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Review on "A SVM Adaptive Approach for Venticular Disease Classification"

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Abstract: ECG signal processing is the electric form of heat signal. It is analyzed to identify the various associated disease and disorder. There are number of classification methods to identify these disease. One of such critical disease form is ventricular disease identification. In this work, a feature adaptive classification approach is defined to identify the ventricular disease over the ECG signal. The presented work model is divided in three main stages. In first stage, the improvement to the ECG signal form will be done using dynamic thresholding approach. In this stage, the baseband effective thresholding will be applied to remove the signal noise. Once the improved signal form will be obtained, the next work is extract the signal features. In this work, HMM based statistical feature identification will be done. These features will be obtained for fixed segments. Based on this, the featured dataset will be composed. In final stage, SVM will be applied to perform the signal classification. The presented work will be implemented in mat lab environment. The work is here defined to improve the classification rate.

Keywords: ECG, SVM, HMM, NSR etc.

INTRODUCTION

The usual rhythm of the heart where there is no cardiac disease or disorder in the ECG signal is called Normal sinus rhythm (NSR). The heart rate of NSR is usually characterized by 60 to 100 beats/minute. The reliability of the R-R interval may change slightly with the breathing cycle. When the heart rate rises above 100 beats/minute, the rhythm is called sinus tachycardia. This is not an arrhythmia but a usual reaction of the heart which requires higher blood circulation. When the heart rate is very slow then this is called bradycardia and it can badly affect vital organs. If the heart rate is very fast, the ventricles are not wholly filled before contraction for which pumping efficiency decreases, adversely affecting perfusion.

- Sinus Node Arrhythmias
- Atrial Arrhythmias
    - ✓ Premature Atrial Contractions (PAC)
    - ✓ Atrial Tachycardia
    - ✓ Atrial Flutter
    - ✓ Atrial Fibrillation
- Junctional Arrhythmias
- Ventricular arrhythmias
    - ✓ Premature Ventricular Contractions (PVC)

Ventricular Tachycardia (VT)

Noise in Signal

Usually the ECG signal is often polluted by different kinds of noises and artifacts that may be inside the frequency band of ECG signal, which can alter the features of ECG signal. Therefore it is tough to take out useful information of the signal. The corruption of ECG signal is due to following noises.

- Power line interferences
- Baseline drift
- Motion artifacts
- Muscle contraction (EMG)

Signal Issues

P wave –

- the amplitude intensity of this voltage signal wave is low (approx. 1 Mv) and represent contraction and depolarization of the right and left atria .
- A clear p wave before the QRS complex stands for sinus rhythm.
- Absence of P waves may suggest atrial fibrillation, junctional rhythm or Ventricular rhythm.
- It is very tough to examine p waves with a high signal-to-noise ratio in ECG signal.

QRS complex –

- The QRS complex is the major voltage deflection of approximately 10–20 Mv but can vary in size depending on gender and age.
- The voltage Amplitude of QRS complex can give info about the cardiac Disease too.
- Interval of the QRS complex points out the time for the ventricles to Depolarize and give info about the conduction troubles in the Ventricles such as bundle branch block.

T wave –

- indicates ventricular repolarization.
- Large T waves can represent ischemia, and hyperkalaemia.

DWT

The transform of a signal is just another form of representing the signal. It does not change the information content present in the signal. The Wavelet Transform provides a time-frequency representation of the signal. It was developed to overcome the shortcoming of the Short Time Fourier Transform (STFT), which can also be used to analyze non-stationary signals. While STFT gives a constant resolution at all frequencies, the Wavelet Transform uses multi-resolution technique by which different frequencies are analyzed with different resolutions. A wave is an oscillating function of time or space and is periodic. In contrast, wavelets are localized waves. While Fourier Transform and STFT use waves to analyze signals, the Wavelet Transform uses wavelets of finite energy.

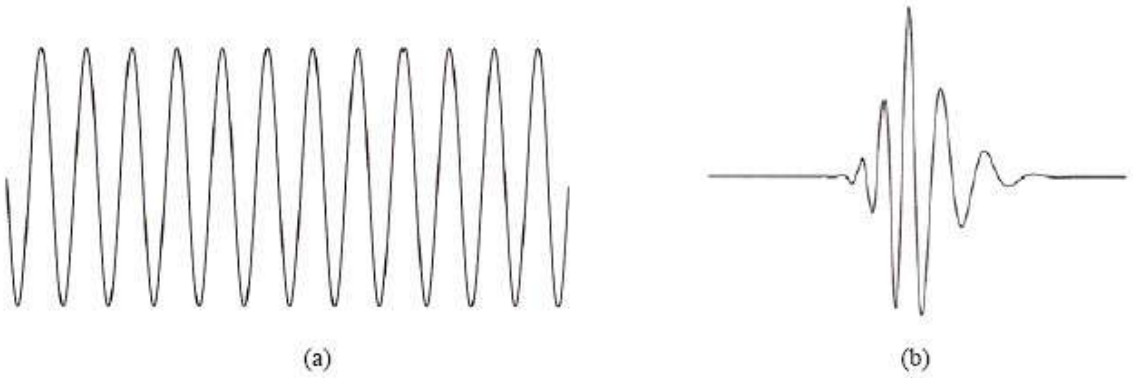

Figure 1: Difference between Wave and Wavelet (a) wave (b) wavelet

In wavelet analysis the signal to be analyzed is multiplied with a wavelet function and then the transform is computed for each segment generated. The Wavelet Transform, at high frequencies, gives good time resolution and poor frequency resolution, while at low frequencies; the Wavelet Transform gives good frequency resolution and poor time resolution.

Review of Literature

S. S. Mehta (2007) has defined a work on QRS detection on ECG signal under entropy value analysis. Author defined an entropy improved SVM approach for ECG signal classification. Author has defined a digital filtration based approach for power line interference analysis. Author has defined work to analyze the complex ECG signal so that QRS detection over the signal will be obtained. Author has applied the work for ECG dataset. The performance analysis of the work shows the high accuracy rate over 99% is obtained from the work. Author has defined the analysis criteria so that the effective recognition rate will be obtained from the system [1].

Mohamed Elgendi [2008] has defined a threshold analysis based dynamic work to identify the QRS over the EEG signal. Author analyze the signal complexities to analyze the signal and generated the improved quantization model to generate the adaptive results from the system. Author has defined the algorithm to obtain the automatic threshold values and defined the static analysis over the signal to detection the QRS. Author has defined a threshold specific predictive model to detect the signal QRS and obtained the accurate results over 90%. Author has applied the work on Arrhythmdia dataset [2].

K.Vimala (2014) has defined a work to analyze the ECG signal to measure the heart rate and relative regulateries. Author analyze the signal under arrhythmia identification and diagnosed approach. Author has defined an assessment model based on feature analysis. This model used the DWT at the earlier stage to extract the signal features. This signal feature is adaptive to the signal noise and reduce the signal noise. The wavelet coefficient vector is used as the decision vector to retain the relevant information and discard the abnormal information. The classification is here been defined using Hidden Markov Model (HMM) based predictive approach[3].

Indu Saini (2012) has defined a neural network based work to classify the Arrhythemia dataset for cardiac disease identification. Author has defined the ECG signal processing under neural network approach perform the detection and classification under heart beat analysis. Author has defined an error adaptive back propagation approach for block level analysis defined over the signal. Author has defined a brach block analysis scheme for beat identification in ECG signal. By analyzing different beats patterns over the signal, the network architecture is defined to generate the model under feature level analysis. Once the feature set is identified, the next work is to perform the recognition. The multilayer perceptron model is here been used to identify the QRS complexities over the signal and classify them under feature paramerers [4].

Nicos Maglaveras (1998) has defined an ECG processing scheme using non linear transformation and neural network approach. Author has defined a study based work for ECG signal processing and recognition. Author has defined the analysis of signal under pattern level analysis. Author has defined a parameter enabled analysis to generate the signal patterns and to obtain the non linear transformation over the signal. Author has defined a PCA based approach to classify the ECG signal and to recognize the input signal. Author worked on different singal level disorders such as P, QRS and T waves. Author has defined the scheme for beat and atrial fibrillation analysis to classify the signal using NN approach and radial basis function network approach[5].

Jakub Kuzilek(2012) has defined an ICA based approach for beat detection in ECG signal and to perform the recognition and classification over the signal. Author has defined an artefact analysis approach to identify the distortion over the signal. Author has defined an improvement over the Christov's beat detection algorithm, which detects beat using combined adaptive threshold on transformed ECG signal. Author has defined the noise analysis based predictive approach to improve the signal performance under beat detection algorithm[6].

Ahmet Turan (2011) has defined a neural network based embedded classifier to classify the signal and identify the abnormalities over the signal. Author has defined a feature enable approach to identify the prediction characteristics and used these characteristics model as input process for neural network scheme. Author enables the implementation of a simple ANN architecture with lower requirements for hardware resources. The features of the ECG signal are reduced dramatically using principle component analysis (PCA) while keeping the error rate of the ANN at an acceptable level, near 5%. In this study, field programmable gate arrays (FPGA) implementation of a fully parallel, fault-tolerant ANN for ECG arrhythmia classification (FPAAC) is realized[7].

Yu Hen Hu [8] has defined a patient adaptive ECG signal classification approach for beat classification. Author has defined the performance analysis scheme defined over the signal so that the heath care improvement will be obtained. Author has analyzed various aspects of the dataset signals and defined a general classifier to analyze the signal characteristics and verified the effective recognition rate. Author also observed the significant improvement over the detection[8].

S. S. Mehta(2007) has defined a SVM improved approach for cardiac beat detection in ECG signal. Author has performed the entrophy level analysis to identify the QRS complexities over the ECG signal. Author applied the filtration filters to identify and remove the signal noise. Entropy criterion is used to enhance the QRS complexes. Support Vector Machine (SVM) is used as a classifier to delineate QRS and nonQRS regions. The detection rate depends strongly on the quality of training, data representation and the mathematical basis of the classifier[9].

S. Sumathi (2009) has defined a work on QRS detection for complex ECG signals. Author has defined the work using DWT approach. Author has presented a robust algorithm for the QRS detection using the properties of the wavelet transform is proposed in this paper. Wavelet transform provide simultaneous time and frequency information. The algorithm has explained the effect of wavelet with different properties such as linearity and time frequency localization on the accuracy of QRS detection. The wavelet transform decomposes the ElectroCardioGram (ECG) signal into a set of frequency band[10].

Paweł Tadejko(2010) has presented a QRS detection approach over ECG signal under wavelet singularity analysis. Author has defined a complex detection algorithm under wavelet transformation approach. Author used this decomposition approach based on spectral characteristics anlaysis applied on ECG signal. This analysis is defined on multiscale and respective to the change in the signal. The location adaptive QRS analysis is defined here to recognize

the signal. The performance of the algorithm was tested using the records of the MIT-BIH Arrhythmia Database. The method is less sensitive to time varying QRS complex morphology, minimizes the problems associated with baseline drift, motion artifacts and muscular noise, and allows R waves to be differentiated from large T and P waves. Author defined a new approach to adaptive threshold algorithm that exploits statistical properties of the observed signal and additional heuristic [11].

R. Janani (2014) has defined a wavelet adaptive classification approach to identify the disorder over the ECG signal. Author has defined the abnormality analysis scheme to identify the adverse effects over the signal. Author has defined a noise adaptive approach for signal filteration and classification. Author defined the work on twelve different ECG samples from MIT BIH Arrhythmia database are analyzed using six mother wavelet functions- haar, db8, sym5, coif5, bior4.4 and rbio4.4. And cardiac disorders like Myocardial Infarction, Premature Ventricular Contraction (PVC), Ventricular Tachycardia, Supra ventricular arrhythmias, ST deviation, Ventricular Fibrillation (VF) are classified using Naive Bayes (NB) classifier and Support Vector Machine (SVM) classifier. The wavelets are evaluated using three different performance measures such as Peak Signal to Noise Ratio, Mean Squared Error and Mean Absolute Error. The experimental result shows that coif5 wavelet is efficient in significantly reducing the baseline wandering in the ECG signals.

Significance of Work

The significance of presented work are given here under

- The improved signal form will increase the chances of disease detection over the signal.
- The statistical feature adaptive approach will be able to improve the accuracy.

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