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Screening For Obstructive Sleep Apnea At Home Based On Deep Learning Features Derived From Respiration Sounds

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Abstract:
Introduction: Analysis of sleep breathing sounds has been employed to screen obstructive sleep apnea (OSA). However, most current methods rely on specialized equipment (e.g., tracheal microphones), require additional physiological data (e.g., oxygen saturation), are rule-based, or are trained on data collected in-lab, making them less suitable for home use. In this study, deep learning methods were leveraged to explore the hypothesis that sleep audio recordings collected via smartphones can be used alone to screen for OSA by exploiting the temporal pattern of respiration sounds.

Methods: Adult participants with suspected sleep-disordered breathing of varying degrees of severity were recruited from the general population and from GP referrals to sleep clinic. Audio recordings were collected via smartphones during home sleep apnea testing (HSAT). HSAT data were scored by a registered polysomnographic technologist in accordance with current international guidelines (AASM V2.5, 2018) and used as reference. To exploit acoustic respiration temporal pattern, time interval histograms were computed for sequences of audio-words that were automatically learned from spectral features with a deep neural network. Means and standard deviations of the time intervals for each audio-word were employed by a Gaussian mixture model to classify 2-minute audio recording segments as either containing OSA events or not.

Results: Preliminary data from 4 valid nights' recordings obtained from 2 consented participants was analysed. 550 segments were used for training, with 180 segments used for evaluation. Audio recording demonstrated a sensitivity of 0.71 and specificity of 0.66 when compared with manually-scored HSAT.

Conclusion: Preliminary results suggest that an approach to OSA screening based on deep learning with inter-audio-word intervals to capture information about respiration temporal pattern may be a useful tool in diagnosis of OSA. Further model development is underway using data collected from up to 200 patients and full study data will be presented.

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