Self-Learning Digital Health Interventions: How to Learn from Personal Data with an Application to Cough Monitoring

Author(s):
Barata, Filipe; Tinschert, Peter; Chiesa, Gabriella; Elser, Niklas; Kowatsch, Tobias (iD); Fleisch, Elgar (iD)

Center for **Digital Health Interventions** CSS Health Lab | Health IS Lab

ETHzürich

University of St.Gallen

CSS Insurance

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Filipe Barata[1], Peter Tinschert[2], Gabriella Chiesa[3], Niklas Elser[3], Tobias Kowatsch[2] & Elgar Fleisch[1,2]

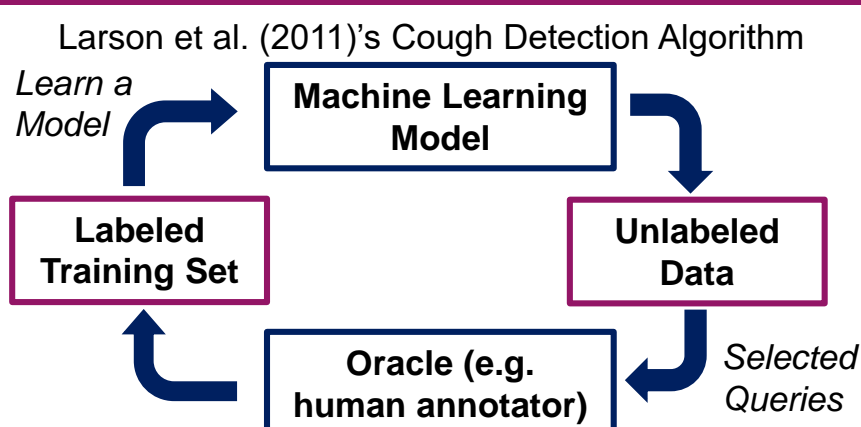[1]ETH Zurich, [2]University of St.Gallen, [3]CSS Insurance

1. Problem

Sensing applications, such as smartphone-based **cough monitor** systems, can objectively monitor disease symptoms. However, the general applicability of those systems lack the capability to tailor to the **personal** disease symptom fingerprint.
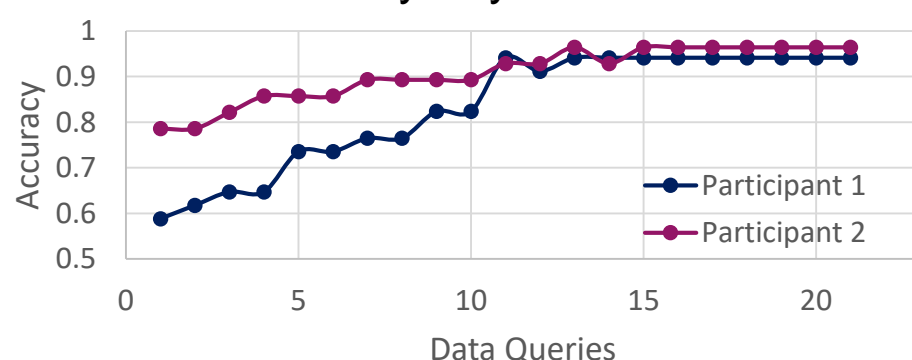
2. Research Question

Can we **improve** the individual specific **accuracy** of a general coughing detection model by continuously including **personal data** and employing **active learning**?

3. Research Framework

Larson et al. (2011)'s Cough Detection Algorithm

Learn a Model → **Machine Learning Model** → **Unlabeled Data** → *Selected Queries* → **Oracle (e.g. human annotator)** → **Labeled Training Set**

4. Method

Data acquisition included a population of 47 subjects (33 female, 14 male). Audio signals were **recorded** by means of five different devices and their built-in microphones:

- 2 Android phones and 1 iPhone
- Android tablet
- Studio microphone

The participant were instructed to **intentionally cough** and perform various **control sounds** (i.e. throat clearing, induced laughter and speech) while being recorded.

5. Results

Preliminary results include data from 8 participants. Evaluation of the initial coughing model yielded an accuracy of 84.2%. Active learning, however, further increased accuracy beyond 94 %.

References

Larson, E. C., Lee, T., Liu, S., Rosenfeld, M., & Patel, S. N. (2011). Accurate and privacy preserving cough sensing using a low-cost microphone. In *Proceedings of the 13th international conference on Ubiquitous computing* (pp. 375-384). ACM.

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