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Machine learning approach for sudden cardiac arrest prediction based on optimal heart rate variability features

Abstract

Sudden Cardiac Arrest (SCA) is a devastating heart abnormality which leads to millions of casualty per year. Thus, early detection or prediction of SCA could save the human lives in greater scale. This present work is aimed to predict SCA two minutes before its occurrence and significant results has been obtained using the proposed signal processing methodology. Two international standard databases namely, MIT/BIH Sudden Cardiac Death (SCD) Holter Database for SCA and Physiobank Normal Sinus Rhythm (NSR) for normal control data were used in this work. Initially, five minutes R-R interval of a subject which is two minutes before the onset of SCA was extracted from MIT/BIH database's annotation files for predicting the SCA. Then, Heart Rate Variability (HRV) signal was pre-processed for ectopic beats removal and detrending using mean and discrete wavelet transform (DWT) respectively. Pre-processed HRV was analysed in time, frequency and nonlinear domains to extract various features to efficiently predict SCA. Totally, 34 features (15 time domain, 13 frequency domains, and 6 nonlinear domains) were extracted from each HRV signal samples of normal and SCA subjects. Sequential Feature Selection (SFS) algorithm is used to select optimal features and seven features (2 time, 3 frequency and 2 nonlinear) among 34 features was chosen as a result. Finally, Support Vector Machine (SVM) and Probabilistic Neural Network (PNN) were used to predict the SCA and normal control cases. SVM and PNN give maximum mean SCA prediction rate of 96.36% and 93.64% respectively. Thus the present experimental results clearly indicates that, SVM classifier is more efficient in predicting SCA than PNN and mean classification rate reported in this work is higher compared to the earlier works on predicting SCA

Keywords

Analysis of Variance; Heart Rate Variability; Probabilistic Neural Network; Sequential Feature Selection; Sudden Cardiac Arrest; Support Vector Machine