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SIMULATION OF BIOMEDICAL SIGNAL USING VIRTUAL INSTRUMENTATION

[1]Devdatta Y. Gandole, [2]Anjali. J. Deshmukh

[1]Department of Electronics and Telecommunication
PVPIT, Pune (India)

[2] Department of Electronics
Shri Shivaji College
Akola-444001 (India)

Abstract: Biomedical signals are the collection of electrical signals acquired from any organ of human body. Careful analysis of biomedical signals such as ECG, EMG, and EEG are very important for proper diagnosis of disease. Biomedical signal ECG can be acquired using various software's. National Instruments Lab VIEW is used to design the biomedical signal (ECG) acquisition experimental system and then briefly outlines its salient characteristics. The aim is to provide a new approach to fully understand signal acquisition, and data-saving process in biomedical research. It is a flexible experimental platform for exploring new biomedical signal acquisition methods.

Index Terms **- Virtual instrumentation, Lab VIEW, Biomedical Signal**

I. INTRODUCTION

Biomedical signal means a collective electrical signal acquired from any organ that represents a physical variable of interest. This signal is normally a function of time and is describable in terms of its amplitude, frequency, and phase. The analysis of these signals is very important for researchers and careful medical diagnosis and proper treatment are also essential. If the signals are not properly diagnosed and analyzed, it will lead to wrong diagnosis and can be dangerous for the lives. The design of real time ECG acquisition system is difficult since real time environment is not always available for the performance analysis of these systems. The existing biomedical signal analyzer systems are more expensive. The use of advanced virtual instrumentation system based on National Instruments LabView software makes the system cost efficient and can be utilized as a test bench for the study of biomedical signals at the laboratory level. ECG is an important biomedical parameter and is used clinically in diagnosing various diseases and conditions associated with the heart. The acquisition of a real time ECG signal requires an expensive cardiac machine and experienced doctors who can interpret the output signal. However in developing and underdeveloped nations due to scarcity of resources and manpower, especially in rural areas, common people cannot make use of this technology. Thus deaths due to common heart problems are very frequent as they are not diagnosed in properly by the expert doctors.

II BIOMEDICAL SIGNAL - ECG

The ECG records the electrical activity of the heart, where each heart beat is displayed as a series of electrical waves characterized by peaks and valleys. Any ECG gives two kinds of information.

(i) The duration of the electrical wave crossing the heart which in turn decides whether the electrical activity is normal or slow or irregular

(ii) The amount of electrical activity passing through the heart muscle which enables to find whether the parts of the heart are too large or overworked

Normally the frequency range of an ECG signal is 0.05– 100 Hz and its dynamic range – of 1–10 mV. The ECG signal is characterized by five peaks and valleys labelled by the letters P, Q, R, S, T. In some cases we also use another peak called U. The performance of ECG analyzing system depends mainly on the accurate and reliable detection of the QRS complex, as well as T and P-waves. The P-wave represents the activation of the upper chambers of the heart, the atria, while the QRS complex and T-wave represent the excitation of the ventricles or the lower chamber of the heart. The detection of the QRS complex is the most important task in automatic ECG signal analysis. Once the QRS complex has been identified a more detailed examination of ECG signal including the heart rate, the ST segment etc. can be performed [1]. From the recorded shape of the ECG, we can say whether the heart activity is normal or abnormal. The electrocardiogram is a graphic recording or display of the time variant voltages produced by the myocardium during the cardiac cycle. The P-, QRS- and T-waves reflect the rhythmic electrical depolarization and repolarization of the myocardium associated with the contractions of the atria and ventricles. This ECG is used clinically in diagnosing various abnormalities and conditions associated with the heart.

The normal value of heart beat lies in the range of 60 to100 beats/minute. A slower rate than this is called bradycardia (Slow heart) and a higher rate is called tachycardia (Fast heart). If the cycles are not evenly spaced, an arrhythmia may be indicated. If the P-R interval is greater than 0.2 seconds, it may suggest blockage of the AV node.

• Each action potential in the heart originates near the top of the right atrium at a point called the pacemaker or sinoatrial (SA) node.
• The wave generated by action potential, terminates at a point near the center of the heart, called the atrioventricular (AV) node.
The horizontal segment of this waveform preceding the P-wave is designated as the baseline or the isopotential line. The P-wave represents depolarization of the atrial musculature. The QRS complex is the combined result of the repolarization of the atria and depolarization of the ventricles, which occur almost simultaneously. The T-wave is the wave of ventricular repolarization, where as the U-wave, if present is generally believed to be the result of after potentials in the ventricular muscle.
So, the duration amplitude and morphology of the QRS complex is useful in diagnosing cardiac arrhythmias, conduction abnormalities, ventricular hypertrophy, myocardial infection and other disease states
The growing health concerns, especially for cardiac disorders reflect on the need of developing a simple inexpensive and portable ECG system. In the present work, a simple Biomedical Signal simulator module has been developed using LabVIEW that displays ECG wave [3].

III CHALLENGES IN BIOMEDICAL SIGNAL ACQUISITION

Biomedical signals are a very small signals and it is difficult to capture. The biomedical signals are noisy as well as artifacts and reduce the performance of biomedical signal. During signal processing, the system picks up noise signal along with desired signal. Therefore for the proper treatment of a patient, it should be removed from the original signal. Using an amplifier with high gain, high input impedance and differential input with good common mode rejection, various filter circuits could reduce the noise from biomedical signals. Now various mathematical techniques and Artificial Intelligence approaches are being used for noise reduction. Literature reviews show that in nonlinear system identification, a mathematical model includes wavelet transform, time frequency approaches, Fourier transforms, Wegner-Villie Distribution, statistical measures and higher order statistics. AI includes artificial neural network, dynamic recurrent neural network, Fuzzy logic system and genetic algorithm. Measuring and accurately of biomedical signal depends on the properties of electrodes and their interaction with skin, amplifier design and the conversion and subsequent storage of the biomedical signal from analog to digital form.
Biomedical applications using signal processing techniques are a major area of interest and investigating various adaptive filters and artificial intelligent model. The lot of bio-engineers and researchers from medical field are keenly interested for design of techniques to obtain noiseless biomedical signals.

IV VIRTUAL INSTRUMENTATION

A virtual instrument consists of a computer, software, and modulator hardware; all combined and configured to emulate the function of traditional hardware instrumentation. Because their functionality is software-defined by the user, virtual instruments are extremely flexible, powerful and cost-effective.
A typical system of Virtual Instrumentation is constituted by a set of devices capable of communicating between them and for a program that controls the mentioned communication. From the information loaded by the different devices we can change the conditions of the test, modifying parameters of the measurement instruments.
LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a commercial product from National Instruments and runs on several host machines (PC, Macintosh, or Sun workstations). LabVIEW is a powerful graphical development environment for signal acquisition, measurement analysis, and data presentation, giving the flexibility of a programming language without the complexity of traditional development tools.
LabView is a graphical programming environment which provides high-level network capabilities. This software platform has provided us with the ability to perform remote handling of equipment in a highly interactive manner, but with enough simplicity. Labview allows to load, to analyze and to monitor the information inside a graphical programming environment in which there are assembled objects called virtual instruments to form the program of application with which the user will interact.
In addition LabView allows the information representation in interactive panels that work as if it was a real instrumentation, and it allows multiple options of information treatment, as his storage on disc and to share them in network or with other applications. The interaction with other applications will be able to be carried out by means of calls to bookshops of dynamic link (DLL: Dynamic Link Library) and dynamic exchange of information (DDE: Dynamic Data Exchange) in local way or by means of TCP/IP in remote connections. Always looking for independence of the platform in which we have carried out our application. A measurement instrument that we can have in any laboratory remains perfectly defined by a few controls and a few elements of representation. However, a virtual instrument will be related to the concept of software. This software will execute in a computer that will have a few elements lodged hardware concrete, information acquisition cards (analogical and digital), cards of interface with the buses of instrumentation and a few channels of control also analogical and digital [2].

V SIMULATION OF BIOMEDICAL SIGNAL USING LABVIEW

For viewing the biomedical signal such as ECG signal, software must be used to convert the electrical impulse into a visual representation that we can see and understand. Virtual cardiograph has been designed using LabVIEW software of National Instruments. The cardiograph is used for monitoring of the ECG signal [4, 5]. In this case the signal was taken from ECG simulator. Figure (1) shows front panel diagram. ECG signal was displayed for various parameters such as P-wave magnitude, T-wave magnitude, QRS-magnitude, Noise amplitude, Baseline fluctuation frequency, No. of iterations and others as shown in block diagram The acquired signal from ECG simulator has been shown in Figure (2) for BMP = 30 which indicates the abnormality of bradycardia. Similarly Figure (3) shows the virtual cardiograph for BMP = 60. Figure (4) shows the virtual cardiograph for BMP = 140 which shows the problem of tachycardia. Figure (5) shows virtual cardiograph for BMP = 60, with noise amplitude = 4 mV, T-wave Mag.= 0.5 Volt , P-wave Mag.= 0.3Volt, Functional amplitude 3Volt. Thus by adjusting the various parameter values different types of virtual cardiographs can be generated and studied. Data logger can also be made that provides the numeric values of acquired waveforms in terms of Virtual voltage and x-values. The corresponding data can be read in terms of graph on LabVIEW. Cardiograph has provision to start acquisition and save data that gives more flexibility to the cardiologist.
It is often necessary to permanently store ECG-data acquired. LabVIEW includes the ability to create a LabVIEW measurement file, an ASCII text file that can be read by a spreadsheet, or a text editor. The LabVIEW measurement file is easy to create. When we place the Write LabVIEW Measurement File Express VI on the block diagram, a configuration dialog box appears where we can specify how to store the file. [2]

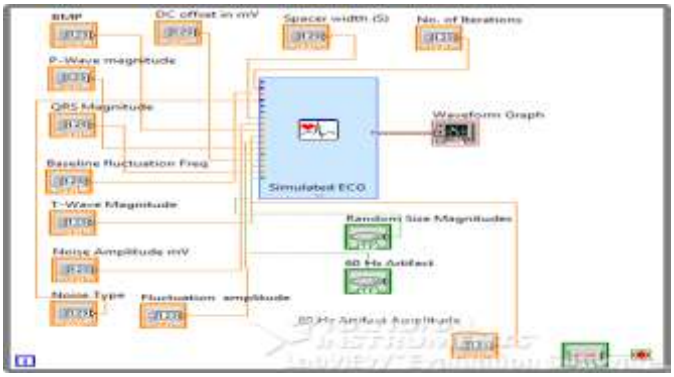

Figure (1): Front panel of ECG Simulator

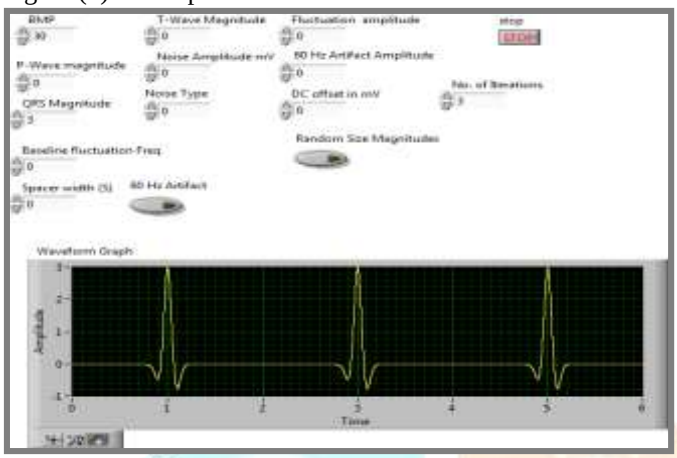

Figure (2): Simulation of ECG for BMP = 30

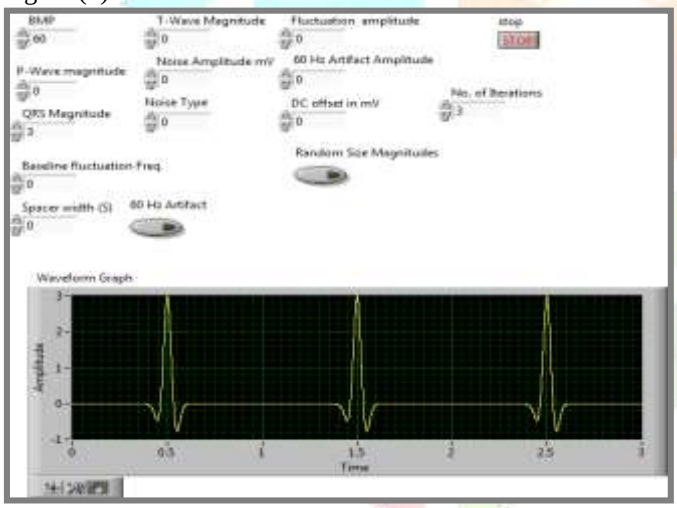

Figure (3): Simulation of ECG for BMP = 60

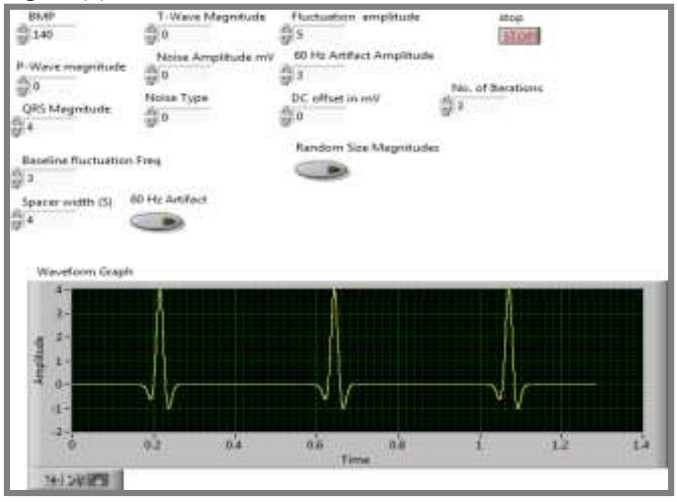

Figure (4): Simulation of ECG for BMP = 140

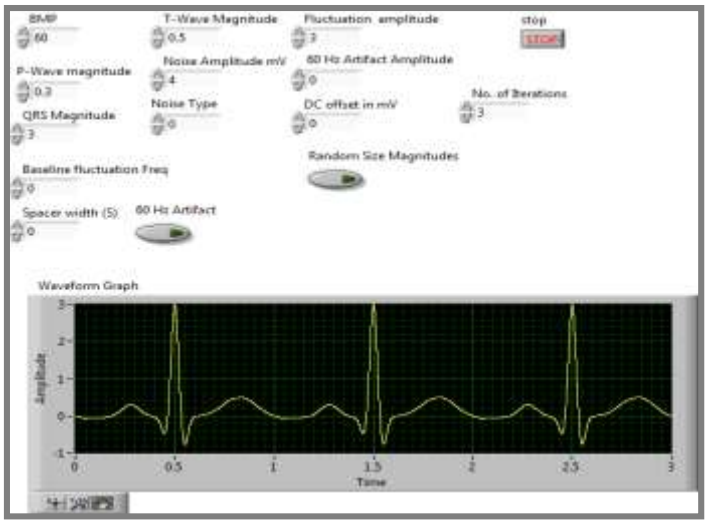

Figure (5): Simulation of ECG for BMP = 60 , with noise amplitude= 4mV, T-wave Mag.= 0.5V, ,P-wave Mag.= 0.3V, Functional amplitude 3V.

CONCLUSION

The use of virtual instrumentation system based on National Instruments LabView software is much more helpful for the acquisition and analysis of biomedical signals. Thus software makes the system cost efficient and can be utilized as a test bench for the study of biomedical signals at the laboratory level with more interactive and simplicity.

It can rapidly create applications using intuitive graphical language, it is easy to customize the instruments and add new functionality by modifying the LabVIEW code.

REFERENCES:

[1] [Online]. Available: http://matlab-project-codes.blogspot.com/2010/08/algorithms-for-ecgs

[2] LabVIEW based Advanced Instrumentation Systems. By: S. Sumathi and P. Surekha © Springer-Verlag Berlin Heidelberg 2007

[3] The ECG Biomedical Engineering The University of Connecticut, BME Program Director: Dr. John D. Enderle**]**

[4] J. A. Moczko, L. Kramer, et.al "virtual instrumentation
in medical investigation and diagnosis support' proceeding of 23rd Annual EMBS international conference of IEEE pp 1888-1891 Oct. 25-28, 2001, Istanbul, Turkey.

[5] D .S. Benitez, A. zaidi, "virtual instrumentation for clinical assessment of cardiovascular and automatic functions'" IEE Proc- Sci. Measurement Technology, vol. 147, no. 6 pp 397-402, Medical Signal Processing, IEEE, Nov. 2000. WSEAS TRANSACTIONS on BIOLOGY and BIOMEDICINE