



Project 8 : Audiovisual Content Generation Controlled by Physiological Signals for Clinical and Artistic Applications



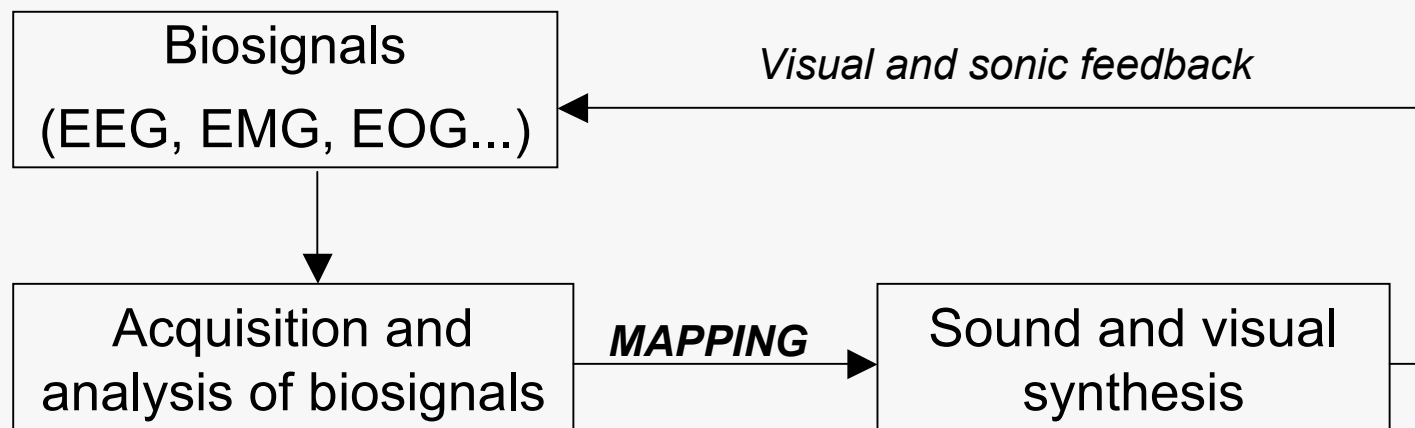
Opening Day - Project 8

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Introduction

- Project initiated during eNTERFACE'05 and '06 workshops
- Purpose: using physiological signals to control real-time sound and visual synthesis processes.



Objectives of the project

- Provide a flexible framework for the design of physiologically-controlled multimedia interfaces

- Develop a number of demonstrative prototypes :
 1. Sonification of bio-signals (clinical apps)
 - Transcription of physiological activity into sound/image
 2. Brain Computer Musical Interfaces (BCMI)
 - Musical instrument controlled by brain waves
 3. Bio-augmented Hyper instruments
 - Bio-controlled artistic performance

Towards a flexible open-oriented framework for Bio-Music

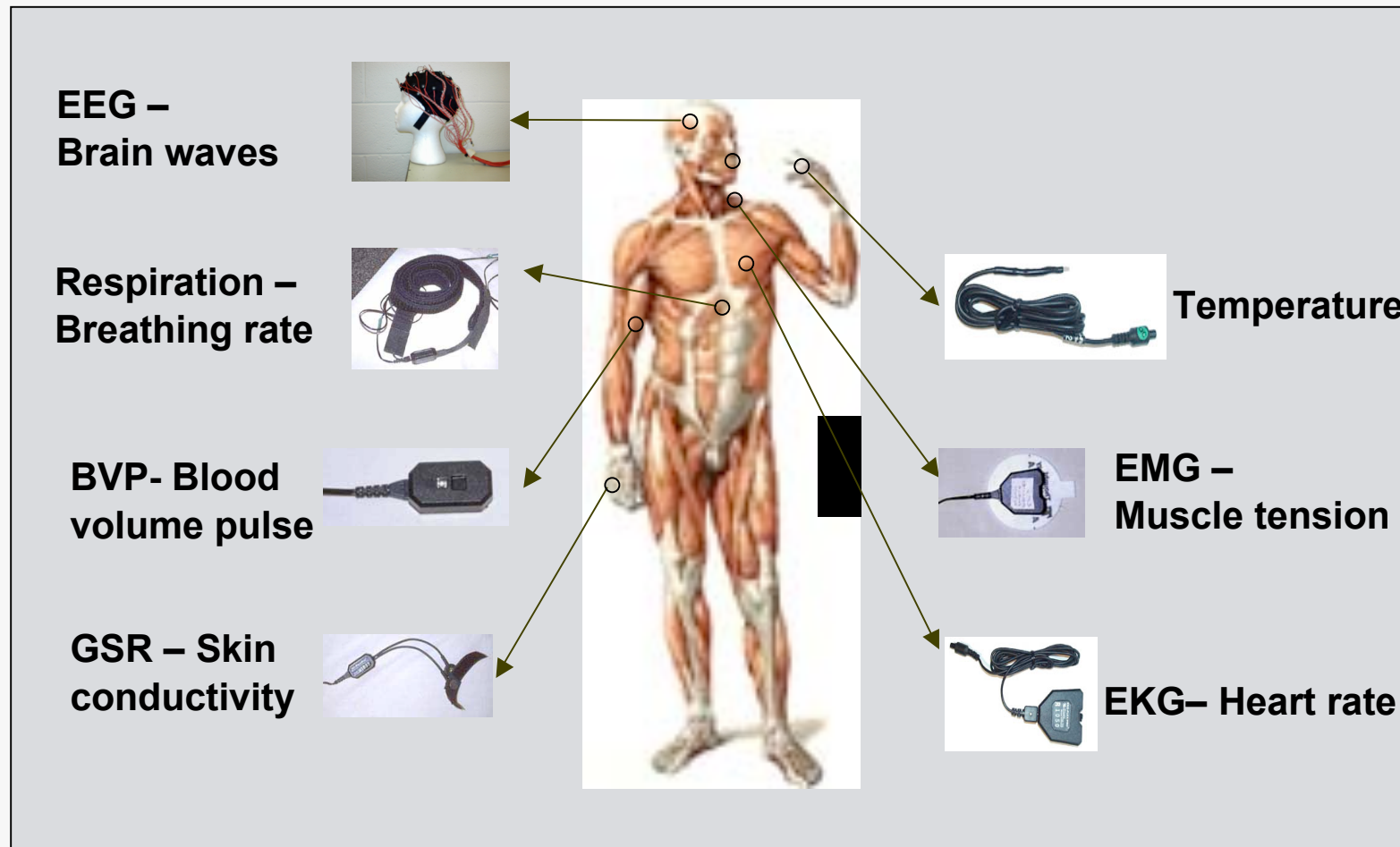
eNTERFACE '07

The SIMILAR NoE
Summer Workshop
on Multimodal Interfaces



- Full set of biosignals considered
- Large range of hardware units tested and integrated
- Software
 - Biosignal analysis: Matlab
 - Communication protocol : Open Sound Control (OSC)
 - Sound/visual synthesis : Pure Data, Processing, Max/MSP-Jitter, Csound...

Bio-signals acquisition





1. Sonification of bio-signals

- Sonification : use of non speech audio to convey information

- Sonification of bio-signals : Providing an auditory display of physiological activity
 - Online sonification
 - data monitoring
 - bio-feedback
 - Offline sonification (datasets)
 - Data exploration differential diagnosis of EEG pathologies (offline)
 - Rapid data scanning

- Enhanced with visual feedback

2. Brain Computer Interfaces

- A Brain Computer Interface (BCI) is a communication system based on direct measures of brain activity (EEG) rather than physical movement.
 - **Training is needed !!**

- EEG Analysis in BCI
 - Frequency band analysis (alpha, beta, theta etc...)
 - Alpha band (8-14 Hz) = relaxation and closed eyes
 - Theta band (4-8 Hz) = sleep, meditation, hypnosis
 - Beta band (higher frequencies) = alertness
 - Spectral features extraction (spectral entropy, spectral edge)
 - ERP (event detection)
 - ...

2. Brain Computer Musical Interfaces

- Mapping EEG salient features with sound synthesis parameters
 - Musical instrument controlled by brain waves
- Ex: BCMI-piano (Miranda & Brouse 2005)
 - Generative Musical Composition (MIDI piano) <-> energy in EEG different frequency bands
 - Tempo <-> complexity of EEG signal (spectral entropy)
- Our objectives:
 - Improve the mapping EEG <-> synthesis parameters
 - Offer a better control of the instrument (EEG analysis methods)
 - Enhanced with visual feedback



3. Bio-controlled Hyper Instruments

- Artistic performance driven by the emotional/physiological state of the performer
 - Not only EEG signals
 - Map all the physiological data to synthesis parameters
 - Performer doesn't control everything

- **Affective HCI** approach
 - ***Affective Computing** is computing that relates to, arises from, or deliberately influences emotion or other affective phenomena.*

- Validation ?
 - Evaluation of the system



Composition of the team

- **Andrew Brouse**, University of Plymouth (UK) - UCL (Belgium)
- **Mitchel Benovoy**, McGill University (Canada)
- **Thomas Greg Corcoran** (UK)
- **Hannah Drayson**, University of Plymouth (UK)
- **Cumhur Erkut**, University of Art and Design Helsinki (Finland)
- **Jean-Julien Filatriau**, Université catholique de Louvain (Belgium)
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- **Koray Tahiroglu**, University of Art and Design Helsinki (Finland)

References



- *“A real time music synthesis environment driven with biological signals”*, Arslan & al., ICASSP 2006.
- *“Brain–computer interfaces for communication and control”*, Wolpaw & al., Clinical Neurophysiology, 2002.
- *“Toward direct Brain-Computer musical interface”*, Miranda & Brouse, NIME 2005.
- *“Musical Performance Practice on Sensor-based Instruments”*, Tanaka, IRCAM 2000.
- *“Sonification for EEG data analysis”*, Hermann & al, ICAD 2002



Thanks for your attention !!

