**Classification of arrhythmia by using deep learning with 2-d ECG spectral image representation**

**Literature Survey**

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| SL.NO | 1 |
| TITLE | Multi-model Deep Learning Ensemble for ECG Heartbeat Arrhythmia Classification |
| PROPOSED WORK | In this paper, we introduced a novel deep learning system for classifying the electrocardiogram (ECG) signals. The heartbeats are classified into different arrhythmia types using two proposed deep learning models. The first model is integrating the convolutional neural network (CNN) and long short-term memory (LSTM) network to extract useful features within the ECG signal. The second model combines several classical features with LSTM in order to effectively recognize abnormal classes. These deep learning models are trained using a bagging model then aggregated by a fusion classifier to form a robust unified model. |
| TOOLS USED/ALGORITHM | 1.Convolutional Neural Network(CNN)  2.Long Short-Term Memory(LSTM) |
| TECHNOLOGY | Deep Learning |
| ADVANTAGE | The proposed system is evaluated on the MIT-BIH arrhythmia database and produces an overall accuracy of 95.81%, which significantly outperforms the state-of-the-art. |
| DISADVANTAGE | (1)The most ECG databases are not specific to their clinical context.  (2)The description of the patient population in which these ECGs were obtained is lacking. This is important in interpreting the methodology and clinical utility in context.  (3)The algorithms are trained based on specific environments, and the generalized methodologies are ignored. |

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| SL.NO | 2 |
| TITLE | CardioNet: An Efficient ECG Arrhythmia Classification System Using Transfer Learning |
| PROPOSED WORK | This paper presents a novel method of heartbeat classification from ECG using deep learning. An automated system named ‘CardioNet’ is devised that employs the principle of [transfer learning](https://www.sciencedirect.com/topics/computer-science/transfer-learning) for faster and robust classification of heartbeats for arrhythmia detection. It uses pre-trained architecture of [DenseNet](https://www.sciencedirect.com/topics/computer-science/convolutional-network" \o "Learn more about DenseNet from ScienceDirect's AI-generated Topic Pages) that is trained on ImageNet dataset of millions images. The weights obtained during training of DenseNet are used to fine-tune CardioNet learning on the ECG dataset, resulting a unique system providing faster training and testing. |
| TOOLS/ALGORITHM USED | 1.Transfer Learning.  2.DenseNet  3.ImageNet |
| TECHNOLOGY | Deep Learning(Transfer Learning) |
| ADVANTAGE | The proposed CardioNet system achieves higher [classification accuracy](https://www.sciencedirect.com/topics/computer-science/classification-accuracy) of 98.92% outperforming other methods and shows robustness to different irregular heartbeats or arrhythmias. |
| DISADVANTAGE | 1. One of the biggest limitations of transfer learning is the problem of negative transfer.  2.Transfer learning only works if the initial and target problems are similar enough for the first round of training to be relevant. |

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| SL.NO | 3 |
| TITLE | ECG Arrhythmia Classification By Using Convolutional Neural Network And Spectrogram |
| PROPOSED WORK | The proposed approaches operates with a large volume of raw ECG time-series data and ECG signal spectrograms as inputs to a deep convolutional neural networks (CNN). Heartbeats are classified as normal (N), premature ventricular contractions (PVC), right bundle branch block (RBBB) rhythm by using ECG signals obtained from MIT-BIH arrhythmia database. The first approach is to directly use ECG time-series signals as input to CNN, and in the second approach ECG signals are converted into time-frequency domain matrices and sent to CNN. The most appropriate parameters such as number of the layers, size and number of the filters are optimized heuristically for fast and efficient operation of the CNN algorithm. The proposed system demonstrated high classification rate for the time-series data and spectrograms by using deep learning algorithms without standard feature extraction methods. |
| TOOLS/ALGORITHM USED | 1.Convolutional Neural Network  2.MIT-BIH database |
| TECHNOLOGY | Deep Learning |
| ADVANTAGE | 1.Performance evaluation is based on the average sensitivity, specificity and accuracy values.  2. It is also worth to note that spectrogram increases the performance of classification since it extracts the useful time-frequency information of the signal. |
| DISADVANTAGE | 1. Lack of ability to be spatially invariant to the input data. 2. Lots of training data is required. |

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| SL.NO | 4 |
| TITLE | Arrhythmia Classification Techniques Using Deep Neural Network |
| PROPOSED WORK | The primary goal of this research is to review the development of arrhythmias classification techniques over time, i.e., January 2010 to January 2020, using the machine and deep learning approach. The primary objectives of this research study are, To examine the arrhythmia classification techniques as practically implementable, To overview the existing research studies based on arrhythmia classification benefits and future research direction,Identify the latest research trends and publication interests based on arrhythmia classification. |
| TOOLS/ALGORITHM USED | a. Recurrent neural network (RNN)  b. Long short-term memory (LSTM)  c. Autoencoder  d. Convolutional neural network (CNN)  e. Deep neural network (DNN)  f. Deep belief network (DBN |
| TECHNOLOGY | Artificial Intelligence |
| ADVANTAGE | 1.When performed on databases with vast volumes of high-quality data, deep learning models perform well.  2.As a result, a study on newly created big ECG datasets might lead to more effective models. |
| DISADVANTAGE | The most ECG databases are not specific to their clinical context. The description of the patient population in which these ECGs were obtained is lacking. This is important in interpreting the methodology and clinical utility in context. The algorithms are trained based on specific environments, and the generalized methodologies are Ignored |

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| SL.NO | 5 |
| TITLE | Classification of Arrhythmia in Heartbeat Detection Using Deep Learning |
| PROPOSED WORK | Automatic exposure to ECG-based arrhythmia is very convenient since it eliminates physicians’ need to personally interpret the signs and allows people to track their cardiac symptoms using handheld devices |
| TOOLS/ALGORITHM USED | a. MIT-BIH Arrhythmia Dataset (N, S, V, F, and Q)  b. NumPy  c. Seaborn for python backend deep learning library to implement deep learning techniques. |
| TECHNOLOGY | Artificial Intelligence |
| ADVANTAGE | When performed on databases with vast volumes of high-quality data, deep learning models perform well. As a result, a study on newly created big ECG datasets might lead to more effective models. |
| DISADVANTAGE | 1.The challenges in designing and adjusting CNN models, the high computational cost of neural networks.  2.They require a large dataset for successful training. |

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| SL.NO | 6 |
| TITLE | Auto-encoder and bidirectional long short-term memory based automated arrhythmia classification for ECG signal |
| PROPOSED WORK | The proposed AE-biLSTM method contains an encoder that extracts higher level feature from the Electro cardiogram arrhythmias signals using bidirectional long short- term memory (biLSTM) network, then a decoder output reconstruct Electro cardiogram arrhythmias signals from higher level features using biLSTM network. Finally, the proposed method accurately classifies the 6 heartbeats types, such as normal (N) sinus beat, atrial fibrillation (AFIB), ventricular bigeminy (B), pacing beat (P), atrial flutter (AFL), sinus brady cardia (SBR). The simulating process is activated in MATLAB. Lastly, the AE-biLSTM method utilize 2 extra databases: (i) new N beat (ii) AFIB beat, which is self-determining of the network’s training database. |
| TOOLS/ALGORITHM USED | 1.Normal sinus beat  2.Bidirectional LSTM  3.Pacing beat  4.Sinus bradycardia |
| TECHNOLOGY | Deep Learning |
| ADVANTAGE | The proposed model attains the better performance of 97.15 % accuracy, 98.33% positive predictive value, 99.43% sensitivity, 96.22% specificity compared to the existing methods, such as Automated arrhythmia classification based convolutional neural networks with long short-term memory networks (CNN-LSTM), and automated arrhythmia classification based deep code features with long short-term memory networks (DCF-LSTM) respectively. |
| DISADVANTAGE | * Since BiLSTM has double LSTM cells so it is costly. * Not Good fit for Speech Recognition |