Center for Digital Health Interventions
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Smartphone-based Biofeedback Breathing Training for Stress Management

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1. Problem

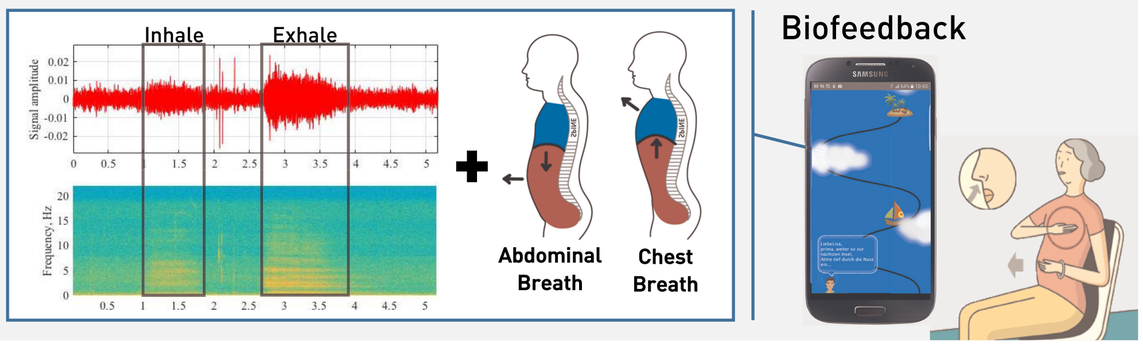
Biofeedback-based Breathing Trainings (BBTs) shows significant effect on health (WAN10, DIL16). State-of-the-art BBTs require dedicated (high cost) **hardware** and **health professionals** which represent a significant barrier for their widespread adoption. It has been shown that a **smartphone microphone** 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**?

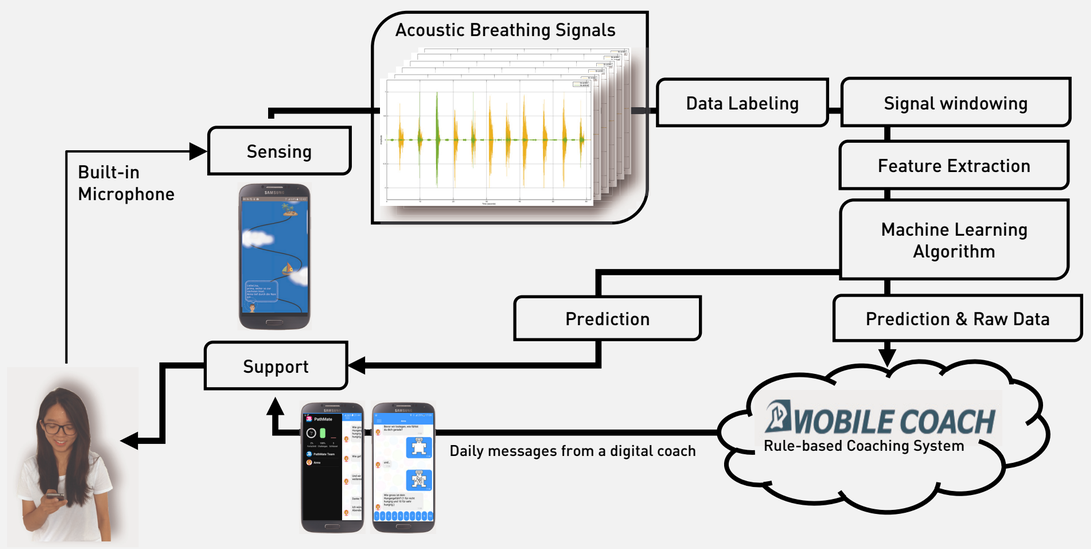
3. Research Framework

Justificatory 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.

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