Analysis and Multi-class Classification of pathological Heart Murmurs based on Segmented Phonocardiogram Recordings

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Phonocardiogram (PCG) based classification methods have the potential to provide a low cost, readily available, less subjective and easy to use diagnostic tool to assist primary care physicians diagnose certain cardiovascular pathologies. The aim of this research is to develop an accurate method for automatically detecting different types of Valvular Heart Disease using Phonocardiogram recordings.

A public database that contains PCG recordings from patients with systolic murmurs has been used. Currently, an algorithm has been developed to classify a certain PCG interval as Normal or Abnormal. The PCG recordings are first segmented into PCG intervals, cycle, S1, systole, S2 and diastole, using Springer's Hidden Semi-Markov Model (HSMM) based method. The algorithm then analyzes the segmented PCG intervals using Frequency and Time-Frequency methods before extracting features using fractal and statistical methods. An approach to validate the extracted features has also been developed based on detecting the first abrupt change in a signal constructed from normal and abnormal features. Principal Component Analysis (PCA) has been applied in order to reduce the number of features that are fed to the classification algorithm. A three-layer neural network has been implemented and trained with part of the dataset. The classification algorithm was tested using the other part of the dataset and the performance of the algorithm was evaluated for each PCG interval.

The algorithm was able to achieve 96% sensitivity and 92% specificity when the whole PCG cycle was used for classification. The second major milestone of this research will be **(1)** to determine the contribution from each feature class to classification accuracy; **(2)** to apply the developed algorithm on a multi-labelled database in order to achieve multi-class classification; **(3)** to build a demo around the developed algorithm to capture PCG data from a subject, analyze it either locally or on the cloud and determine the patient's condition using the developed classification algorithm.