DEEP LEARNING FOR ECG CLASSIFICATION

B.H. Nisal Sudila

A Dissertation Submitted in Partial Fulfilment of the Requirement for
Bachelor of Engineering (Honours) Degree in Software Engineering

Department of Computing
Informatic Institute of Technology, Sri Lanka
in Collaboration with
University of Westminister, UK

2020

Abstract

The global number one deadliest cause is Cardiovascular diseases (CVDs) and it is responsible for 17.9 million global deaths annually. CVDs are a group of disorders of the heart and blood vessels and include coronary heart disease, cerebrovascular disease, rheumatic heart disease, and other conditions(Cardiovascular diseases (CVDs), 2017).
Most of the CVDs are related to heartbeats and an arrhythmia is a cause with the pattern of the rhythm of the heartbeat. It means that the electrical signals responsible for heartbeats are not having smooth functionality. Irregular heartbeat signals may cause racing or fluttering heart(Different heart diseases, 2018).
A cardiologist has to spend a considerable amount of time to examine ECG signals specially when the signals are beyond 30 minutes or more. ECGs are sometimes taken over a span of 48 hours. In these particular scenarios, it's a time-consuming job and this worsens with the increasing number of patients.

In this research, the main focus is to develop an open source decision support framework to classify the arrhythmias of lengthy ECG signals using a Convolutional based Deep Neural Network along with the highly regarded MIT-BIH arrhythmia dataset to train and validate the deep learning approach. The automated system considers 13 arrhythmias in classification and all of it is made generic and not-patient specific. The system is able to classify 30 minute long ECGs well within 1 minute. Extensive research and visualization methods were adopted to analyze and understand the dataset. This led to the exact numbers of data points available for each arrhythmia. The results clearly indicated that the dataset is highly unbalanced. Therefore, as an approach to solve the issue of unbalanced dataset, GANs was used in generating datasets for the arrhythmia classes with low data to increase its sensitivity and specificity values. In addition, three other high-level architectures including LSTM, DNN and CNN were tested for the same dataset before concluding on Convolutional based Deep Neural Network and their results are mentioned.