BCI-driven robot: A pilot project

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P300-BASED BCI CARACTERISTICS:

- 4 stimuli (flashing arrows in a random sequence)
- one cursor (ball)
- one target (red cross or symbol)
- Inter-Stimuli Interval equal to 2.5s or 2s
- on-line implementation
- single trial P300 wave detection

Reported four arrows paradigm (alias P1, Clin. Neurophysiol. 2006; 117(3): 531–537)

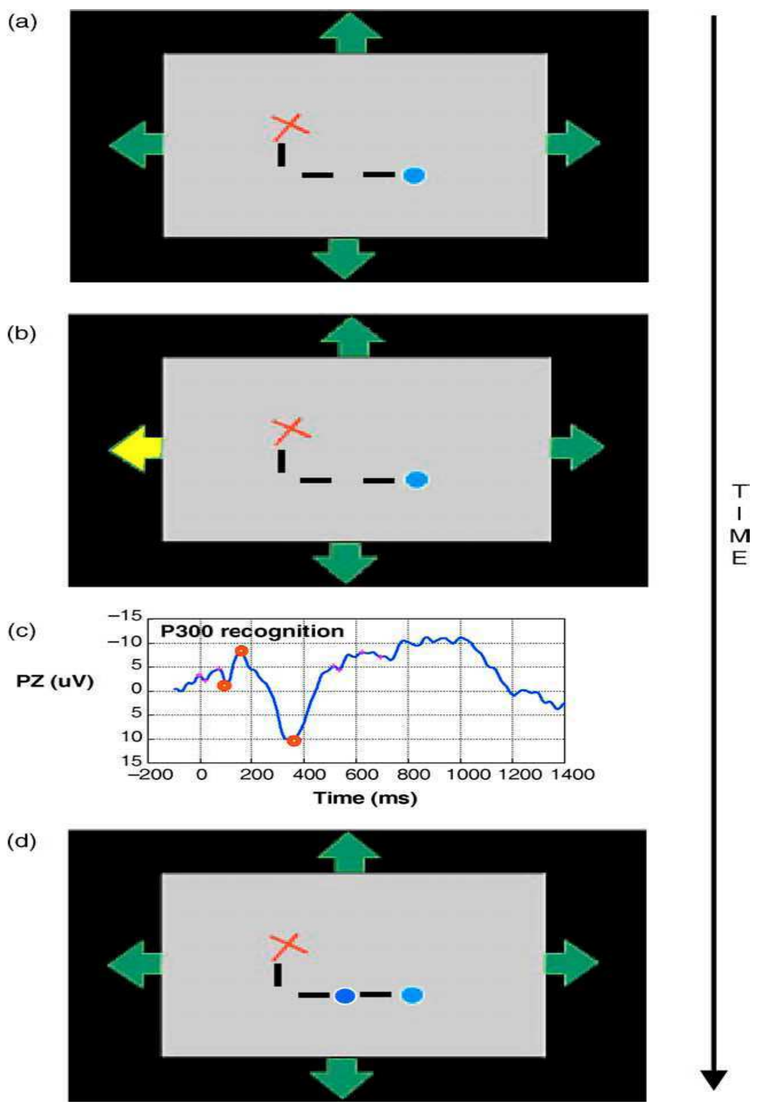


Fig. 1: Representation of a trial. (a) The virtual object (blue ball in the starting-point), the required path (hatched-line, not visualized during the experiment), and the goal-point (red cross); (b) yellow flashed arrow (i.e. target) indicating the required direction of the movement of the ball towards the goal-point; (c) the P300 is elicited by the target stimulus and is recognised by the system; (d) movement of the ball following P300 recognition.

Real-time classification system

Description	Measure unit	Healthy		Paralised		All	
		Mean	STD	Mean	STD	Mean	STD
Performance	%	76.2	4.4	68.6	8.9	73.1	7.4
Transfer bit rate	bit/min	7.59	1.47	7.77	2.98	7.67	2.1
Percentage of sessions successfully completed	%	71.6	14.5	51.9	28.9	63.4	22.8
Number of trials before first successful session	-	301	96	351	219	322	152

OBJECTIVES

PLANNING OF A PROJECT INTEGRATING P300-BASED BCI AND A ROBOT

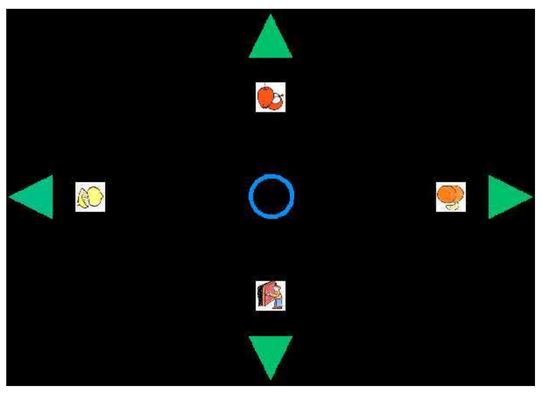
- inter-disciplinary context project development (neuroscientists, psychologists, and engineers)
- interface the P300-based BCI system with the robot
- allow paralysed patients to communicate high-level commands to the robot in a house-like environment

METHODS

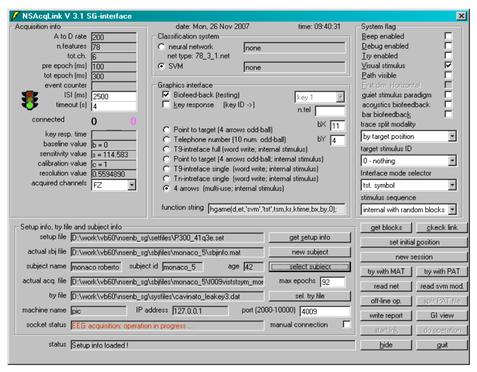
ELEMENTS TO BE INTEGRATED

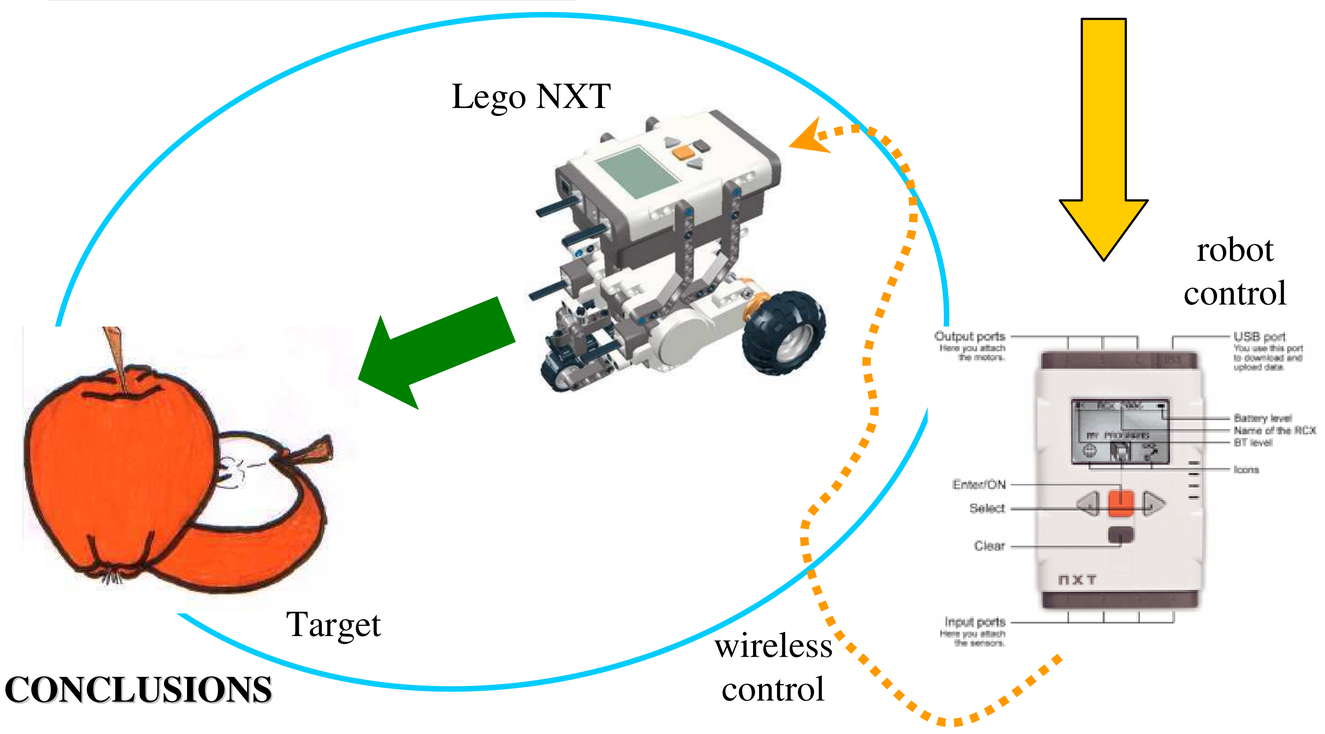
- a graphical interface to allow participants to interact with the whole system
- a P300-based BCI system that allows the participant to take choices
- a robot which acts based on the selected choice

graphical interface



P300-based BCI system





CONCLUSIONS

This project addresses the combination of BCI techniques, human cognitive factors, and robotic technology to improve the patient's social interaction and autonomy.

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