Smartphone-based Biofeedback Breathing Training for Stress Management

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1. Problem

Biofeedback-based Breathing Trainings (BBTs) shows significant effect on health (WAN10, DIL16). State-of-the-art BBTs require dedicated (high cost) hardware and health professionals which represent a significant barrier for their widespread adoption. It has been shown that a smartphone microphone has the ability to record audio signals from exhalation in a quality of professional respiratory devices (LAR12).

2. Research Question

To which degree of accuracy can a mobile application detect respiratory acoustic patterns in quasi real-time with a smartphone’s microphone, thus capable of triggering adequate biofeedback?

3. Research Framework

Justification knowledge from physics and physiology (diaphragmatic breathing) is applied as respiration is the only autonomic function you have direct control over.

4. Method: Design & Learning

a. Data Collection: Feasibility Study + Lab Study (47 subjects)
b. Data Annotation: Human Perception + Respiratory Belt
c. Learning Algorithms: (0. Signal pre-processing)
   1. Feature Extraction: Energy / Spectrogram / MFCC
   2. Classification: RF / HMM / ANN / RNN
   3. Evaluation: Leave-One-Out / Confusion Matrix
d. Game-based Biofeedback Design: Game + Visual + Audio

5. Expected Results

- A smartphone’s acoustic sensor can obtain useful breathing signals which can be classified as inhale/exhale and chest/abdominal breathing.
- Evidence-based biofeedback can be generated based on the classification results.
- A positive effect of Smartphone-based Biofeedback can be observed through a designed intervention.

References


http://p3.snf.ch/Project-159289

www.c4dhi.org