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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

NAALAIYATHIRAN PROJECT

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

DOMAIN : ARTIFICIAL INTELLIGENCE

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

ABSTRACT:

ECG is a non-invasive tool used to detect cardiac arrhythmias. In this work, a method with a morphological feature is proposed for accurate recognition and classification of arrhythmias. Feature for analyzing complex morphology changes as visual patterns as well as a new clustering-based feature extraction algorithm is proposed. Finally, the feature vectors are applied to well-known classifiers (neural network, SVM, and KNN) for automatic diagnosis. The proposed method was assessed with different types of heartbeats as recommended by the Association for Advancement of Medical Instrumentation from the MIT-BIH arrhythmia database and can be achieved the best overall high accuracy based on KNN, using the combined parametric and visual pattern features of ECG Morphology. The accuracies for the six main types - normal (N), left bundled branch blocks (L), right bundled branch blocks (R), premature ventricular contractions (V), atrial premature beats (A) and paced beats (P). Comparisons with peer works prove a marginal progress in automatic heart arrhythmia classification performance.

LITERATURE SURVEY

1. Arrhythmia Classification with ECG signals based on the Optimization-Enabled Deep Convolutional Neural Network:

Arrhythmia classification is the need of the hour as the world is reporting a higher death troll as a cause of cardiac diseases. Most of the existing methods developed for arrhythmia classification face a hectic challenge of classification accuracy and

they raised the challenge of automatic monitoring and classification methods. Accordingly, the paper proposes the automatic arrhythmia classification strategy using the optimization-based deep convolutional neural network (deep CNN). The optimization algorithm named, Bat-Rider optimization algorithm (BaROA) is newly developed using the multi-objective bat algorithm (MOBA) and Rider Optimization Algorithm (ROA).At first, the wave and gab or features are extracted from the ECG signals in such a way that these features represent the individual ECG features. Finally, the signals are provided to the BaROA-based DCNN classifier that identifies conditions of the individual as arrhythmia and no-arrhythmia from the ECG signals. The methods are analyzed using the MIT-BIH Arrhythmia Database and the analysis is performed based on the evaluation parameters, like accuracy, specificity, and sensitivity, which are found to be 93.19 %, 95 %, and 93.98 %, respectively.

2. ECG arrhythmia recognition via a neuro-SVM–KNN hybrid classifier with virtual QRS image-based geometrical features:

In this study, a new supervised noise-artifact-robust heart arrhythmia fusion classification solution, is introduced. Proposed method consists of structurally diverse classifiers with a new QRS complex geometrical feature extraction technique. the events of the electrocardiogram (ECG) signal are detected and delineated using a robust wavelet-based algorithm. Then, each QRS region and also its corresponding discrete wavelet transform (DWT) are supposed as virtual images and each of them is divided into eight polar sectors. Next, the curve length of each excerpted segment is calculated and is used as the element of the feature space. Discrimination power of proposed classifier in isolation of different Gold

standard beats was assessed with accuracy 98.20%. Also, proposed learning machine was applied to 7 arrhythmias belonging to 15 different records and accuracy 98.06% was achieved. Comparisons with peer-reviewed studies prove a marginal progress in computerized heart arrhythmia recognition technologies.

3. An effective LSTM recurrent network to detect arrhythmia on imbalanced ECG dataset:

To reduce the high mortality rate from cardiovascular disease (CVD), the electrocardiogram (ECG) beat plays a significant role in computer-aided arrhythmia diagnosis systems. However, the complex variations and imbalance of ECG beats make this a challenging issue. Since ECG beat data exist in heavily imbalanced category, an effective long short-term memory (LSTM) recurrence network model with focal loss (FL) is proposed. For this purpose, the LSTM network can disentangle the timing features in complex ECG signals, while the FL is used to resolve the category imbalance by downweighing easily identified normal ECG examples. The advantages of the proposed network have been verified in the MIT-BIH arrhythmia database. Experimental results show that the LSTM network with FL achieved a reliable solution to the problem of imbalanced datasets in ECG beat classification and was not sensitive to quality of ECG signals. The proposed method can be deployed in telemedicine scenarios to assist cardiologists into more accurately and objectively diagnosing ECG signals.

4. Real-time patient-specific ECG classification by 1-D convolutional neural networks.:

This paper presents a fast and accurate patient-specific electrocardiogram (ECG) classification and monitoring system. Methods: An adaptive implementation of 1-D convolutional neural networks (CNNs) is inherently used to fuse the two major blocks of the ECG classification into a single learning body: feature extraction and classification. Therefore, for each patient, an individual and simple CNN will be trained by using relatively small common and patient-specific training data, and thus, such patient-specific feature extraction ability can further improve the classification performance. Since this also negates the necessity to extract hand-crafted manual features, once a dedicated CNN is trained for a particular patient, it can solely be used to classify possibly long ECG data stream in a fast and accurate manner or alternatively, such a solution can conveniently be used for real-time ECG monitoring and early alert system on a light-weight wearable device.

5. Medical image classification with convolutional neural network:

Image patch classification is an important task in many different medical imaging applications. In this work, we have designed a customized Convolutional Neural Networks (CNN) with shallow convolution layer to classify lung image patches with interstitial lung disease (ILD). While many feature descriptors have been proposed over the past years, they can be quite complicated and domain-specific. Our customized CNN framework can, on the other hand, automatically and efficiently learn the intrinsic image features from lung image patches that are most suitable for the classification purpose. The same architecture can be generalized to perform other medical image or texture classification tasks.

TABLE OF ARTICLES

S. No	ARTICLE NAME	AUTHOR NAME	PUBLISHED YEAR	PROPOSED SYSTEM
1	Arrhythmia classification with ECG signals based on the optimization-enabled deep convolutional neural network.	Atal, D. K., and Singh, M	2020	The methods are analyzed using the MIT-BIH Arrhythmia Database and the analysis is performed based on the evaluation parameters, like accuracy, specificity, and sensitivity, which are found to be 93.19 %, 95 %, and 93.98 %, respectively.
2	ECG arrhythmia recognition via a neuro-SVM-KNN hybrid classifier with virtual QRS image-based geometrical features.	Homaeinezhad, M. R., Atyabi, S. A., Tavakkoli, E., Toosi, H. N., Ghaffari, A., and Ebrahimpour, R.	2012	proposed learning machine was applied to 7 arrhythmias belonging to 15 different records and accuracy 98.06% was achieved.
3	An effective LSTM recurrent network to detect arrhythmia on imbalanced ECG dataset.	Gao, J., Zhang, H., Lu, P., and Wang, Z.	2019	The proposed method can be deployed in telemedicine scenarios to assist cardiologists into more accurately and objectively diagnosing ECG signals.
4	Real-time patient-specific ECG classification by 1-D convolutional neural networks.	Kiranyaz, S., Ince, T., and Gabbouj, M.	2015	The results the database demonstrate that the proposed solution achieves a superior classification performance than most of the state-of-the-art methods for the detection of ventricular ectopic beats and supraventricular ectopic beats.
5	Medical image classification with convolutional neural network.	Li, Q. Cai, W, Wang,X., Zhou, Y., Feng, D. D., and Chen, M.	2014	CNN framework can, on the other hand, automatically and efficiently learn the intrinsic image features from lung image patches that are most suitable for the classification purpose.

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