Estimating cardiac time intervals from analysis of seismocardiogram signal using ML techniques

Problem Statement

In recent past, human health especially cardiac health has deteriorated significantly, because of the presence several risk factors. Cardiovascular diseases (CVD) are the key source of increasing number of deaths across the globe. Improving CVD patient care and outcomes is an essential public health goal. Cardiac anomalies are not regular and in some cases they may go unnoticed. In this situation it becomes very challenging to detect cardiac problems in early stage. In this project we aim to estimate cardiac time intervals through analysis of seismocardiogram (SCG) signal for monitoring the cardiac abnormality. Using this, we can closely monitor heart activities of a person regularly and identify several heart related problems like cardiovascular diseases.

Background

Seismocardiogram (SCG) is the recording of body vibrations induced by the heartbeat. SCG contains information on cardiac mechanics, in particular heart sounds and cardiac output. Vibrations on the chest wall induced by heart-beats and cardiac movements in a cardiac cycle can be measured using the SCG signal. SCG has an ability to identify clinical information like closing and opening instants of valves, so use of SCG signals will be proving very useful if they are annotated properly and extract information from them correctly and gives additional information about the quality of the ECG signals recorded: during phases of activity.

Methodology

Step 1: Data collection and dataset preparation

This will involve collection of images from CEBS database available at physionet.org repository and preprocessing them, and extracting features.

Step 2: Developing Binary classification model

In this step a binary classification model for annotation of SCG peaks is developed.

Step 3: Training and experimentation on datasets

Training and testing is performed on binary classification model on the CEBS datasets to do the prediction accurately.

Step 4: Finding cardiac time intervals

Based on the annotation result achieved different cardiac time intervals are found.

Experimental Design

Dataset

CEBS dataset available at physionetatm.com is collected. Dataset contains the ECG (electrocardiogram) and SCG (seismocardiogram) records of 20 presumed healthy volunteers in three different states (basal, listening music, and post music). The datasets for this project:

i) Basal state data of subject's b001, b002, b005, and b006

ii) We changed the dataset based on our requirements like creating dataset for IM and AC points.

iii) For IM, data of all four subjects is considered.

iv) For AC, data of only b006 is considered.

v) Total 4053 samples were considered for IM and 1625 samples for AC.

Evaluation Measures

Evaluation is measured in terms of precision, recall, accuracy, f1-measure, log loss, error rate and roc-auc.

Software and Hardware Requirements

Python based Machine Learning libraries will be exploited for the development and experimentation of the project. Tools such as Anaconda Python and libraries such as Scikit will be utilized for this process.