

Automatic classification of cardiac disorders for cardiac alert system

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Keywords

Wavelet; ECG Feature extraction; WEKA; MLP; RF; RBF; Cardiac alert system

Abstract

In the modern industrialized countries every year millions of people die due to cardiac disorders. India has highest incidence of heart related diseases in the world. The WHO's world statistics report 2016 shows that the life expectancy in India was 68.3 years. If no initiative is taken to check this most predictable and preventable among all chronic diseases, life expectancy may further decrease. Most of the cardio vascular diseases can be preventable by taking healthy diet, doing physical activity, avoiding alcohol & tobacco. Various feature schemes have been proposed by various researchers for identification and classification of cardiac arrhythmias. There is a large variation in number of features, number of cardiac signals and classification accuracy. However, selecting better signal processing technique for feature extraction, selecting optimum set of features, choosing proper neural network classifier to improve the classification accuracy remains an open problem. This aspect is motivation to take up the issue of automatic classification of cardiac arrhythmias. This research work will enable the clinical doctors and cardiologists to diagnose type of cardiac disorder to initiate proper treatment to save the life of heart patients. Computer based analysis is paramount importance for early diagnosis of cardiac disorder for saving the life of heart patients. Most of ventricular and Atrial Arrhythmias are dangerous. If ventricular arrhythmias neglected it leads to sudden cardiac arrest. Sudden cardiac death occurs when the heart's electrical system malfunctions.

When SCA happens, blood stops flowing to the brain and other vital organs. People who have heart disease are at increased risk for SCA. However, most SCAs happen in people who appear healthy and have no known heart disease or other risk factors for SCA. We need to take care of SCA patient using Cardiac Pulmonary Resuscitation (CPR) guide lines till the patient reaches cardiac centre. Based on the requirement SCA patient is treated with Implantable cardioverter defibrillator(ICD).Cardiac ischemia (CI) is a heart disease that covers heart issues caused by narrowing of the arteries which makes less oxygenated blood to reach the heart muscle. This may lead to heart attack with no prior warning.CI patient is treated with heparin injection or stents or open heart surgery based on the requirement. So, early detection of cardiac disorder is of paramount importance for saving the life of heart patients as there will be different treatment for different diseases. All the developed linear algorithms considered that the ECG signal as stationary but on observing the fact that ECG is a non-stationary, nonlinear and a quasi-periodic signal. This paper introduces a classification of cardiac arrhythmias and identifying cardiac disorder using artificial intelligence. Supervised learning techniques such as Multi-Layer Perceptron (MLP), Random Forest (RF) and Random Basis Function (RBF) algorithms are used for

nonlinear classification of cardiac arrhythmias. Clinical diagnosis is done Mostly by doctor's expertise and patients were asked to take number of diagnosis tests. This work will be helpful to doctors for early detection of type of cardiac disorder to propose proper treatment to save the life of heart patient. Even it's helpful to patients to reduce the no. of diagnosis tests.

In the proposed research work to publish as an extended abstract is involving different signal processing techniques such as time domain, spectral and higher order spectral domain and wavelet domain for ECG feature extraction. The time domain temporal features of ECG, frequency domain spectral and bispectral parameters and wavelet based wavelet features are used for classification of 7 types of cardiac signals using different types of artificial neural network algorithms. From this ECG analysis it is identified that out of four signal processing techniques, wavelet based technique is a suitable method for ECG feature extraction and MLP classifier has given more accuracy than existing works. All the methods developed in this research work are novel and better compared to existing methods. However, optimum feature scheme has been proposed in the last method is superior in terms of number of cardiac signals classification and to improve classification of accuracy. For this purpose 1-minute ECG data of 7 types of cardiac signals such as ventricular arrhythmias-Ventricular Tachycardia, Ventricular Fibrillation, Supraventricular Tachycardia, Normal Sinus Rhythm and Atrial arrhythmia -Atrial Fibrillation data is collected from MIT-BIH data base, Cardiac Ischemia data is collected from European ST-T data base and Sudden Cardiac Arrest data has been collected Sudden Cardiac Death Holter data base.

Cardiology applications of Tele-Medicine which has a unique capacity to improve the health care service to millions of rural people. Cardiac arrhythmias classification has become an active research area over the last two decades. Further, from a literature survey, it is identified that finding an efficient feature scheme is a major challenge to enhance classification accuracy of cardiac disorders. Existing feature extraction methods may not be sufficient to detect the possibility of cardiac disorders as ECG is a quasi-periodic, nonlinear and non-stationary signal. Hence, in this paper, it is proposed to use a wavelet transform technique to extract ECG features. These features are used to classify seven types of cardiac arrhythmias (Cardiac Ischemia, Ventricular Tachycardia, Supra Ventricular Tachycardia, Ventricular Fibrillation, Atrial Fibrillation, and Sudden Cardiac Arrest including Normal Sinus Rhythm.

Most scrutinized literature was collected from different sources including IEEE transactions and peer reviewed biomedical journals. This method has been implemented using MATLAB tool. The performance of different classifiers on selected feature set has been evaluated in Waikato Environment for Knowledge Analysis (WEKA).Further validation has been done with the existing works. This work was done by understanding

the needs of cardiac health care industry. Further with this wavelet based feature scheme a hardware unit of cardiac alert system has been developed with the help of Arduino and GSM module for remote monitoring of heart patients. Main objective of the work is to enable cardiologist for early detection of cardiac disorder to save life of heart patients. This research will be suitable for telecardiology application of telemedicine as it has unique capacity to improve the health care service to millions of rural people.