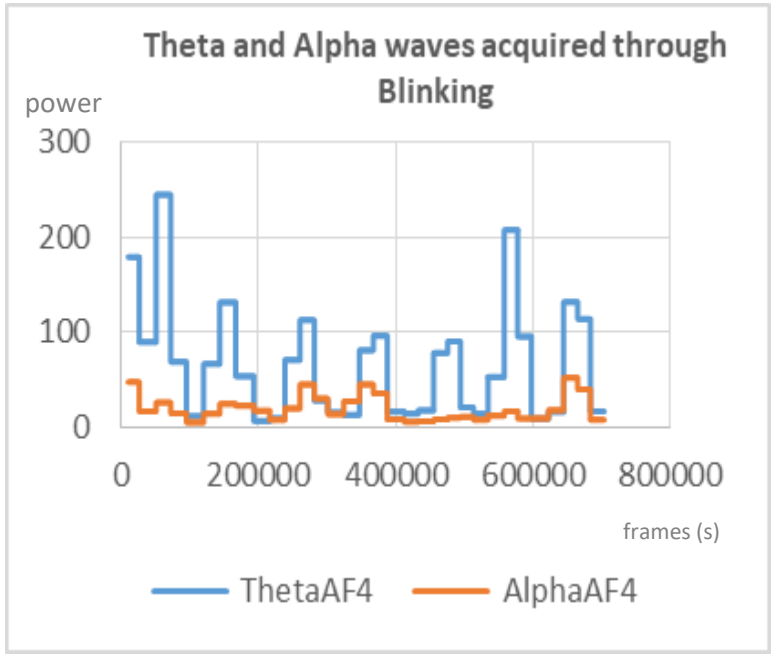


BCI-Robot software framework for neurofeedback control or assessment



New acquisition protocols to extract brain activity during eye blinking (right hemisphere)

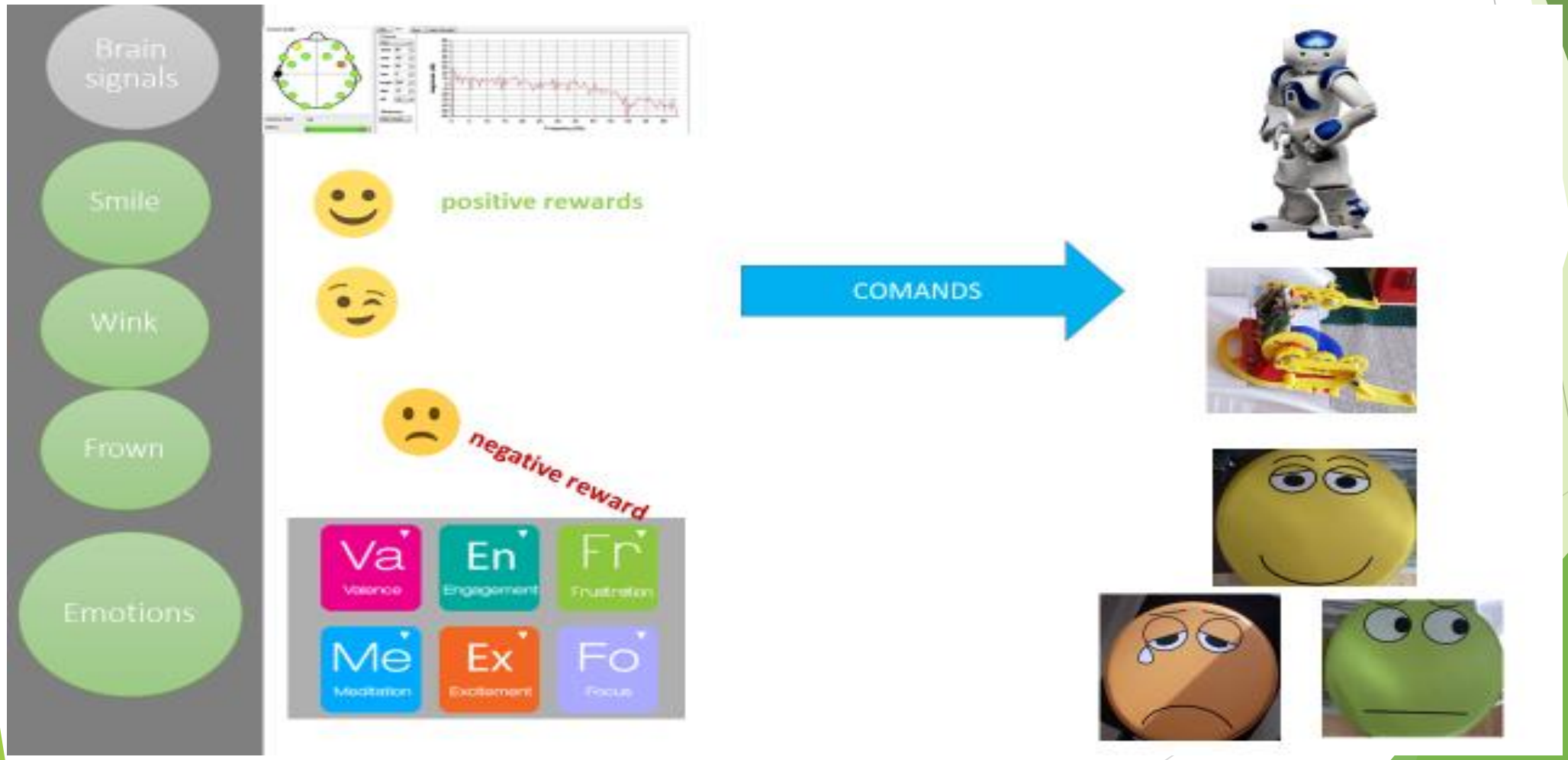




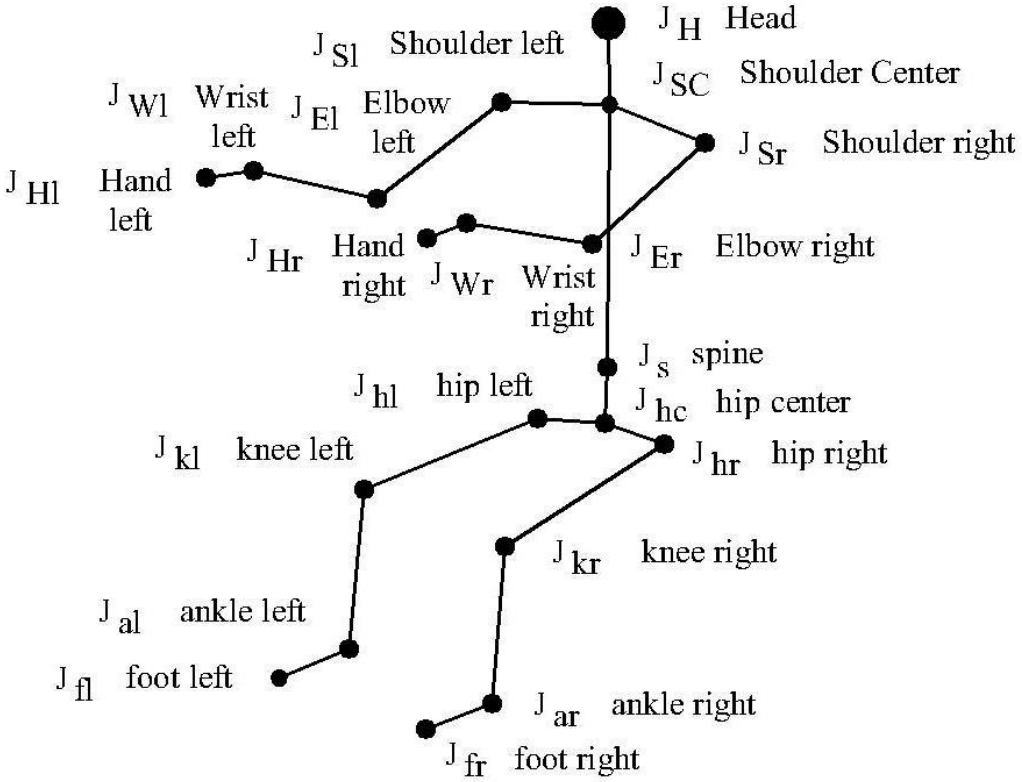
Blinking features - ratio θ_{AF4}/a_{AF4}

Theta and Alpha waves acquired through the channel AF4

Brain-robot game for learning skills by imitation to help the child to become more emotionally engaged with the social world



To make the assessment more consistent - monitoring children socio-emotional states by external vision-based 3D observation over time



- **Depth, RGB, audio - raw data**
- **Microsoft Kinect SDK skeleton data**
- **Free Applications**
- **Cost-effective**

Conclusions

- Practitioners and special educators need assistive technologies when working with children with SEN not only for skills enhancement but to assess the socio-emotional states of the child during the pedagogical rehabilitation in playful environment
- The potential of the BCI-ROBOT frameworks to help children with SEN to learn through play by neurofeedback self-regulatory training where focus and attention levels are inputs in the play.
- Ethical and philosophical issues should be followed when we use the neurofeedback in-the-loop of CPS and put physiologically the human individuality at the center for personalization the interfaces to digital devices
- Using modern technologies in play like BCI and robotic systems, children with SEN will feel confident and will be prepared for the future life

Questions and Remarks?

THANK YOU!