

# Controlling a Virtual Smart Home by Means of a P300 Brain-Computer Interface

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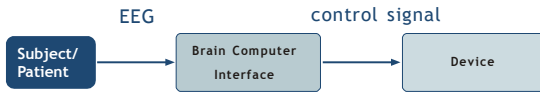
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## BRAIN COMPUTER INTERFACE



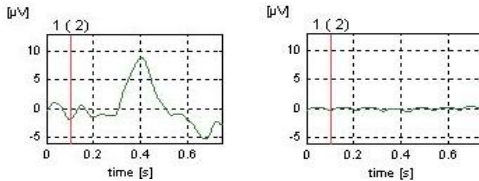
"A system for **controlling a device** e.g. computer, wheelchair or a neuroprosthesis by human intention which does not depend on the brain's normal output pathways of peripheral nerves and muscles"

**HCI** – Human Computer Interface

**DBI** – Direct Brain Interface (Univ. of Michigan)

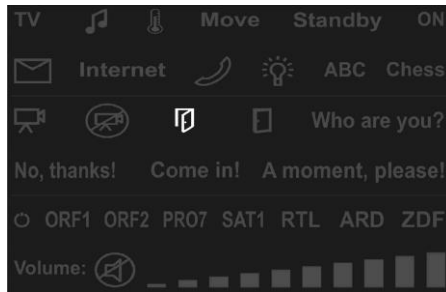
**TTD** – Thought Translation Device (Univ. of Tübingen)

## PHYSIOLOGICAL BACKGROUND



Specific symbols are presented on a computer screen. The symbols are highlighted in a random order and the subject has the task to concentrate on a specific symbol. Whenever this specific symbol is highlighted, the P300 component is produced in the EEG data and can be analyzed.

## BRAIN COMPUTER INTERFACE



The flashing control symbols for the smart home are arranged in different masks.

## RESULTS

Mask	Light	Music	Phone	Temp	TV	Move	GoTo
# Icons	25	50	30	38	40	13	22
Task 1	91,67%	100,00%	66,67%	91,67%	75,00%	91,67%	41,67%
Task 2	83,33%	91,67%	83,33%	83,33%	83,33%	83,33%	33,33%
Task 3	75,00%	83,33%		91,67%	83,33%	75,00%	
Task 4	66,67%	83,33%		83,33%			
Task 5		83,33%					
Total	79,17%	88,33%	75,00%	87,50%	80,56%	83,33%	37,50%

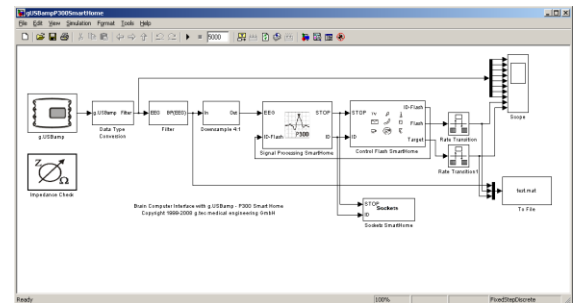
The table above shows the results of 12 participants for all control masks.

## REFERENCES

Zhang H., Guan C., Wang C., "A Statistical Model of Brain Signals with Application to Brain-Computer Interface". Proceedings of the 2005 IEEE on Engineering in Medicine and Biology 27th Annual Conference: 5388 – 5391.

Krusienski D., Sellers E., Cabestaing F., Bayouth S., McFarland D., Vaughan M., Wolpaw J., "A comparison of classification techniques for the P300 Speller". Journal of Neural Engineering 2006;6:299-305.

## REAL-TIME MEASUREMENT



The Simulink model analyzes the measured EEG data in real-time and sends the commands to the VR application.

## SMART HOME



A smart home is a house where devices can be controlled by a computer.

## DISCUSSION

Because of the low accuracy for the Goto mask it was investigated in detail. The results showed, that its accuracy mainly depends on the background image. A large image containing thin lines led to a bad accuracy, whereas a smaller image with bolder lines did not affect the results.

## CONCLUSION

A P300 BCI is a useful and reliable system to control smart home applications with high accuracy, if the user has enough experience and training. Such a system can serve as cheap environment to ease the life of handicapped people.