Towards an Optimal Strategy to Predict Sudden Cardiac Death: The Role of Time Local Subset in Feature Selection

Elias Ebrahimzadeh, Ph.D. of Biomedical Engineering, School of Electrical and Computer Engineering, College of Engineering, University of Tehran, Tehran, Iran.

Abstract (300 word limit)

Statement of the Problem: Taking into consideration the critical importance of Sudden Cardiac Death (SCD), as it could be the first and the last heart condition to be diagnosed in a person while continuing to claim millions of lives around the world, prediction of sudden cardiac death has increasingly been regarded as a matter of substantive significance. The purpose of this study is not to once again define applicable and effective features to predict and detect SCD, as there already has been adequate discussion addressing feature extraction in our previous works and other recent studies. What seems to be lacking attention is the need for an appropriate strategy to manage the extracted features to such an extent that the best classification is presented. To this end, deploying a suitable tactic to select extracted features could bring about outstanding results compared to other works in this field. This research has accordingly applied a novel and automatic approach to Local Feature Subset Selection through the most rigorous methodologies, which have formerly been developed in previous works of this team, for extracting features from nonlinear, time-frequency and classical processes. We are therefore enabled to select features that differ from one another in each minute before the incident through the agency of optimal feature selection in each one-minute interval of the signal. Not only will this facilitate increasing the prediction time from 4 minutes to 12 with a high level of accuracy, but it also will provide us with an opportunity to interpret clinical signs considering the plurality of features in each minute. Additionally, through defining a Utility Function and employing statistical analysis the alarm threshold has been effectively determined as 83% for the predection accuracy. Having selected the best combination of features, based on the ability to generate the highest classification accuracy, the two classes are classified by means of the Multilayer Perceptron (MLP) classifier. Afterwards, the outcome of the obtained prediction would be analyzed and compared to other results. The most applicable and effective features would subsequently be presented according to the number of times they have been chosen in the rank-based selection. Finally, principal features in each time interval are discussed and the importance of each type of processing will be drawn into focus. The results indicate the significant capacity of the proposed method for predicting SCD as well as selecting the appropriate processing method any time before the incident.

Image

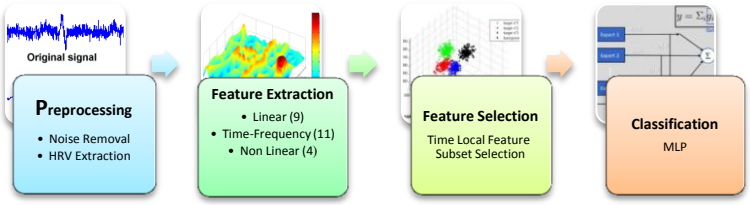


Fig. 1. Block diagram of the proposed approach for prediction of SCD

Recent Publications (minimum 5)

1 Voss A, Schroeder R, Heitmann A, Peters A, Perz S (2015) Short-Term Heart Rate Variability—Influence of Gender and Age in Healthy Subjects. PLoS ONE 10: e0118308.

2. Fujita H, Acharya UR, Sudarshan VK, Ghista DN, Sree SV, et al. (2016) Sudden cardiac death (SCD) prediction based on nonlinear heart rate variability features and SCD index. Applied Soft Computing 43: 510-519.

3. Ebrahimzadeh E, Alavi SM, Bijar A, Pakkhesal A (2013) A novel approach for detection of deception using Smoothed Pseudo Wigner-Ville Distribution (SPWVD). Journal of Biomedical Science and Engineering 6: 8.

4. Ebrahimzadeh E, Pooyan M, Jahani S, Bijar A, Setaredan SK (2015) ECG Signals noise removal: Selection and optimization of the best adaptive filtering algorithm Based on various algorithms. Biomedical Engineering: Applications, Basis and Communications 27: 1550038.

5. Acharya UR, Fujita H, Sudarshan VK, Ghista DN, Lim WJE, et al. Automated prediction of sudden cardiac death risk using Kolmogorov complexity and recurrence quantification analysis features extracted from HRV signals; 2015. IEEE. pp. 1110-1115.

6. Ebrahimzadeh E, Pooyan M (2011) Early detection of sudden cardiac death by using classical linear techniques and time-frequency methods on electrocardiogram signals. Journal of Biomedical Science and Engineering 4: 699.

7. Ebrahimzadeh E, Pooyan M (2013) Prediction of Sudden Cardiac Death (SCD) Using Time-Frequency Analysis of ECG Signals. Computational Intelligence in Electrical Engineering 3: 15-26.

8. Ebrahimzadeh E, Pooyan M, Bijar A (2014) A novel approach to predict sudden cardiac death (SCD) using nonlinear and time-frequency analyses from HRV signals. PloS one 9: e81896.



Elias Ebrahimzadeh was born in Tehran in 1984, obtained his mathematics and physics diploma under supervision of NODET (National Organization for Developing Exceptional Talent) in Tehran in 2003. He has received the B.Sc. Degree in Electronic Engineering in 2008, Tehran, and the M.Sc. Degree in Biomedical Engineering from Shahed University, Tehran, in 2011. He is currently Ph.D. student of Biomedical Engineering, at University of Tehran, Tehran, Iran. His research interest includes biomedical signal processing, Artificial Neural Network Statistical Pattern Recognition, System Identification, Bio Electromagnetic, Machine Learning and Image Processing. He has authored or co-authored more than 20 publications in international journals.

He has worked on A Novel approach to predict sudden cardiac death by Linear and Nonlinear methods from ECG and HRV Signals. Also he is improving and developing the effective methods in order to predict Sudden Cardiac Death(SCD).

Email: e_ebrahimzadeh@ut.ac.ir, elias.ebrahimzadeh@yahoo.com

Notes/Comments: