IASET: International Journal of Electronics and Communication Engineering (IJECE)
ISSN (P): 2278-9901; ISSN (E): 2278-991X
Vol. 5, Issue 4, Jun – Jul 2016; 15-22

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

DETECTION OF HEART ABNORMALITIES USING LABVIEW

C. SOMASUNDAR REDDY[1] & M. SARAVANAN[2]

[1]Assistant Professor, SVEC, A. Rangampet, India

[2]Professor, SVEC, A. Rangampet, India

ABSTRACT

This paper gives an insight to labview software tools which helps in analysis of ECG signals. The raw ECG data are taken from MIT-BIH Arrhythmia database. In the first stage ECG signal is acquired which is then followed by filtering the raw ECG signal to remove unwanted noises. The next stage focuses on extracting the features from the acquired signal. Finally different types of abnormalities are detected on the basis of features obtained. Thus the developed system predicts the heart abnormalities of a person, even before him/her consulting a doctor (preliminary investigation). The technique is user-friendly, low cost and hence anyone skeptic of heart problem can analyse his/her ECG using this efficient method.

KEYWORDS: ECG, LabView, Biomedical Tool Kit, Abnormalities

INTRODUCTION

The method to monitor and record electric current generated due to the contraction and Expansion of atria and ventricles of the heart is known as Electrocardiography and the device used for these is called as electrocardiogram. ECG is most commonly used instead of electrocardiogram. For the recording and measuring these electrical signals electrodes are placed on the skin of subject (patient). Locations are specified for picking up the signals through electrode are between muscles on the upper arms and lower legs. The waveform so obtained after connecting electrodes through ECG could be traced out on computer or paper plot. The result helps the specialist in observing the condition of heart and diagnosis the problem associated with the various heart activity of the subject. A normal ECG tracing is shown in Figure 1 and the various components of the ECG are shown in Figure 2.

Figure 1: A Normal ECG Signal

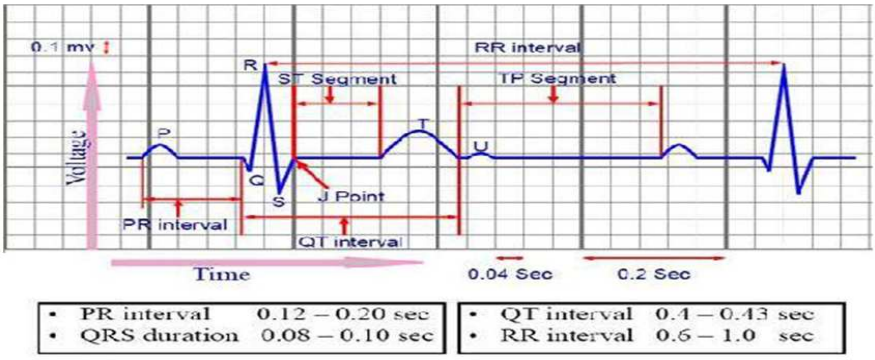

Figure 2: Different Segment of a Single Waveform and Time Duration

An electrocardiogram (ECG) signal shows the electrical activity of the myocardium, which appears as a periodic signal. Generally, ECG cycle is labelled utilizing the letters P, Q, R, S and T, sometimes U wave for the individual peaks of the whole cycle's waveform where R peak is always positive as shown in Figure 2, The diagnosis is performed on the basis of features extracted from the morphology and timing of these important points.The LABVIEW has the facility to read ECG signals from external files that can be downloaded from MIT-BIH Arrhythmia Database. The signal taken can be processed with the help of Advanced Signal Processing tool kit and biomedical tool kit of LabVIEW to extract various features of ECG like P onset, P offset, QRS onset, QRS Offset, T onset, T offset, R, P & T wave, with which we can calculate various parameters like Heart rate, QRS amplitude and their time duration.

ECG SIGNAL PROCESSING

The recorded ECG signal is most often contaminated with noise and artifacts. To process that contaminated signal will give incorrect information about the patient which may lead to dangerous condition. To circumvent such situation processing of raw ECG is necessitates.

To process the raw ECG functionally signal processing is divided into two parts: pre-processing and feature extraction. During the pre-processing stage the unwanted noise suppresses from ECG signal and feature extractor process gives lead to diagnostic information while extracting the various features of ECG wave.

With the help of LabVIEW and its tool kits Advanced Signal Processing, Digital filter Design and Biomedical we can do the needful for ECG signal. Figure 3 shows the flowchart of ECG signal processing.

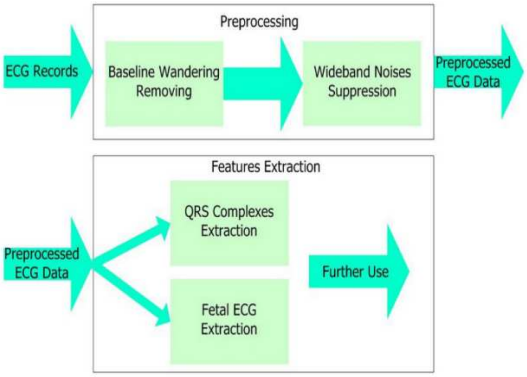

Figure 3: Flow Chart of ECG Signal Processing

ECG can be contaminated with power line interference, contact noise or electrode pop, patient–electrode motion artifacts, electromyography (EMG) noise, baseline wandering. ECG signal analysis can be strongly affected by the power line interference and the baseline wandering amongst all noises. The ECG signal also gets distorted with other noises which could be wideband and usually a complex stochastic process except for these two noises.

The power line interference is narrow-band noise centered at 50 Hz with a bandwidth of less than 1 Hz. Power line interference from ECG signal can be removed during acquisition of signal through hardware. A more powerful and feasible software scheme is used to remove the baseline wandering and other wideband noises which are not easy to be suppressed by hardware equipments.

LABVIEW PROGRAM

The LabVIEW has been used to acquire the ECG data obtained from physionet and display the raw ECG. Afterthe data acquisition, the ECG waveform data are sent to Express Virtual Instruments for signal processing. This part of the process consists of digital filtering, digital smoothing, wavelet de trend, and wavelet de noise. The wavelet de-trend and wavelet de-noise is a part of the Advanced Signal Processing Toolbox, which is very useful for ECG signal processing.

Signal processing removes the noise artifact .i.e., power interference, white noise from the signal. The signal is then passed to ECG feature extractor which gives parameter of ECG waveform. To calculate heart rate, the program will first find the maximum and minimum value from the processed signal in order to decide the threshold needed for the peak and valley detection.

Virtual Instrument (VI) provides the period from peak and valley and thus the heart rate based on peak and valley is obtained. After heart rate calculation is done, this signal is passed to disease detection module which compares the ECG parameters with the normal parameter according to some rule specified and indicate the disease in front panel of virtual instrument.

The processed signal is simultaneously being displayed in front panel to show the result of each step performed in virtual instrument designed After that, the program loops to the first stage and start to collect the next data and repeats the above process up to the length of prediction period. It performs the whole process until the end of data or process stopped by the user to view the result.

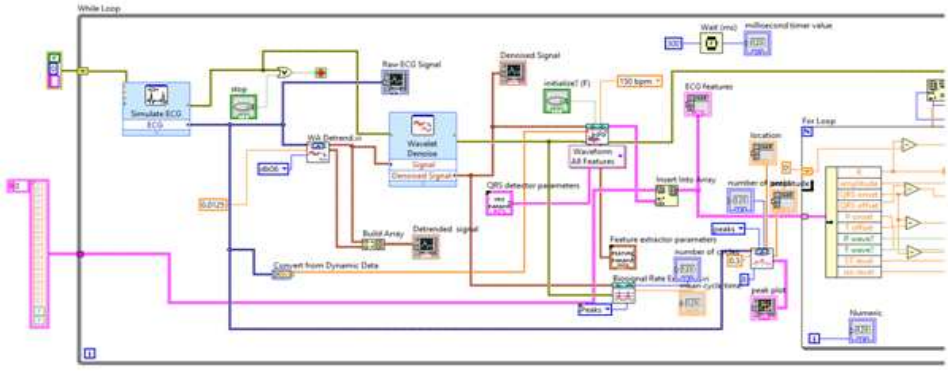

Figure 4: VI Diagram for Pre-Processing and Peak Detection

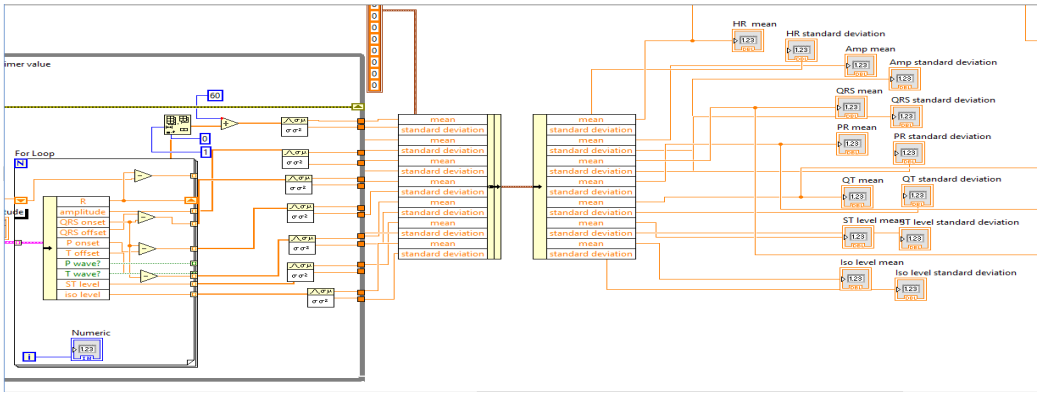

Figure 5: VI Diagram for Feature Extraction

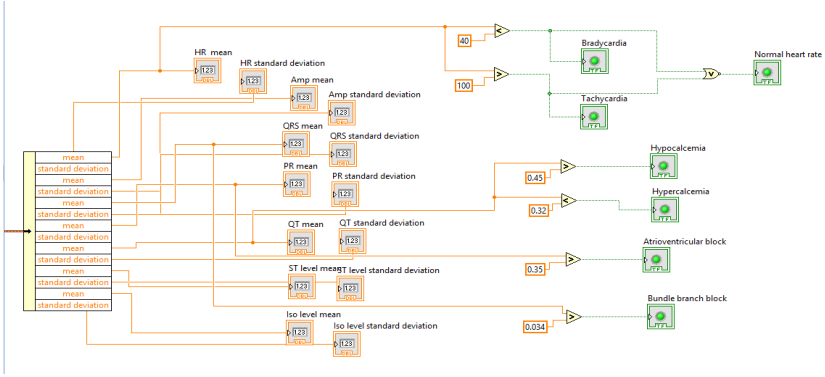

Figure 6: VI Diagram for Detection of Cardiac Disorders

RESULTS AND DISCUSSIONS

The Heart rate module present inLabVIEW can also be used to detect heart rate as shown. This rate is approximately equal to heat rate calculated from the bio-signal rate using mean cycle time between two R waves. Heart rate is equal to 60/mean cycle time. After getting various parameters of ECG signal, these values are compared with the normal ECG parameters and if abnormality persists then it will indicate the disease mostlikely present in patient whose waveform is being analysed.

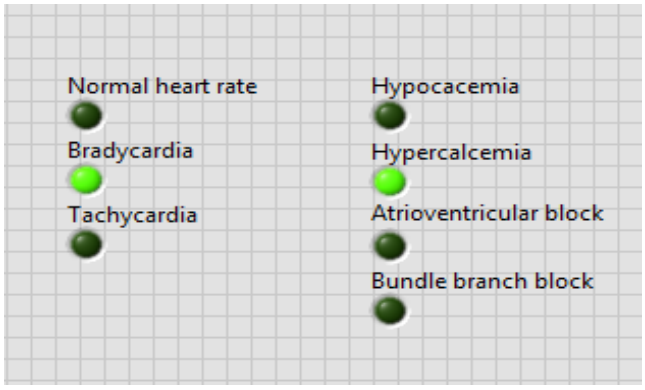

Figure 7: Feature Extraction

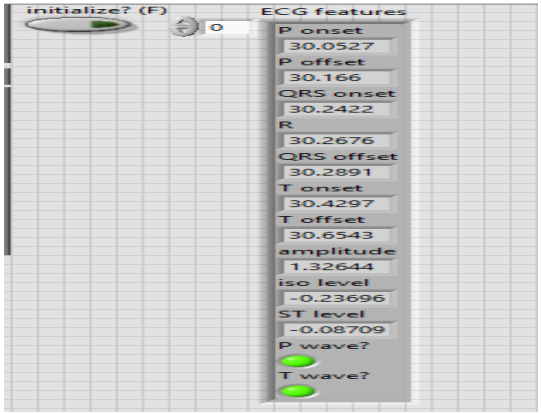

Figure 8: Calculation Mean and Standard Deviation

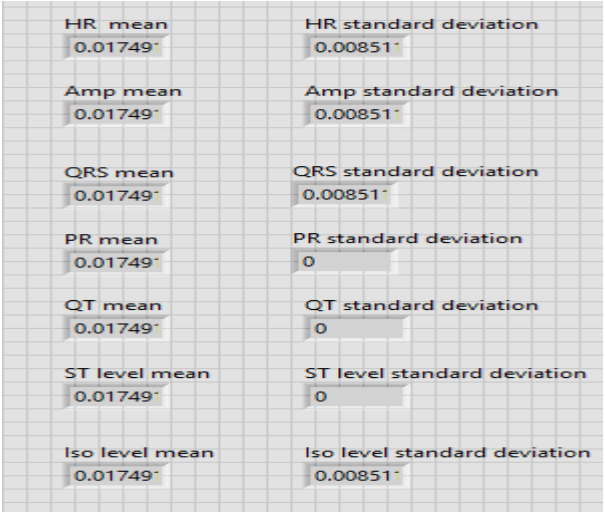

Figure 9: Detection of Heart Abnormalities

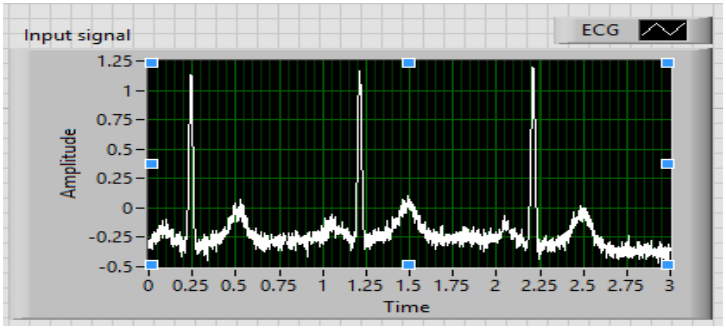

Figure 10: Input Normal ECG Signal

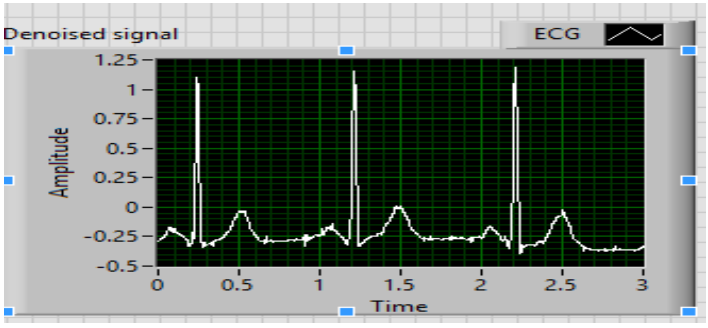

Figure 11: Output Denoised Signal of ECG

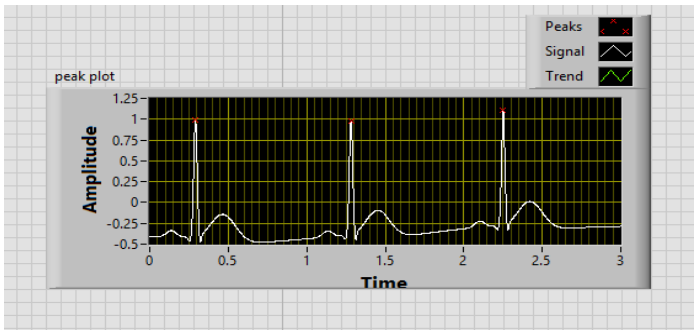

Figure 12: Output Waveform of Peak Plot

CONCLUSIONS

In this paper we see that LabVIEW has immense effect on signal processing. By using Lab View WA detrend VI and Wavelet Denoise Express VI of Advanced Signal Processing tool Kit the baseline wandering and wideband noise in ECG signal data taken from MIT-BIH database 100,101 and 103 has been successfully removed. Due to varied of algorithm, large diversified waveform not universally accepted solution has been found which can extract ECG features. The advantage of LABVIEW graphical programming language is that, it provides a robust and efficient environment and tool for generating very fast, less complex and useful algorithms.

REFERENCES

1. Goutam Kumar Sahoo, Samit Ari,Sarat Kumar Patra," ECG signal analysis for detection of Heart Rate and Ischemic Episodes" International Journal of Advanced Computer Research (ISSN (print): 2249-7277 ISSN (online): 2277-7970) Volume-3 Number-1 Issue-8 March-2013.
2. Juan Pablo Martínez, Rute Almeida, Salvador Olmos, Ana Paula Rocha, and Pablo Laguna, "A Wavelet-Based ECG Delineator: Evaluation on Standard Databases". IEEE Transactions on Biomedical Engineering, Vol. 51, No. 4, April 2004.
3. R. M. Rangayyan, Biomedical Signal Analysis: A Case-study Approach, Wiley-Interscience, New York, 2001, pp. 18-28.
4. Pan, W.J. Tompkins, A real-time QRS detection algorithm, IEEE Trans. Biomed. Eng. BME-32 (3) (1985) pp. 230-236.
5. S. C. Saxena, V. Kumar and S.T. Hamde, "Feature Extraction from ECG signals Using Wavelet Transform for disease diagnosis", International journal of system science, 2002, volume 33, number13, 1073 -1085.
6. S. Nibhanupadi, R.Youssif and Purdy, "Data specific signal denoising using wavelets, with applications to ECG data", The 47th IEEE International Midwest symposium on circuits and systems, 2004, 219- 222.
7. J. S. Sahambi, S. N. Tandon and R. K. P. Bhatt, A new approach for on-line ECG characteristics, 409-411.
8. www.physionet.org