Wearable systems for monitoring of emotions, mood and consciousness disorders

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Artificial Senses and Artificial Muscles  Tactile, kinesthesia and vision. Smart materials (gel, carbon nanotubes, conducting polymers)

Biofabrication  Development of several microfabrication techniques, including PAM (Pressure Assisted MicroSyringe), PAM2 (Piston Assisted Microsyringe), and SOFT-MI (soft molecular imprinting). Other methods in use are lithography, ink-jet, microlaser ablation and sintering and single-screw extrusion.

Affective Computing  Cross-disciplinary research domain on the design of systems that can recognize, interpret, and stimulate human emotions and related affective phenomena.

Wearable Monitoring Systems  Wearable technologies—such as sensor embedded garments for fashion and leisure, healthcare and emergency.

Human Machine Social-Emotional Interaction  Can a machine express emotions? How people feel during interaction with robots or machines able to socially act like human beings?
Special focus on

- **Emotions**
  - Entertainment, virtual reality, physiological response, man-machine interface, artificial devices

- **Mood disorders**
  - Psychiatric or mental disorders such as major depression, bipolar disorders, anxiety, social phobia, etc...

- **Consciousness disorders**
  - Patients in vegetative states or minimally consciousness state

**WEARable HAPTics for Humans and Robots**

**The Collective Experience of Empathic Data Systems**

**Personalised monitoring Systems for Care in mental Health**
Link between Emotions, Mood States, Consciousness and Autonomic Nervous System Dynamics

- Emotions
- Mood State
- Consciousness State

Signal Processing
Data-Mining
Statistics
Modeling

Psycho-Physiological State
Russell’s Circumplex Model of Affect

Two dimensions of affective states:
Valence (pleasure-displeasure)
Arousal (high-low)

Dimensional scores are derived from the rated intensity of four types of feelings

Positive-activated (PA), e.g., excited
Positive-deactivated (PD), e.g., calmness
Negative-deactivated (ND), e.g., bored
Negative-activated (NA), e.g., anxious, tense, stressed
Elicitating Emotions

IAPS - International Affective Pictures System
IADS - International Affective Digitalized Sounds

Proposed Procedure

P. Lang, M. Bradley, and B. Cuthbert, “International affective picture system 2005.”
What are DOC patients?

Patients suffering from Disorders Of Consciousness.

**Vegetative State**
- Complete absence of behavioral evidence for self or environmental awareness
- Patients can show autonomic activity
- Sleep-wake cycles could also be shown

**Minimally Conscious State**
One or more signs of knowledge about self or the environment

**Severe Disorders of Consciousness**
Lostness of several cognitive functions

Imaging (e.g. fMRI)

Neurobehavioral rating scales **LCFS(1:8)**

Electrophysiology (e.g. EEG, ANS signals etc.)

40% of Vegetative State Patients are Misdiagnosed

Major Depressive and Manic Episodes

**Manic-depressive disorder**

- Immoderate and unusual mood swing from extremely happy and energized (mania) to extremely sad (depression)
- Damages relationships & performance
- Can be life-threatening: often ends in suicide
- Chronic illness
- Most often diagnosed in adolescence

**Persistent feelings of:**

- Sadness - Anxiety - Guilt - Anger - Isolation - Hopelessness - Disturbances in sleep and appetite - Fatigue and loss of interest in sexual activity - Irritability - Lack of motivation - Morbid suicidal ideation

**Distinct period of:**

- Elevated, expansive, irritable mood state - Racing thoughts - Low attention span - Easily distracted - Impaired judgment - Spending sprees, unusual behavior - Substance abuse (esp. alcohol, stimulants) - Aggressive behavior - Increased sexual drive

http://www.thelensflare.com/large/depression_22319.jpg
Thoracic respiration
Abdominal respiration

Elbow articulation
Shoulder articulation

ECG (Einthoven’s triangle)
RA

Thoracic impedance

EMG triceps

Fabric Electrodes and Sensors

EMG biceps

ECG (Einthoven’s triangle) RA

Thoracic respiration

Precordial leads

Abdominal respiration

Wearable concept
Wearable system specifications

- Autonomy up to 15 hours
- Data storage up to 7 days
- Bluetooth communication (10 m)

Observed signals
- One ECG derivative
- Resistive gauge
- 3D accelerometer

On-body generic processing
- Heart rate, heart rate variability
- Breathing rate, breathing activity
- Activity level and classification, pace
PSYCHE personalised monitoring system
Thank You

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