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Design and Development Virtual ECG Machine with Problem Identification Using Labview

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----------ABSTRACT----------
The electrocardiogram (ECG) is a recording of the electrical activity of the heart which serves in diagnostic application. The ECG records the electrical activity that results when the heart muscle cells in the atria and ventricles contract. The ECG waveform is analyzed by the cardiologist in diagnosis various disease and condition associated with the heart. The purpose of this project is to develop a virtual ECG machine through Lab VIEW. The function of this system is to identify the various heart diseases with respect to change in QRS complex, P wave, and T wave of the patient. Three electrodes a signal from ECG amplifier is then interfaced with Lab VIEW software for the purpose of display and enabling for further signal processing. Signal is analyzed through Lab VIEW, the output of the system re connected to the human body, one on the right arm, left arm and other on the right leg as reference or ground to extract ECG signal from human body. The electrical signal appeared at the ECG input is typically less than 1mV and it is essential to amplify. An Amplifier circuit is designed to acquire and process the signal. The output of the circuit is recorded on a PC using Lab VIEW (DAQ card) interface card. Normally, the problem of amplification is signal has a lot of noise interference which appears at the input from ac power line, arrangement of component and other source. These interferences should be overcome.

KEYWORDS: *Data Acquisition, ECG, LabVIEW, Virtual instrumentation.*

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I. INTRODUCTION

A recording of the electrical activity of the heart, which serves in diagnostic application, is called the electrocardiogram (ECG). In 1893, Willem Einthoven introduces the term of electrocardiogram at the meeting of the Dutch Medical Society. In 1924, he got the Nobel Prize for his life's work in developing the ECG. All the information on the condition and performance of the heart can be gain from the ECG recording. The ECG recording can be made by applying electrodes to various parts of the body. Normally for the standard recording, the electrodes can be applied at four points and the chest wall. In this project, only three electrodes are used to capture the signal, which is on the right arm, left arm and the right leg. Standardizing electrocardiogram makes it possible to compare them as taken from person to person and from time to time from the same person.

Biomedical signals are fundamental observations for analyzing the body functions and for diagnosing a wide spectrum of diseases. The analysis of ECG has been widely used for diagnosing many cardiac diseases. The ECG is a graphic record of the duration and magnitude of the electrical activity that is generated by depolarization and repolarization of the atria and ventricles. One cardiac cycle in an ECG consists of the P-QRS-T waves. Most of the clinically useful information in the ECG is found in the intervals and amplitudes defined by its features (characteristics wave peaks and time durations). The development of accurate and quick methods for automatic ECG feature extraction is of major importance. The ECG feature extraction provides fundamental features (amplitudes and intervals) to be used in subsequent automatic analysis. Producing an algorithm for the detection of the P wave, QRS complex and T wave in an ECG is a difficult problem due to the time varying morphology of the signal subject to the physiological conditions and presence of noise. The algorithms in the relevant bibliography adapt a range of different approaches to yield a procedure leading to the de-noising and identification of the waves under consideration.

These approaches are mainly based on wavelet, matched filters, Poisson transform, mathematical morphology, fuzzy logic, Lab VIEW. From the bibliography, it is seen that Lab VIEW can be used effectively for QRS detection. In a virtual instrumentation system, a computer including calculating, storing, replaying, accessing, displaying and file managing etc. are used which realize performing the functions of traditional instrumentation via software. Therefore a Virtual ECG Instrumentation system is a new Instrumentation system, which is much better and flexible with the aid of computer intelligent resource.

1.2 Heart Blood Flow Sequence

In the lungs up oxygen and releases carbon dioxide. This oxygenated blood flows back through the pulmonary vein to the left atrium. The blood then travels through In the lungs, the blood picks the mitral valve to the left ventricle, and is then pumped through the aortic valve to the aorta. The aorta branches into the many arteries, and then capillaries, delivering oxygenated blood to the body's organs, tissues and cells. Once the capillaries deliver the oxygen to the cells, the now deoxygenated blood travels to veins, and then to the superior and inferior vena cava to start all over again. Both left and right sides of the heart pumps blood at the same time. The blood is pumped out of the heart each time the heart muscle contracts or beats. This is called the systole. This pumping takes place in two stages. First the right and left atria contract pumping blood into the right and left ventricles, respectively. Then the ventricles contract pumping blood out of the heart. The heart muscle then relaxes, called the diastole, and the heart fills with blood again before the next heartbeat. the heart just like any other organ requires blood to supply it with oxygen and other nutrients so that it can do its work.

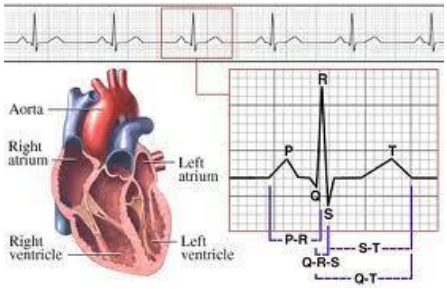

Figure 1.2.1 Heart Blood Flow Sequence

The heart does not extract oxygen and other nutrients from the blood flowing inside it. The heart gets its blood from coronary arteries that eventually carry blood within the heart muscle.

In Figure 1.2**, P wave** is created by atrial depolarization. **PR interval** represents transmission of an electrical impulse from node through the atria. **QRS complex** represents depolarization of ventricles and their subsequent contraction. **ST segment**, from completion of QRS complex to the beginning of T wave, represents the start of the repolarization of the ventricles. **T wave** represents the repolarization of ventricles. **U wave** is not clear and it is difficult to identify, frequently causing miscalculations in ECG readings.

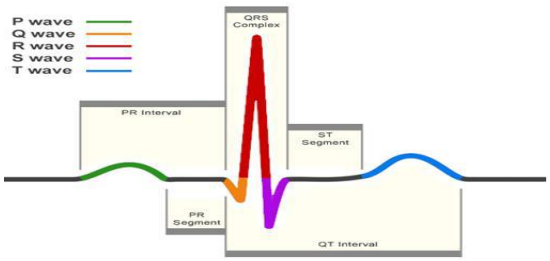

Figure 1.2.2 normal ECG wave

Physiological conditions and presence of noise. The algorithms in the relevant bibliography adapt a range of different approaches to yield a procedure leading to the de-noising and identification of the waves under consideration. Then the amplified signal is given to NI-DAQ which provides interface between the hardware and the pc(Lab VIEW),which display the output waveform.

2.1block Diagram Of Virtual Ecg Machine

The major components involved in virtual ECG machine are electrodes, amplifier, NI-DAQ and Lab VIEW software. Input Signal from Electrode Leads ECG Amplifier NI-DAQ (PC Interface) Lab VIEW Software.

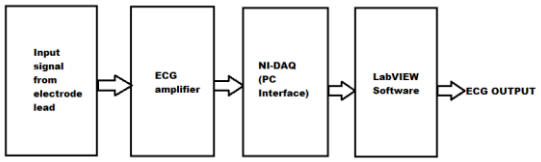

Figure 2.1 Block diagram of virtual ECG machine

Figure2.1 the biopotential signal picked up from patient body through the electrode that can be amplified by the ECG amplifier then the signal is given to NI-DAQ which provides interface between the hardware and the pc(labview).

3.1WORKING PRINCIAL OF VIRTUAL ECG MACHINE

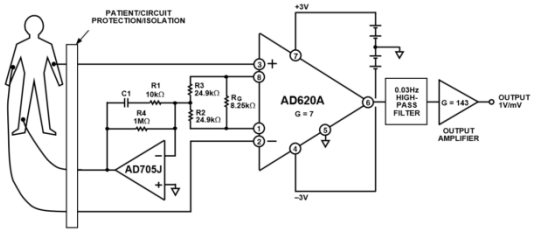

Figure 3.1 Circuit Diagram as isolation, must be added to this circuit

The low current noise of the AD620 allows its use in ECG monitors where high source resistances of 1 MΩ or higher are not uncommon. The AD620's low power, low supply voltage requirements, and space-saving 8-lead mini-DIP and SOIC package offerings make it an excellent choice for battery- powered data recorders. Furthermore, the low bias currents and low current noise, coupled with the low voltage noise of the AD620, improve the dynamic range for better performance. The value of capacitor C1 is chosen to maintain stability of the right leg drive loop. Proper safeguards, such to protect the patient from possible harm.

4.1ABNORMAL P-R INTERVAL

In this ECG signal, the time period of P-R interval is varied. A short PR interval may indicate a pre-excitation syndrome via an accessory pathway that leads to early activation of the ventricles.

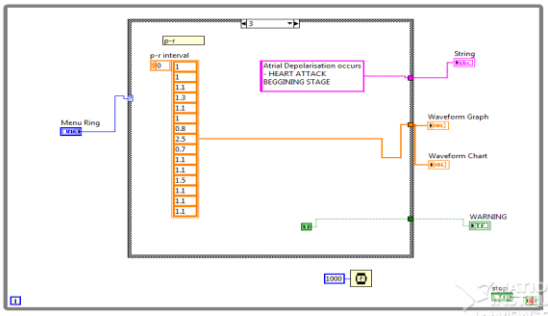

Figure 4.1.1 Block diagram of abnormal P-R interval

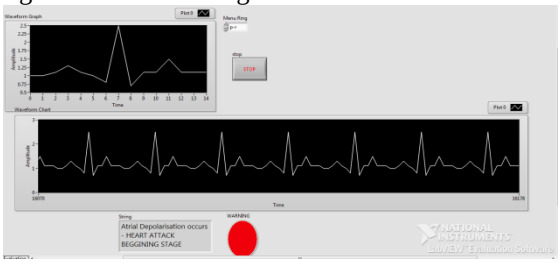

Figure 4.1.2 Simulation result for abnormal P-R interval

Figure 4.1.2 shows the simulation result of ECG signal with abnormal P-R interval. It displays the result as beginning stage of heart attack along with warning signal. A variable PR interval may indicate other types of heart block.

5. CONCLUSION

The simulation of ECG signal using LabVIEW and Hardware implementation of Virtual ECG Machine was obtained. From this machine the problem is identified by comparing both reference and test signal and it displays the type of the problem present in the patient.

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