

Efficient Hybrid Electrocardiogram Arrhythmia Classification using Machine Learning and Deep Learning

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Abstract

There are various obstacles to detecting ECG arrhythmias using automated techniques due to the high level of imbalance among classes in which there are significantly more cases of normal heartbeats compared to abnormal heartbeats (imbalanced by over 25,000 times). The current study proposes a new hybrid deep learning algorithm for the diagnosis of ECG arrhythmia based on the re-conceptualization of the problem into a binary "Normal vs. Abnormal" classification, thus making the level of class imbalance 6.9 times. The proposed solution includes extracting 68 features from two-beat structures and applying meta-learning using a combination of gradient boosting ensembles and CNN models. This allows achieving accuracy of 99.63% and sensitivity of 99.57%, using 175,723 cases. The model is lightweight (0.49 million parameters) and may be used in real-time IoMT systems.

Keywords

ECG arrhythmia, hybrid deep learning, gradient boosting, CNN, binary classification, IoMT, class imbalance.