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Noise Reduction In Ecg Using Filters

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ABSTRACT

An electrocardiography (ECG) is an easy and helpful analysis which records the electrical activity and rhythmic of the cardiac (heart) of the patient that endures from any cardiac illness. An ECG waveform can be used to detect problems in electrical activity of cardiac rhythmic. It can assist doctors to identify the problem, that the patient having a cardiac attack or if the patient had a cardiac attack in the past. A digital filter circuit involves the reduction of a noise signals occurred in the ECG waveform. MATLAB simulation method can be used to get the output waveform of the filter circuit; it is the superior tool for digital signal processing applications. Also it assists to check the results and design that comes from the hardware.

Keywords: IIR filter, electrocardiogram and digital filter.

INTRODUCTION

The noise reduction in ECG waveform signal is done by using various methods, which may engage the finite impulse response (FIR) or infinite impulse response (IIR) filter. FIR filter is constantly stable but the coefficients used in this technique are very huge, so it requires a much memory space to accumulate its coefficients. Alternatively the IIR filter has fewer amounts of coefficients and can be unbalanced occasionally due criticism loop concerned in it. Fundamentally, equation for FIR filtering is a 1-Dimensional intricacy among the filter coefficients and the source signal [1].

Infinite impulse response (IIR) is a possessions relating to numerous linear time-invariant (LTI) systems. A similar example of LTI systems are digital and electronic filters. Systems with this possession are known as IIR filters or IIR systems and are differentiated by having an impulse response which does not suit accurately zero past a convinced point, but persists forever. This is in disparity to a FIR in which the impulse response h(t) does suit accurately zero at times t > T for some finite T, thus being of finite duration.

I. Degital Filter Design Process:

The most frequently used IIR filter design technique uses allusion analog model filter. It is the well suited technique to use when designing typical filters such as low-pass, high-pass, band-pass and band-stop filters.

The filter design process begins with patterns and constraints of the attractive IIR filter. A type of allusion analog model filter to be used is precise according to the patterns and after that the whole thing is ready for analog model filter design.

The next step in the design process is scaling of the frequency range of analog model filter into attractive frequency range. This is how an analog model filter is converted into an analog filter.

After the analog filter is designed, it is time to go through the last step in the digital IIR filter design process. It is conversion from analog to digital filter. The most popular and most commonly used converting method is bilinear transformation method. The resulting filter, obtained in this way, is always stable. However, instability of the resulting filter, when bilinear transformation is used, may be caused only by the finite word-length side-effect.

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II. *Design Of Digital Iir Filter Architecture:*

The digital filter circuit design problem grips the fortitude of a group of filter coefficients to assemble a group of design patterns. These patterns usually contain of the width of the pass-band and the equivalent gain, the width of the stop-band and the transmission loss within the band edge frequencies and the maximum wave acceptable in the stop-band and pass-band. Obviously the IIR filter is easy to realize. A group of samples taken at fixed time period, and multiply them by a set of coefficients [2,3]. The mixture of the length of the filter and the ranges of the coefficients verify the filter's operation.

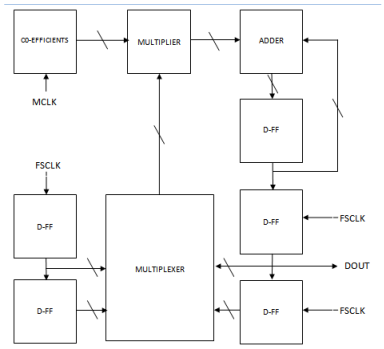

Fig. 1: Architecture of digital IIR filter.

The architecture of digital IIR filter was shown in figure 1. It consists of multiplier, multiplexer, adder and flip flops (FFs). Usually, the recorded ECG signal is frequently infected by noise and relics that can be in the frequency band of interest. In order to extort valuable information from the noisy ECG signals, digital filters are used to process the raw ECG signals. MATLAB simulation method can be used to get the output waveform of the filter circuit; it is the superior tool for digital signal processing applications. Also it assists to check the results and design that comes from the hardware.

III. *Result And Performance Analysis:*

The computational algorithm executing equation of an IIR filter can be expediently characterized in architecture diagram. It is through using structure components such as Unit Delays, Adders and the Multipliers. A typical ECG waveform has been shown in figure 2. It is the normal and correct cardiac rhythmic of the ECG signal waveform for adults.

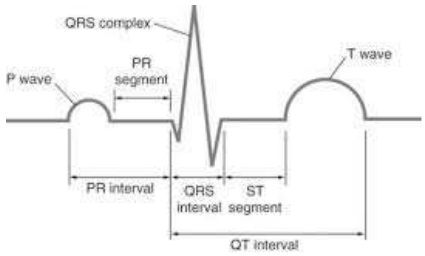

Fig. 2: A typical ECG waveform.

The figure 3 shows the ECG signal waveform with and without noise. In that, the green colored waveform signal is noisy ECG signal and the blue colored waveform signal is noiseless ECG signal. The digital IIR filters are used in that algorithm and architecture and by using MULTISIM software tool, the design of digital filter was designed, MATLAB simulation tool was used to get the noisy and noiseless ECG waveform signal with the help of MATLAB coding.

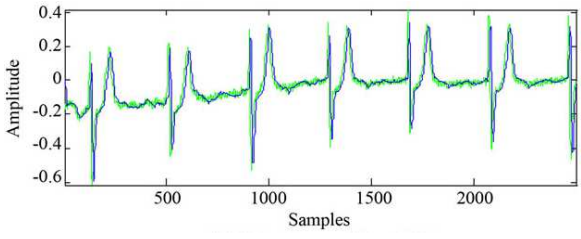

Fig. 3: ECG signal waveform with and without noise.

IV. *Conclusion:*

In this paper, the digital IIR filter was used to remove the noise in ECG waveform signal generated by the electrocardiography machine. Simulation results shows that the difference between noisy and noiseless signals. In that, noiseless signals are used to identify the exact problem of the cardiac rhythmic change. In noisy signal, the exact problem was not able to identify. In future, by using some other implementation in filter design and make implementation in algorithm helps to improve the reduction of noise signals in ECG waveform signal.

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