Comparative Study of ECG Signal using IIR Filter

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Abstract **- This paper is the study for like infinite impulse response (IIR) filter for IIR filtered ECG signal. Filter is Butterworth, Chebyshev Type-1 , Chebyshew Type-2, Eliptic filter is used. This paper represent direct design of IIR filters which minimizes delay without changing the magnitude response. Mean, standard deviation, variance value find out the filtering samples. After adding noise in the samples and effect on noise on signal and change the find and compare it.**

Keywords: **IIR, SNR, ECG, SD, FDA tool**

I Introduction

Electrocardiogram is one of the physiological signal .But use of ECG signals in analysis of stress is very limited. HRV (Heart rate variability) is dominant parameter for analysis of stress. ECG is electrical representation of movement of heart over a period of time when electrode placed on the chest.

We can easily find out the effect on heart such as heart beat and so on.

Butterworth Filter
Chebyshev Type-1 Filter
Chebyshev Type-2 Filter
Frequency used Fs = 360Hz

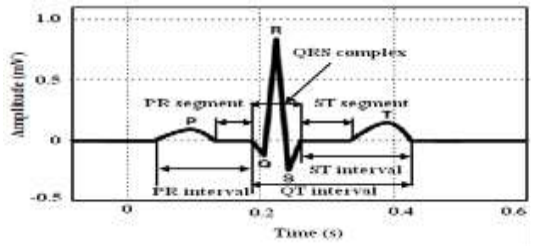

Figure: 1-Schematic ECG Signal

The ECG is a time varying signal causing the ionic current flow which reasons the cardiac fibers to compress and subsequently relaxed. ECG signal can get through by recording the potential difference between two electrodes placed on the surface of the body. A single normal period of the ECG indicates the consecutive atrialdepolarization/repolarization and ventriculardepolarization/repolarization which happen with each heartbeat. These may almost be associated with the peaks and troughs of the ECG waveforms labeled P, Q, R, S and T as shown in figure1.

In this graph Q is the bottom starting point, R the top point, and S the bottom end point of the QRS Complex. Atrial contraction starts in the P-wave and continues throughout the PR interval. The blood is pumped into the ventricles and the ventricular pressure rises. Ventricular contraction begins at R which corresponds to the peak of the QRS complex and continues during the ST segment and T-wave .The mitral and bicuspid valves close due to increase in ventricular pressure, At R, the closing valves produce the heart sound. The QRS complex is the significant characteristic waveform of ECG, and can be used as a reference for the cardiac cycle. This signal may corrupt due to different types of the artifacts. ECG signal are generally corrupt by unwanted interference like motion artifacts, muscle noise, electrode artifacts, base line drift noise .These contain R- peak detection, QT- interval detection, and the derivation of heart rate and respiration rate from the ECG signal. The RR- interval is the time among consecutive R- peaks .A series of RR –intervals is called as a RR tachogram and variability of these RR –intervals data about the physiological condition of the subject.

II Design

This is a frequency selective circuit that is used to allow certain band .the parameters selected are given below:

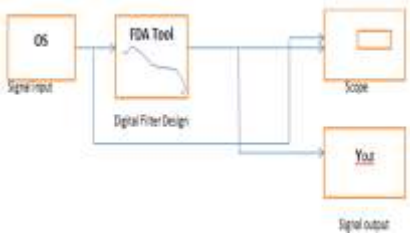

Figure 2 Simulation mode for the ECG processing

The ECG Signal we used is real clinical data and has been sampled at fs=360 hz for a period

Pass band attenuation: 1db
Stop band attenuation: 80db
Density factor: 20
Pass band frequency: 54Hz

Stop band frequency: 60Hz
Sampling frequency: 360Hz

III. RESULT OF IMPLIMENTATION OF THE TYPES OF IIR FILTER:

In the types of filters, we are taking same value of the pass band frequencystop band frequency, pass band attenuation, stop attenuation and order

Table I
Before filtering the arrhythmia signal following quantities are below:

Signal	Mean	Variance	SD	SNR
Arrhythmia signal	0.1367	63.6745	7.9796	3.0171

Table II
After the adding noise in the arrhythmia signal and effect of noise on signal the quantities are change due to noise:

Signal	Mean	Variance	SD	SNR
Arrhythmia signal	0.3067	416.49	20.408	8.1549

Table III

After denoise the arrhythmia signal by using IIR filter in different order and measure the quantities are change due IIR filter:

Filter Name	Order	Mean	SD	Variance	SNR
Butterworth	10	0.1367	7.9796	63.6745	3.0125
	20	0.3045	12.164	147.644	3.9540
Chebyshev Type1	10	0.0169	12.078	189.258	4.5620
	20	0.0165	13.785	193.658	4.6485
Chebyshev Type 2	10	0.0189	13.945	167.861	4.5023
	20	0.0203	12.978	186.250	3.3215
Elliptic	10	0.0024	13.239	176.256	3.2564
	20	0.0172	12.959	192.635	4.2564

IV Conclusion

We have seen that table-I, table-II, table-III show that noise has been reduced when ECG signal is filtered using IIR Filter and result have been concluded by using IIR filters. Table-I shows the different parameters before filtering like mean, variance, SD, and SNR, Table-II shows the parameters when the noise is added in the signal, Table-3 shows the result after being filtered using IIR filter. In this paper noise reduced from different ECG data signal using IIR digital filter. Results have been published by using various filters. Results are modified after filtering process.

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