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Sleep Apnea Detection from Single-Lead ECG: A Comprehensive Analysis of Machine Learning and Deep Learning Algorithms

Aaryan Dhage[1], Shubham Bornare[2], Siddhi Karve[3], Siony Chaudhari[4], Prof. V. M. Dilpak[5]
Students, Department of Artificial Intelligence and Machine Learning[1,2,3,4]
Professor, Department of Artificial Intelligence and Machine Learning[5]
All India Shri Shivaji Memorial Society Polytechnic Pune, Maharashtra, India

Abstract: *Sleep apnea, a prevalent sleep breathing disorder, poses significant health risks, necessitating accurate detection for appropriate treatment. This study comprehensively analyzes machine learning and deep learning algorithms using the PhysioNet ECG Sleep Apnea v1.0.0 dataset. Electrocardiogram signals underwent preprocessing and segmentation before applying various algorithms for sleep apnea detection. Conventional machine learning methods such as linear and quadratic discriminate analyses, logistic regression, support-vector machines, and decision trees, along with deep learning techniques including convolutional and recurrent networks, were implemented and modified to suit biosignal processing tasks. The dataset was divided into training, validation, and test sets, with a fivefold cross-validation scheme ensuring robust evaluation. Hybrid deep models demonstrated superior performance, achieving an accuracy of 88.13%, sensitivity of 84.26%, and specificity of 92.27%. This study offers valuable insights into the efficacy of different machine learning and deep learningalgorithms for sleep apnea detection, with potential extensions to other sleep-related events. The developed algorithms are publicly available on GitHub.*

Keywords: Deep learning, detection, electrocardiogram (ECG), machine learning, sleep apnea

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