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HEART RATE MEASUREMENT FOR EARLIER DETECTION OF ATRIAL ARRHYTHMIAS

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Abstract- Cardiovascular Disease (CVD) is the heart abnormalities which means malfunctioning and disfunction of heart in which it eventually leads to less oxygen supply to all vital parts of the body. The proposed method aims at the recent advancement in prediction of various cardiovascular diseases research using ECG signal analysis. The goal of this paper is to access and improve the efficiency of prediction system for early stage of CVD with knowledge of current advancement in technology. This is done by means of constructing various functional blocks to detect the number of pulses of electrocardiogram. Generally, the heart beats ranges from 60 bpm to 80 bpm for adults. This proposed methodology aids in early and easy detection of several abnormal cardiac arrhythmias such as Tachycardia, Bradycardia, atrial fibrillation etc.in order to avoid the increase in casuality.

Keywords: Cardiovascular Disease (CVD), Arrythmia, Tachycardia, Bradycardia, RR interval.

I. INTRODUTION

Wireless Ambulatory ECG recording is one of the applications in biotelemetry which is routinely used to detect arrhythmias and cardiac abnormalities. Cardiovascular Disease is one of the major leading causes of mortality in the worldwide including Malaysia. The main cardiovascular diseases are heart attack, angina, stroke and peripheral vascular disease (PVD). CVD is the heart abnormalities which mean malfunctioning and dysfunction of heart in which it eventually leads to less oxygen supply to all vital parts of the body. It affects oxygen transportation to brain, lungs, internal and heart itself and supply of less oxygen leads to cause more problems in the body. As the ECG signal contains numerous artifacts such as baseline wander, powerline interference, motion artifacts and muscle artifacts, these artifacts have to be removed before monitoring, from the receiver point-of-view, so that a correct decision can be taken. So, it is necessary to remove the different artifacts and also to process the ECG signal for the accurate diagnosis of heart related diseases.

The paper is organized as follows. Section 2 deals with the proposed system. Section 3 discuss the diagnosis. Section 4 discuss the result and Section 5 concludes the paper.

II. PROPOSED SYSTEM

A. OBJECTIVE

An algorithm to prevent and detect the various Cardio Vascular Diseases can be done by using peak detection where the number of pulses is calculated after the series of steps of filtering, differentiating, squaring and integration. Usually, the normal heart beat of a person is 72bpm if the number of pulses exceeds 80 it give raise to tachycardia and if the number of pulses is less than 60 it give raise to Bradycardia from which the diseases is diagnosed.

B. BLOCK DIAGRAM

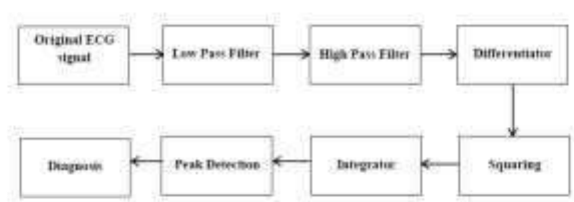


Fig 2.1: Block Diagram of Proposed Method

C. ECG Filtering

ECG signal processing is a huge challenge since ECG signal has been a major diagnostic tool for the cardiologists and it provides almost all the information about electrical activity of the heart. So care should be taken while doing the ECG filtering, such that the desired information is not distorted or altered in any way. There exists a maximum probability of unwanted signals called noise which gets added to the original ECG signal in real time applications like biotelemetry,etc,

Low-pass filters provide a smoother form of a signal, removing the short-term fluctuations, and leaving the longer-term trend. High-pass filters are also used in digital signal processing to perform signal modifications, enhancements, noise reduction, etc.,

Differentiator plays an important role in modeling virtually every physical, technical, or biological process, from celestial motion, to bridge design, to perform interactions between neurons, such as those used to solve real-life problems may not necessarily be directly solvable, i.e. do not have closed form solutions and it is standard technique to find high slopes.

Integration is often introduced as the reverse process to differentiation, and has wide applications, for example in finding areas under curves and volumes of solids, central points and many useful things, but it is easiest to start with finding the area under the curve.

Peak formation is based on peak build up or degradation, peak shift, multiple peaks mechanisms, etc. Peak shape depends on classical geometry rules such as skewnness, curtosis, parabolic approximation, baseline, non-linearity, continuity, weak peaks etc.

III. DIAGNOSIS

a.Tachycardia

The arrhythmia often appears under circumstances characterized by an increase in sympathetic tone (fear, stress, exercise), in the presence of fever, heart failure or hyperthyroidism or after administration of stimulants (coffee, tea, snuff) and some drugs. Tachycardias occur with rapid irregular heartbeat in the chest, chest discomfort, weakness, shortness of breath, sweating, and dizziness. They are further classified into

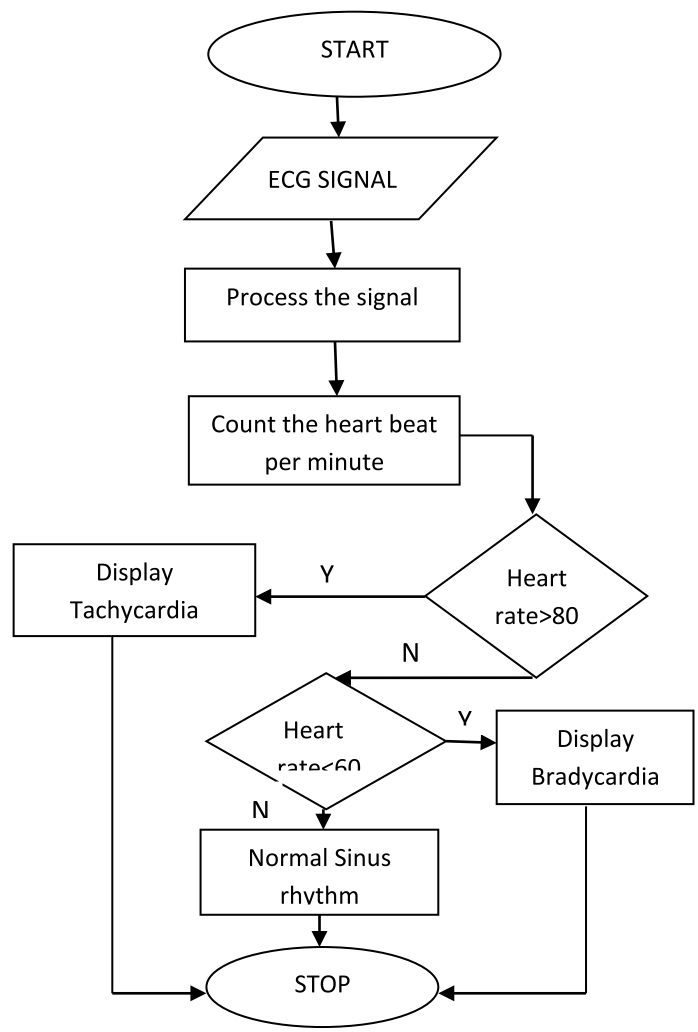
- Supraventricular tachycardia
- Ventricular tachycardia

b. Bradycardia

Bradycardias are those situations in which the heart beats at a frequency slower than normal, i.e., less than 60 beats per minute. Bradycardia can occur by decreasing the frequency at which pulses are generated in the sino- atrial node (sinus bradycardia) or because the impulses which are generated at this level cannot stimulate the whole heart because they are blocked at some point of the conducting system that conduct electrical impulses through the heart.
They are classified into

- Sinus Bradycardia
- Atrio-ventricular (AV) block
- Intraventricular abnormalities

C.FLOW CHART



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V. EXPERIMENTAL SETUP

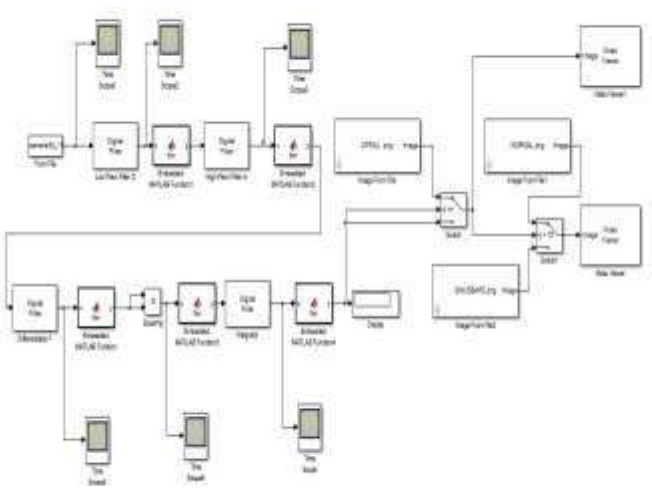

Figure 4.1 Simulink Block Diagram

The block diagram of the overall process is shown in Figure. Initially the ECG signal is extracted from MIT-BIH Arrythmia Database and it is given as an input to the low pass filter by using the From File Directory and the noise is removed which can be viewed in scope. The output of the low pass filter is fed as an input to the high pass filter which maximizes the ECG signal and the numerator and denominator co-efficients are extracted from the result and the output is viewed through scope1. The output of high pass filter is differentiated using derivative operator which is a standard technique for finding the slopes. The derivative procedure suppresses the low frequency component and increases the gain of high frequency component and the output can be viewed via scope 2. The differentiated output is squared so as to bring the data points on positive side that emphasizes large differences resulting from QRS complexes and the small differences arising from P and T waves which are suppressed. The high frequency components in the signal related to the QRS complex are further enhanced. The squared waveform passes through a moving window integrator which sums the area under the squared waveform over a suitable interval, and integrates the new predefined interval window. For adults normal heart beats ranges from 60-80 bpm . Therefore,from the output of integrator the number of peaks are determined and displayed in display screen as “Normal”, “Atrial Tachycardia”, “Sinus Bradycardia”.

V. RESULTS

LOADING SAMPLE VALUES OF ECG SIGNAL

From the MIT-BIH arrhythmia database, several samples of ECG signals were taken. The Figure 5.1 shows the plot of ECG signal for data set.100.Imported ECG signal is passed into low pass filter so as to remove the power line interference noise which is a sinusoidal signal of 60Hz frequency.

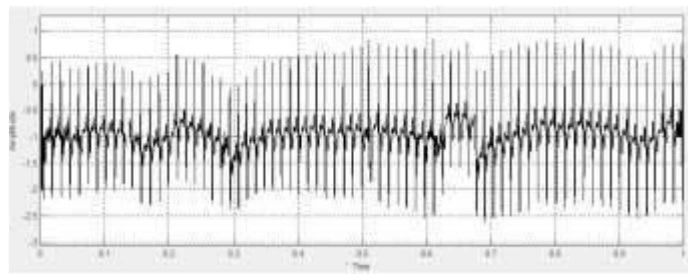

Figure 5.1 Original Noisy Signal

LOW PASS FILTERING

The low pass filter for the QRS detection algorithm reduces noise in the ECG signal by matching the spectrum of the average QRS complex. The pass band that maximizes the QRS energy is in the 5Hz-35Hz range. This attenuates noise such as power line interference, baseline wander and T wave interference. The output of low pass filter is fed as an input to high pass filter where the unwanted noise sources are removed. The output of low pass filter is shown in Figure 5.2 where the power line interference noise is removed

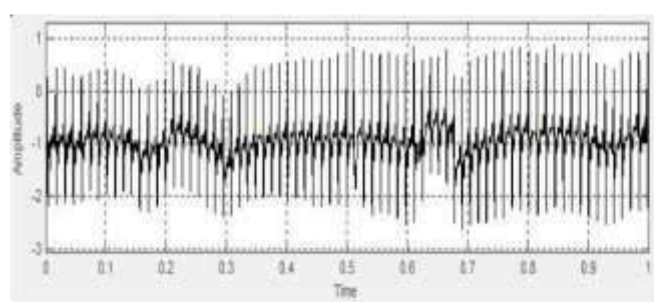

Figure 5.2 Output of low pass filter

HIGH PASS FILTERING

The high pass filter will maximizes all the available QRS peaks. The filter implemented in this algorithm is composed of cascaded high pass and low pass Butterworth FIR filters.The

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output of high pass filter is fed as an input to the differentiator. The output of high pass filter is shown in Figure 5.3 where the ECG signal is maximized.

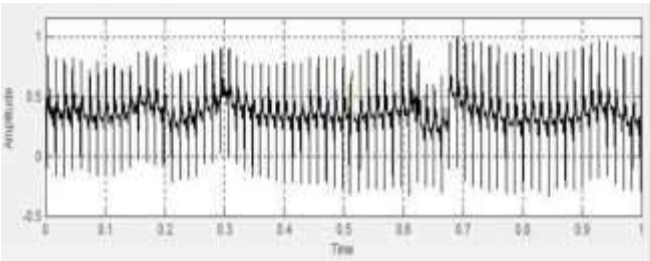

Figure 5.3 Output of high pass filter.

DIFFERENTIATING

The next processing step is differentiation standard technique for finding the high slopes that normally distinguish the QRS complexes from other ECG waves.The output of differentiator is shown in Figure 5.4 where the P and T waves are suppressed and provides a large gain to the high-frequency components arising from the high slopes of the QRS complexes and it is used to maximize the QRS complex.

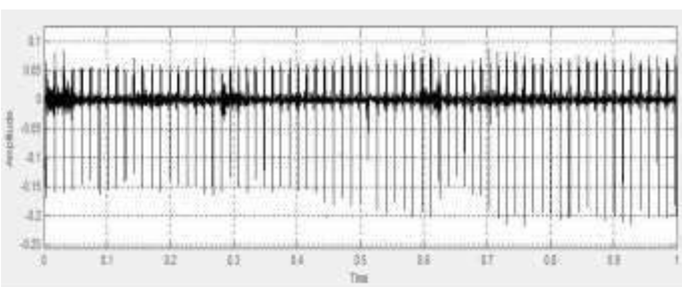

Figure 5.4 Output of differentiator

SQUARING

The squaring operation makes the result positive and emphasizes large differences resulting from QRS complexes. The small differences arising from P and T waves are suppressed. The high frequency components in the signal related to the QRS complex are further enhanced. The output of squaring is shown in Figure 5.5 where all the data points of the signal are made positive.

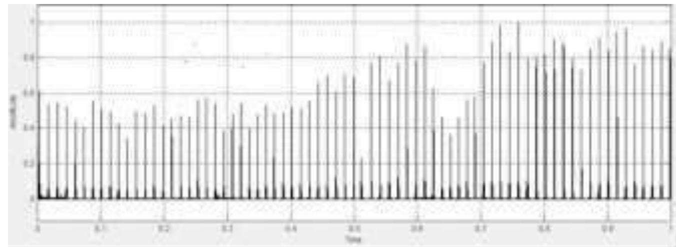

Figure 5.5 Output of squaring

INTEGRATING

The squared waveform passes through a moving window integrator. This integrator sums the area under the squared waveform over a suitable interval, advances one sample interval and integrates the new predefined interval window.The output of integrator is shown in Figure 5.6 where the waveform feature information are extracted

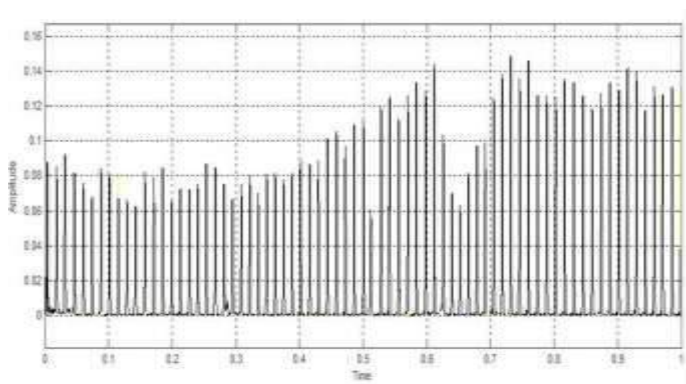

Figure 5.6 Output of integrator

PEAK DETECTION

From the output of integrator the number of pulses is determined. Figure 5.7 shows the heart beat of a normal person where the heart beat is counted and displayed as 72 bpm.

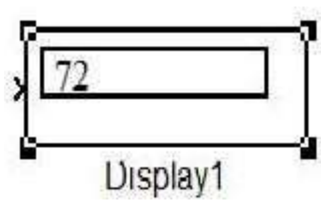

Figure 5.7 Heart beat of a normal person (72bpm)

If the number of beats is above 90, it gives rise to tachycardia. Data set.212 is taken as an input for the algorithm and Figure shows 5.8 the heart beat of a abnormal person where the heart beat is 91 bpm

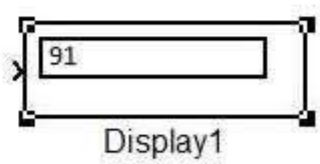

Figure 5.8 Heart beat of an abnormal person (91bpm)

V. CONCLUSION

The detection of cardiovascular diseases using the Simulink blocks was constructed and tested on real signals with different artifacts obtained from MIT-BIH database. From the result, it is clear that this proposed treatment diagnoses different cardiac arrhythmias based on the number of pulses. Moreover, this will help to make faster the diagnosis procedures and it will be more accurate diagnosis before the doctors indicate that the patient have serious heart related illnesses. In future, it is expected that the implementation of this proposed efficient diseases predictor algorithm in any DSP/FPGA hardware kit plays a vital role in cardiology as well as in the field of biotelemetry applications.

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