LITERATURE REVIEW

CLASSIFICATION OF ARRHYTHMIA BY USING DEEP LEARNING WITH 2-D ECG SPECTRAL IMAGE REPRESENTATION

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1. Arrhythmia Classification Techniques Using Deep Neural Network (2021):

Description:

The automated screening of arrhythmia classification using ECG beats is developed for ages. The deep learning based automated arrhythmia classification techniques are developed with high accuracy. The primary concerns that affect the success of the developed arrhythmia detection systems are (i) manual features selection, (ii) techniques used for features extraction, and (iii) algorithm used for classification and the most important is the use of imbalanced data for classification.

Result:

The major concerns that affect the success of the developed arrhythmia detection systems are (i) manual features selection, (ii) techniques used for features extraction, and (iii) algorithm used for classification and the most important is the use of imbalanced data for classification.

Future works:

The automated arrhythmia detection required the feature extraction of ECG images that required domain knowledge. Further, the balanced dataset used for classification methods is required to avoid overfitting.

Authors:

Ali Haider Khan, Muzammil Hussain and Muhammad Kamran Malik.

2. Classification of Arrhythmia in Heartbeat Detection Using Deep Learning (2021):

Description:

Aims to apply deep learning techniques on the publicly available dataset to classify arrhythmia. The system combines three different types of information: RR intervals, signal morphology, and higher-level statistical data. It is concluded that fuzzy-based technology is successful in the analysis of computerized ECG but needs more research.

Result:

It has the ability to produce very accurate predictions with a 99.12 percent accuracy rate for the CNN model, 99.3 percent accuracy for the CNN + LSTM model, and 99.29 percent accuracy for CNN + LSTM + Attention Model.

Future works:

This study should be conducted in binding domains like cloud and mobile systems. It is also vital to develop wearable technologies with integrated low-power consumption wearable technologies.

Authors:

Wusat Ullah, Imran Siddique, Rana Muhammad Zulqarnain, Mohammad Mahtab Alam, Irfan Ahmad and Usman Ahmad Raza.

3. Classification of Arrhythmia by Using Deep Learning with 2-D ECG Spectral Image Representation (2020):

Description:

Proposal of two-dimensional (2-D) convolutional neural network (CNN) model for the classification of ECG signals into eight classes; namely, normal beat, premature ventricular contraction beat, paced beat, right bundle branch block beat, left bundle branch block beat, atrial premature contraction beat, ventricular flutter wave beat, and ventricular escape beat. The one-dimensional ECG time series signals are transformed into 2-D spectrograms through short-time Fourier transform. The 2-D CNN model consisting of four convolutional layers and four pooling layers is designed for extracting robust features from the input spectrograms.

Result:

We achieved a state-of-the-art average classification accuracy of 99.11%, which is better than those of recently reported results in classifying similar types of arrhythmias. The performance is significant in other indices as well, including sensitivity and specificity, which indicates the success of the proposed method.

Future work:

The proposed model has attained the highest sensitivity among all the compared CNN algorithms. It is pertinent to note that detecting these cardiac arrhythmias is a labor-intensive task, where a clinical expert needs to carefully observe recordings that can go for up to hours. With such automated methods, the artificially intelligent system could augment the performance of clinical experts by detecting these patterns and directing the observer to look more closely at regions of more significance. This would ultimately improve the clinical diagnosis and treatment of some of the major CVDs.

Authors:

Amin Ullah, Syed Anwar, Muhammad Bilal, Raja Majid Mehmood.

4. Cardiac arrhythmia detection using deep learning (2017):

Description:

An electrocardiogram is an important diagnostic tool for the assessment of cardiac arrhythmias in clinical routine. A deep learning framework previously trained on a general image data set is transferred to carry out automatic ECG arrhythmia diagnostics by classifying patient ECGs into corresponding cardiac conditions. Transferred deep convolutional neural network is used as a feature extractor and the extracted features are fed into a simple back propagation neural network to carry out the final classification.

Result:

We observed that ECG Data obtained from MIT-BIH database are pre-processed, QRS complexes are detected and features in R-T intervals are extracted. When all of the tested networks are evaluated, it is found that networks based on transferred deep learning feature extraction obtained almost 100% recognition rates and accuracies above 96% in training phase.

Future works:

It won't be too surprising to see state-of-the-art performances from deep learning applications not only in medical signals and imaging diagnostics but also in other popular sub-fields of biomedical imaging and signals.

Authors:

Ali Isina, Selen Ozdalili.

5. A deep convolutional neural network model to classify heartbeats (2017):

Description:

The basis of arrhythmia diagnosis is the identification of normal versus abnormal individual heart beats, and their correct classification into different diagnoses, based on ECG morphology. Heartbeats can be sub-divided into five categories namely non-ectopic, supraventricular ectopic, ventricular ectopic, fusion, and unknown beats. It is challenging and time-consuming to distinguish these heartbeats on ECG as these signals are typically corrupted by noise. We developed a 9-layer deep convolutional neural network (CNN) to automatically identify 5 different categories of heartbeats in ECG signals. Our experiment was conducted in original and noise attenuated sets of ECG signals derived from a publicly available database.

Result:

This set was artificially augmented to even out the number of instances the 5 classes of heartbeats and filtered to remove high-frequency noise. The CNN was trained using the augmented data and achieved an accuracy of 94.03% and 93.47% in the diagnostic classification of heartbeats in original and noise free ECGs, respectively. When the CNN was trained with highly imbalanced data (original dataset), the accuracy of the CNN reduced to 89.07%% and 89.3% in noisy and noise- free ECGs. When properly trained, the proposed CNN model can serve as a tool for screening of ECG to quickly identify different types and frequency of arrhythmic heartbeats.

Future works:

In the future studies, the authors would like to extend the proposed model by training a CNN to recognize temporal sequences of ECG heartbeat signals. The occurrence, sequential patterns and persistence of the five classes (N, S, V, F, and Q) of ECG heartbeats considered in this work can be grouped under three main categories of green, yellow, and red, which represents normal, abnormal, and potentially life-threatening conditions of heart electrical activity, respectively. The authors plan to discuss the performance of the CNN model using de-skewed data and data with added different level of noise in the future studies.

Authors:

U. Rajendra Acharya, Shu Lih Oh, Yuki Hagiwara, Jen Hong Tan, Muhammad Adam.