Classification of Arrhythmia by Using Deep Learning with 2-D ECG Spectral Image Representation

Abstract

Deep Learning (DL) has recently become a topic of study in different applications including healthcare, in which timely detection of anomalies on Electrocardiogram (ECG) can play a vital role in patient monitoring. The ECG signals can capture the heart's rhythmic irregularities, commonly known as arrhythmias. A careful study of ECG signals is crucial for precise diagnoses of patients' acute and chronic heart conditions. ECG is a one-dimensional (1D) signal therefore, the anomalies can be detected using machine learning approaches. The ECG signal is pre-processed and converted into a 2D signal using continuous wavelet transform (CWT).

Introduction

Arrhythmia analysis of ECG signal plays a significant role in diagnosing most of the cardiac diseases. One cardiac cycle in an ECG signal consists of the P-QRS-T waves.The classification of arrhythmias and compared it with standard data storage and diagnosis different disease. Presently, many Cardiologists face difficulty in making a correct diagnosis for ECG arrhythmia diseases. In addition to this also conventional technique of visual analysis is more complicated and requires experienced and time. The information obtained from an Electrocardiogram can be used to discover different types of heart diseases. It may be useful for seeing now well the patient is responding to treatment therefore a computerized interpretation of ECG and problems will build for analyze the different arrhythmias using wavelet transform. As mentioned in literature analysis of ECG arrhythmias accuracy are about 90 to 98% that's why by using wavelet transform method we are trying to obtained100% accuracy in arrhythmia analysis.

Literature Survey

J.I.Willams et.al. has carried out the measurement analyzed independently by a group of cardiologists &AHA. Analysis of set of recommendations aimed at standardizing measurement in quantitative ECG is presented. These AHA recommendations have led to the world wide recognition. BekirKarhket et al. carried out artificial Neural network of ECG signal analyzed in the time domain thus corresponding arrhythmias are determined by using ANN, around 95%result is achieved for identification of arrhythmia. Chuang-chienet et.al.has

done efficient arrhythmia detection algorithm using correlation coefficient in ECG signal for QRS complex are detected, the correlation coefficient and RR interval were utilized to calculate the similarity of arrhythmia. S. C. Saxena et.al. has done combined modified Wavelet transform tech for Quadratic spline wavelet is used for QRS detection and Daubechies six coefficient wavelet used P and T detection and diagnosis of cardiac disease. Stefan Gradl et.al. had carried out analysis of A)Pan-Tompkins algorithm for QRS-detection (B) template formation and adaptation; (C) feature extraction; (D) beat classification. The algorithm was validated using the MIT-BIH Arrhythmia and MIT-BIH Supraventricular Arrhythmia databases. More than 98% of all QRS complexes were detected correctly by the algorithm. Overall sensitivity for abnormal beat detection was 89.5% with a specificity of 80.6%.J. Lee, K. et.al. has carried out input feature by wavelet transform and linear discriminate analysis. This proposed algorithm he obtain good accuracy of arrhythmia detection that ofNSR,SVR,PVC and VF was 98.52, 98.43,98.59 and 98.88%respectively. Pedro R.Gomes,et.al carried out the wavelet transform and hidden markov models. Experimental results are obtained in real data from MIT-BIH arrhythmia data base show that outperforms the conventional standard linear segmentation.V.Rathikaraniet.et. al. has carried out the linear predictive coefficients, Linear predictive cepstral coefficients and melfrequency cepstral coefficients This method can accurately classify and discriminate the difference between normal ECG signal and arrhythmia affected signal with 94% accuracy.Sarkalehet.et. al. has done the discrete wavelet transform and neural networks with DWT is used for processing ECG recording and extracting some and neural n/w perform classification task. This method is 96.5 accuracy. Narendra Kohliet et.al. has studied the SVM methods four algorithms One against One (OAO), one against All (OAA), Fuzzy Decision Function (FDF) and Decision Directed Acyclic Graph (DDAG) principal component analysis(PCA) method. Results are obtained from SVM methods, four well-known and widely used algorithms performing Classification of ECG datasets through SVM based methods, One Against All (OAA) gives better results than classification without feature selection. Rune Fensli, EinarGunnarsonet.et.al. has analyzed the wireless and wearable sensor ECG system, hand held device with RF receiver and arrhythmia algorithm. The concept for wireless and wearable ECG sensor transmitting signal to a diagnostic station at the hospital and detecting rarely occurrences of cardiac arrhythmia. Khaled Daqrouqand et.al. studied the continuous wavelet transform CWT for analyzing ECG signals and extracting desired parameters like arrhythmia. This method gives clear threshold between Nomocardia,Bradycardia and tachycardia. S.Karpagachelvi, et.al. studied the Fuzzy logic methods, neural network, support vector machine ,genetic algorithm

and WT ECG feature extraction plays a significant role in diagnosing most of the cardiac disease. It determines the amplitudes and intervals in the ECG signal for subsequent analysis. V.Vijaya, k.kishanrao et.al. has studied the Pan Tomkins algorithm(it is implemented for the detection QRS complex on normal and arrhythmia database and discrete WT.Cardiac arrhythmia is the most common causes of death.ECG feature extraction has developed and evaluated an algorithm for R Peak and QRS complex detection using WT has been development. P. G. Patel,et.al. studied the Pen Tompkins Algorithm(efficient method for ECG Signal Analysis which is simple and has good accuracy and less computation time. For analysis the ECG signals from MIT database are used. The peak detection is very important in diagnosis arrhythmia which is proved as tachycardia, bradycardia, asystole, second degree AV block. The results show that from detected QRS peaks, arrhythmias which are based on increase or decrease in the number of QRS peak, absence of QRS peak can be diagnosed .A.R.Saheb et.al. has analyzed the design a heart diagnosis instrument that has very low complicated computations. Designed classifier gives accuracy 98% have obtained for three different arrhythmia include RBBB,LBBB and normal heart rhythm are analysed. A Dliou ,alatifet.al. has analyzed the three time frequency tech –choi-willams distribution, Bessel distribution and born Jordan distribution are applied for analyzing supraventricualr ECG signal comparative performance study of three time frequency techniques are applied for analyzing supraventricualr ECG signal results that the choi-willams technique gives good performance as compared to other time –frequency tech. A fahoumet.al.has analysed the work dealing with classification problem of four different arrhythmias :NSR – normal sinus rhythm,AF-atrial fibrillation, ventricular fibrillation(VT)and ventricular tachycardia(VT),RPS. Nonlinear dynamical behaviour of the ECG arrhythmia which used to identify the cardiac arrhythmias. This algorithm shows that sensitivity and specificity are within range of 87.7 - 100%.the classification accuracy is 100%forVF arrhythmia . V Mahesh et.al.has studied the discrete wavelet transform, heart rate variability and logistic model tree. These LMT classifier to classify 11 different arrhythmia and results obtained 98% accuracy. Szi-Wen Chen et.al. has modified sequential probability ratio test Using this technique they decreases the overall rate error rate 5% of previous result. M.R.Mhetre1et.al. has analysed the Pan Tompkins algorithm has been modified and used. This software can be immensely helpful to the medical fraternity. An attempt is tried to provide a treatment plan for the more risky and frequently occurring arrhythmias. Heike Leutheuseret.al. has analyzed the feature extraction from pan-tompkins algorithm and Hierarchical system. In , the authors converted the ECG signal into a 2D spectrogram and proposed a framework based on the spectrogram for arrhythmia classification. They

achieved an accuracy of 99.02% for the 2D-based CNN model. They only considered seven classes of arrhythmia. The authors demonstrated a support vector machine (SVM)-based framework for classifying arrhythmia using a 1D ECG signal. They considered 17 classes of arrhythmia and achieved 97.3% accuracy. The authors used YOLO to detect arrhythmia, and they considered only four classes of arrhythmia. Similarly proposed a CNN-based framework for classifying cardiac arrhythmia using short-time Fourier transform (STFT) as input signal and achieved 99.00% accuracy, but they only considered four arrhythmia classes. Majahad et al. demonstrated the conversion of ECG into time–frequency domain representation to classify arrhythmia. They used bagging methods and achieved 99% accuracy.

Conclusion

In literature review it is found that the detection and classification of ECG arrhythmia has carried out but accuracy of detection of ECG arrhythmia is about 90 to 98%. By using wavelet transform method we are trying ECG arrhythmias can be analyzed for 100% accuracy, that gives the detection and classification results better to improve the heart diseases of human being. Early detection of arrhythmic beats in the ECG signal could improve the identification of patients at risk from sudden death for coronary heart disease. It is also concluded that the use of a proper type of Deep Learning method can considerably improve the classification performance for the corresponding application.

Team ID: PNT2022TMID37351

Members:

Saipriya V

Kalakriti K

Sneha K

Thilakavathi K

Priyadharshini M