Time-Recurrent HMM Decision Tree to Generate Alerts for Heart-Guard Wearable Computer

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In this paper we propose a time-recurrent decision tree which picks up most likely state sequence based on trained HMM models and acquired real-time signal. As of now we present simulation results on Physikalisch-Technische Bundesanstalt Database (PTBDB), available on physionet.org as it contains ECG/VCG data records from 294 subjects (healthy as well as various heart disease). We are in a process of building PSoC (Programmable System on Chip) based wearable computer. Use of wearable computers in physiological/ecg monitoring is not new. There are many wearable monitoring systems or portable ambulatory systems available designed by researchers and in industry. Most of them work on heart rate variability/arrhythmia. In some cases RR interval is within normal limits but other parameters show abnormality in the functioning of the heart which go unnoticed. For early detection of signs we need to monitor the entire activity of the heart i.e. polarization/depolarization of atria/ventricles. Keeping in mind the constraints of computing power of wearable computing, we have to rely on temporal parameters and amplitude parameters. Hence the importance of modeling and decision making. ECG is a non-stationary signal. We modeled ECG using HMM-Hidden Markov Model which is suitable for such signals. VCG leads Vx, Vy, Vz are used for modeling, which provide the same information as 12-leads ECG. Before constructing the tree, labeling of data needs to be done. The PTBDB data is not labeled; we have to follow Viterbi labeling. For that purpose we divided the data available in each category into two parts, test data and training data. Eight learning curves are obtained representing eight classes of diseases including normal one. These curves are stored as look up table. The most probable state sequence can then be obtained which gives maximum likelihood. Depending on the state sequence and correlation with other parameters three intensity level alerts are generated