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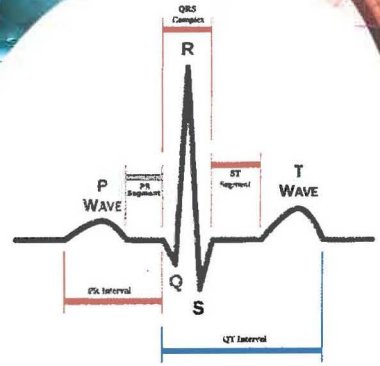
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SUDDEN CARDIAC ARREST (SCA) PREDICTION SYSTEM USING HEART RATE VARIABILITY (HRV) FEATURES AND MACHINE LEARNING ALGORITHMS

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PRODUCT DESCRIPTION

- This product is a composition of software (SCA prediction algorithm) and hardware (ECG data acquisition device).
- SCA prediction 5 minutes before its occurrence is realized by utilizing one minute of Heart Rate Variability (HRV) signal from green region as shown in Figure 1.

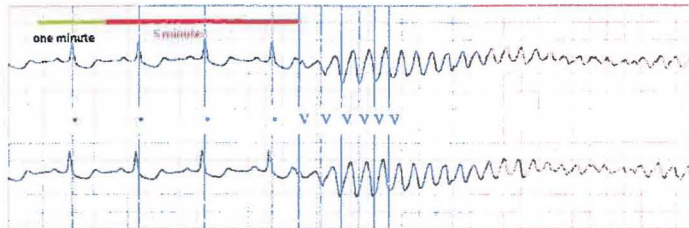


Figure 1 Data segmentation of SCA prediction

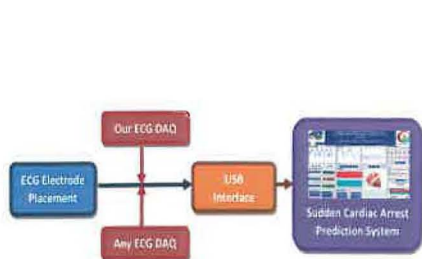


Fig 2: Proposed design of Sudden Cardiac Arrest (SCA) Prediction System



Fig 3: Flow of Sudden Cardiac Arrest (SCA) Prediction Algorithm

PROBLEM STATEMENT

Numerous lives can be saved if SCA can be predicted 5 minutes before the onset as it gives medical personnel some valuable time to prepare the necessities to administer the treatment.

- Current art of design methods are computationally inefficient (higher memory requirement and longer computational time)
- SCA prediction in a short period of time (3 min)
- Higher error rate on SCA detection through HRV signals

PRODUCT ADVANTAGES

- Computationally efficient (lesser computational time and memory)
- Higher SCA prediction rate compared to earlier works
- Lesser cost and most reliable system design
- Higher user friendly design

PUBLICATIONS

1. Sudden Cardiac Death Prediction using ECG Signal Derivative (Heart Rate Variability): A Review. IEEE Colloquium on Signal Processing and its Applications, Kuala Lumpur, 2012.
2. Machine Learning Approach for Sudden Cardiac Arrest (SCA) Prediction Based on Optimal Heart Rate Variability (HRV) Features. Journal of Medical Imaging and Health Informatics (JMIHI) (IF = 0.642) (Accepted)
3. Sudden Cardiac Arrest (SCA) Prediction Based on PCA Optimized Heart Rate Variability (HRV) Features. Biomedical Engineering: Applications, Basis and Communications (BEABC) (IF = 0.233) (Under Review)
4. Sudden Cardiac Arrest (SCA) Prediction Using Machine Learning Algorithms and PCA Optimized Features. Journal of Computational and Mathematical Methods in Medicine (IF = 0.791) (Under Review)

COMMERCIAL POTENTIAL

- Health care development – Hospitals/ Clinics/ Diagnostic centers
- Telemedicine – Remote health monitoring system development
- Highly useful for physicians/cardiologist to have closer monitoring of cardio risk patients
- Prediction of SCA risks of hospital in-patients

NOVELTIES

- Simple and efficient preprocessing algorithm development
- Detecting SCA before Five (5) minutes of SCA onset
- Uses lesser feature (3) to produces higher SCA prediction rate
- Cost-effective 3 lead ECG DAQ system
- An interactive graphical user interface and user-friendly system

Experimental Results:

Table 1: Results of Sudden Cardiac Arrest (SCA) Prediction Algorithm

Classifier	Group	Sen (%)	Spec (%)	PPV (%)	Prediction Accuracy (%)
Fuzzy Subtractive Clustering (FSC)	1	85.00	88.89	89.47	86.84
	2	42.10	80.00	52.63	47.06
Neuro-Fuzzy Classifier (NFC)	1	100.00	88.89	90.91	94.74
	2	100.00	80.00	52.63	52.63
Support Vector Machine (SVM)	1	100.00	88.89	90.91	94.74
	2	80.00	100.00	100.00	89.47

*Sen: Sensitivity * Spec: Specificity *PPV: Positive Predictive Value

Comparison of SCA Prediction Rate:

References	Duration of Signal	Number of Features	Sensitivity (%)	Specificity (%)	Average Accuracy (%)
T.W.Shen [2007]	2 minutes of HRV right up to onset of aVF	4	-	-	67.44
E.Ebrahimzadeh [2011]	2 minutes of HRV right up to onset of VF	15	-	-	91.23
E.Ebrahimzadeh [2014]	1 minute of HRV which is 4 minutes before the onset of VF	13	83.75	0.159	83.93
	1 minute of HRV which is 3 minutes before the onset of VF	13	89.64	0.089	90.36
Present Work	3 minutes of HRV which is 5 minutes before the onset of VF	3	100.00	88.89	94.74
	3 minutes of HRV which is 5 minutes before the onset of VF	3	100.00	88.89	94.74
	3 minutes of HRV which is 5 minutes before the onset of VF	3	85.00	88.89	86.84

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