INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
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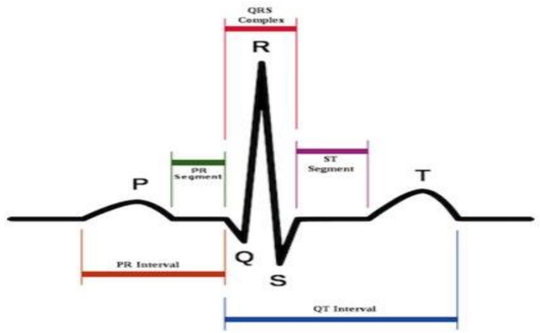
Technology, Social Impact

Cardio-ExNet: Explainable Arrhythmia Detection using Deep Learning

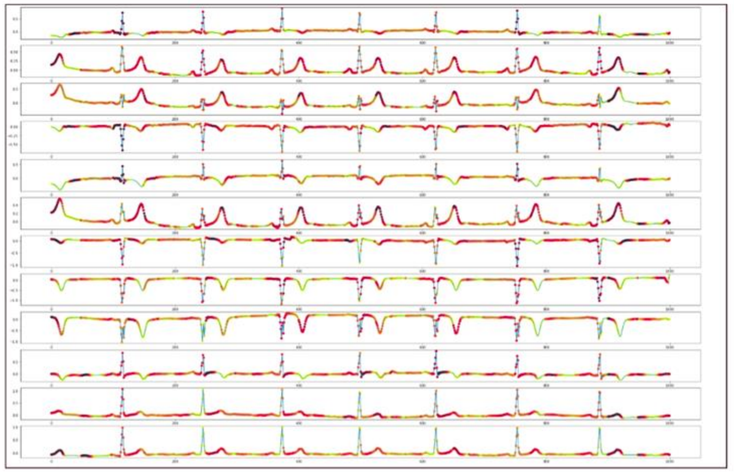
ABSTRACTS

Atrial fibrillation (AF) is one of the most prevalent cardiac arrhythmia that affects the lives of more than 3 million people in the U.S and over 33 million people around the world and is associated with a five-fold increased risk of stroke and mortality. Artificial intelligence (AI)-based algorithms have been used to reliably detect AF from subject physiological signals. The cardiologist level performance in detecting this arrhythmia is often achieved by deep learning-based methods, however, they suffer from the lack of interpretability. In other words, these approaches are unable to explain the reasons behind their decisions. The lack of interpretability is a common challenge towards a wide application of machine learning (ML)-based approaches in the healthcare which limits the trust of clinicians in such methods.



OBJECTIVE

Deep Learning models have shown great success in detecting Arrhythmia from ECG signals, but most models lack interpretability which is important for prognosis of a subject's condition. There have been some good methods to interpret the decision-making process of CNNs that were evaluated on 2D images like Grad-CAM. The objective of the project is to modify and implement 1D interpretations of ECG signals and further extending it to multiple modalities like EEG, EMG & EOG for problems like sleep staging & sudden heart failure.



METHOD

We explored state-of-the-art classical machine learning approaches and 1D ConvNets on familiar datasets like MIT-BIH and moving forward with recent datasets like PhysioNet-2020 and PTB-XL to understand how our baseline model performs and develop interpretability on top of them. In the current arena, various levels of interpretability has been developed on ECG signals by segregating into beat, rhythm and frequency levels, we propose a novel channel level attention. Other areas where the research can be further progress in direction is sudden death due to a heart failure if ejection fraction goes lower than a threshold and by combining physiological signal modalities like EEG, EMG, EOG and to sleep pattern of a subject whether they are having apnea or not.

Results

- Our model has been on-par with the state-of-the-art model for the detection & classification of arrhythmia.
- We propose a new-channel level attention where for a particular abnormality attention maps can be developed which can aid a clinician for better decision making.

Authors: Likith Reddy, Vivek Talwar, Bapi Raju, U. Deva Priyakumar

Research Center Name: HAI Research Center