

## **Arrhythmia Detector Using LabVIEW**

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## Abstract

Human research and knowledge even after such advancement in the technology and available information is yet not capable of reducing or removing cardiac disorder. Arrhythmia in simple term is a case in which heart loses its rhythm of synchronous beating this can be both painful and at times lethal too. Hence there is a need of introduction of an instrument which can detect Arrhythmia and can help doctors to treat patients in a more improvised way. For developing such a detectors we can use software products which can help in real time testing of the ECG signals with great speeds and accuracy. This bodes well for such a device being designed developed with significantly better accuracy and arrhythmia detecting capabilities and can further be linked with artificial intelligence software so as to detect any further occurrences of arrhythmias on the basis of the prior collected data patterns. Therefore the purpose of this paper is to construct a basic arrhythmia detector that can detect and identify basic arrhythmias

## 1. Introduction

The goal of this research work is to develop a device that would help replacing the existing Electrocardiograms and facilitate doctors to record both Electrocardiographs and detect basic arrhythmias simultaneously. With advent of technology and use of software like LabVIEW a virtual instrument can be designed which can be programmed by the users. Hence while developing Arrhythmia detector we choose to develop a hardware which would acquire the ECG signals and further amplify and filter it and then by means of a Data Acquisition Card the data can further be processed using LabVIEW software and the desired calculations can be performed and occurrence of basic arrhythmia can be detected.

### 1.1 ELECTRICAL CONDUCTION OF HEART:

Heart beats are started by a small electric current that is in the millivolt range. This tiny electric pulse spreads rapidly throughout the heart and makes the heart beat. The electric wave in a heartbeat is initiated at the top of the heart, Sino-Atrial node (SA Node). Because of the heart muscle cell's ability to spread its electric charge to adjacent heart muscle cells, this initial wave will be enough to start a chain reaction. The electrical impulse moves in a wave from SA node to AV node, then bundle of his and ends in purkinje fibers. If there was just one impulse there would be no pumping action. [1]

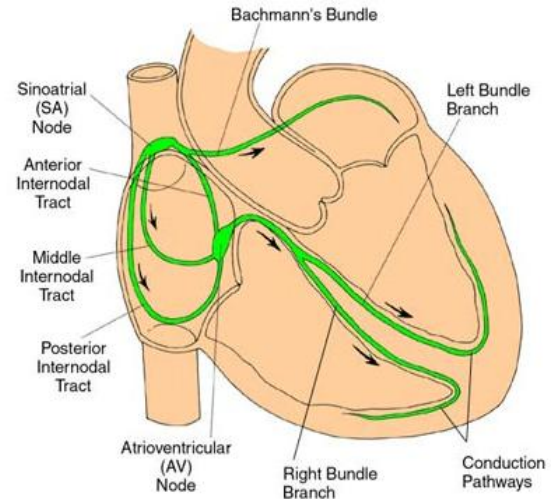


Figure 1. Electric Conduction system of Heart

### 1.2 ARRHYTHMIA:

Arrhythmia is a condition of abnormal electrical activity of heart. Some arrhythmias are lethal while the other basic arrhythmias are just painful. The basic arrhythmias which are detected by this model are:

- Bradycardia-Condition when Heart Rate falls below 60.
- Tachycardia- Condition when Heart Rate increases above 100.[2]

## 2. BLOCK DIAGRAM

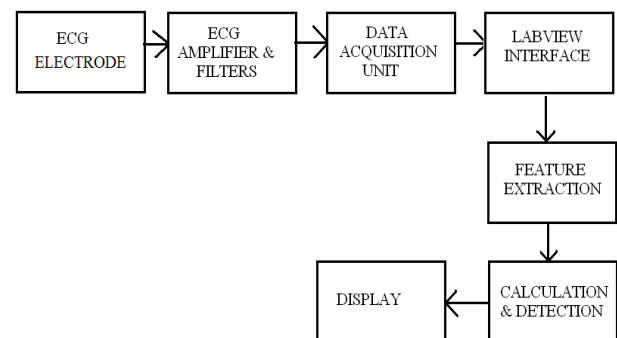


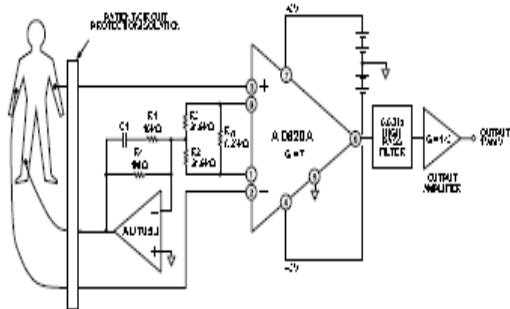
Figure 2. Block Diagram of the system.

Electrocardiograph (ECG) which is acquired from the patient using ECG electrodes are further processed by passing it through filters so as to acquire noise free amplified ECG signal. This signal is then passed through a Data Acquisition Card to the computer. The DAC is interfaced with the LabVIEW software. Hence from the data transferred via DAC to LabVIEW the required information and features are extracted and then heart rate details are acquired based on LabVIEW programming of the essential data acquired and

then further calculation are done to check if the acquired ECG signal is normal or there is occurrence of any arrhythmia. And accordingly the condition is displayed.

### 3. ECG Circuit

For ECG amplifier the Instrumentation amplifier used is AD620 which will gain of 7.



The following circuit was used for ECG amplification[3][4]

### 4. DATA ACQUISITION UNIT

The output of the circuit is given to the data acquisition unit (DAQ). A input channel is selected. The DAQ Assistant is used in the LabVIEW VI to interface between the DAQ unit and the code. The acquisition mode is set to one sample on demand. The type of signal measured is the output voltage of the circuit. The DAQ unit performs analog to digital conversion. Therefore, the sampled data that will be read into LabVIEW is a continuous stream of discrete data points of double precision. The DAQ card used in the model is DAQ 6008 of National Instruments.

### 5. LabVIEW

It is a graphical programming language that is commonly used for data acquisition and instrument control in industry and research labs. Two panels are used to make a complete running VI: a block diagram and a front panel. The block diagram will have objects that are wired together to perform special functions. It corresponds to lines of codes found in conventional language such as C or MATLAB. The front panel is window that the user sees and interacts with to control the program. LabVIEW is a suitable language for this project because of its real-time data acquisition graphical displays and its ease of use for users. LabVIEW version 2011 SP1 is used in the model. [5]

## 6. LabVIEW PROGRAM FOR ARRHYTHMIA DETECTOR

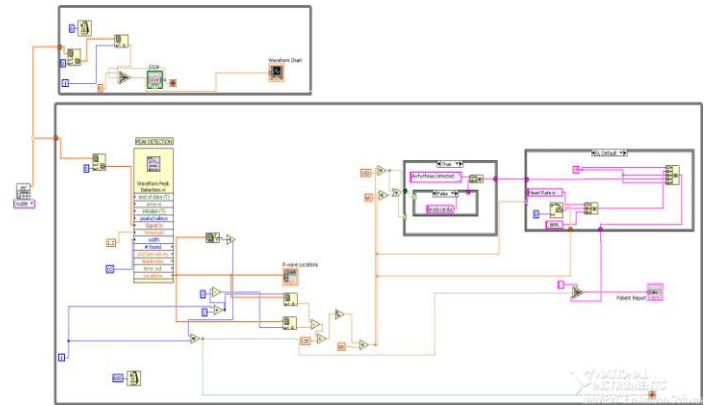


Figure 3. Block Diagram Window of LabVIEW for Arrhythmia Detector

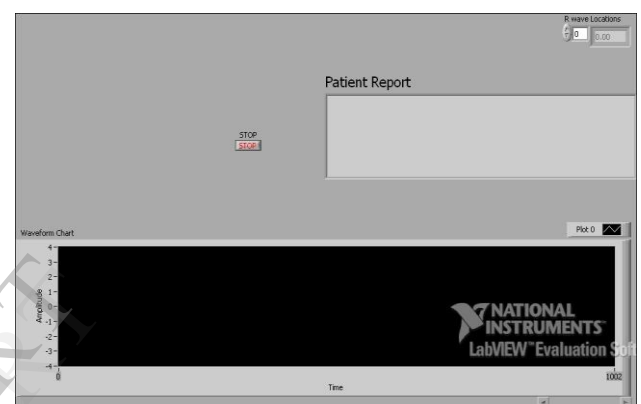


Figure 4. Front Panel Window of LabVIEW for Arrhythmia Detector (Before execution)

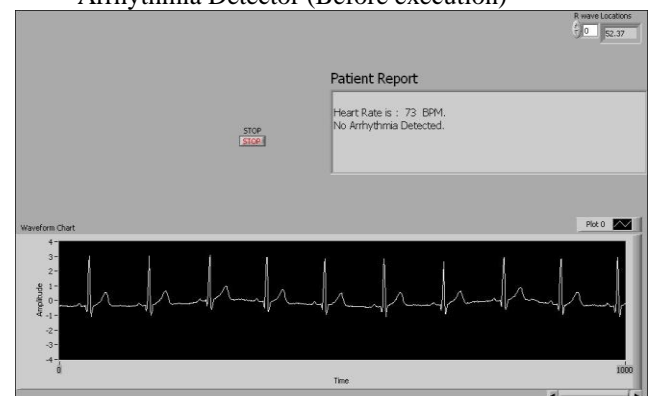


Figure 5. Front Panel Window of LabVIEW for Arrhythmia Detector. (Before execution)

Two different types of input were used. One was real time input given through the Data Acquisition Unit and the other was using a stimulated CSV (Comma-Separated Values) CSV file stores tabular data (numbers and text) in plain-text form. This input is stored in an Array. The array now contains all the various set points values of ECG after periodic intervals based on its sampling rate. These samples are then passed through a Threshold Peak Detector.vi.

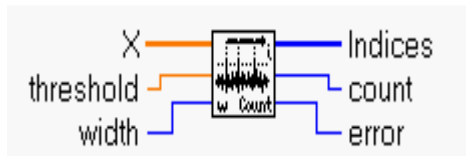


Figure 6.

Threshold Peak Detector.VI[6]

Threshold Peak Detector.Vi analyzes the input Signal X for valid peaks and keeps a count of number of peaks encountered and a record of the indices which locate the beginning index of each valid peak. A valid peak is defined as that section of the input sequence X that:

1. Begins with a sample that is at least equal to the Threshold Value
2. Remains at or above the Threshold value for at least width number of samples.

The Threshold is set by finding the maximum value using Array Max & Min.vi and then multiplying it by 0.5 so as to avoid false calibration of P or T wave as the R wave

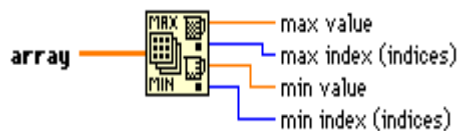


Figure 7. Array Max &amp; Min.vi[6]

Then Location or Two consecutive R waves are calculated and by using the difference heart rate is calculated as given by formula:

Heart Rate =  $[1/(R-R \text{ Interval per Sampling Frequency})] * 60 \text{ BPM}$ .

Normal Sinus Rhythm consists of Normal Heart Rate in the Range 60-100. Bradycardia is detected if Heart Rate is less than 60 and Tachycardia is detected if Heart Rate is greater than 100.

## 7. ADVANTAGES

- Low Cost.
- Can be interfaced with existing ECG amplifiers
- Real time study can be carried on.
- Large amount of data can be stored by using archives.
- The designed Vi can be used multiple number of times to make a single VI which can act as a Nurse
- Centre Display where arrhythmia detection of multiple patients can be detected and monitored. This would be more adequate as this will reduce the cost due to need of only one monitor for multiple patients. This would also make it easy for the doctors and nurses to constantly keep a check of multiple patients simultaneously.

- Digital Filtering can also be carried out in LabVIEW to reduce and remove noise for acquired ECG signal.
- More types of Arrhythmias can be detected by deducing different parameters from ECG signal and programming accordingly as per the traits of that arrhythmia.

## 8. FUTURE SCOPE:

- To make it portable: By using wireless electrodes which can transfer the received ECG signals via GPS Or Bluetooth or any such wireless transmission software, to a remote computer or Laptop having the Arrhythmia Detector so that it can be continuously monitored.
- To include detection of more types of Arrhythmias: Currently the Project module is just detecting a selected few types of Arrhythmias which occur on regular basis. In future other arrhythmias like PVC, flutters, Atrial fibrillation, ventricular Fibrillation can also be introduced for detection.
- To interface the equipment with artificial intelligence softwares to detect any further occurrence of such arrhythmias. This can be achieved by comparing existing simulated patterns with the patient ECG and by doing Template matching so as to detect any similar patterns before an occurrence of an arrhythmia.

## 9. CONCLUSION:

This machine can provide doctors with better information related to patient's heart conditions and help them to identify further chances of occurrences of arrhythmia. In future it can be modified to detect other types of arrhythmias. The major advantage of using the methods used for arrhythmia detection in this model is that the parameters of the code can be easily changed and customized to an individual's unique heart waveform. An individual's waveform may change over the course of years, or the waveform may vary from person to person with respect to his or her age and condition of heart and his or her health and fitness. By adjusting the parameters which determine whether an event has taken place in the subject's unique waveform, either a beat or particular feature of an arrhythmia, the code will detect fewer false positives. The code will detect the features of the arrhythmias with very good accuracy; however, it is still may not be correct all of the time. An improvement would be to increase the accuracy of the code. This is not necessarily difficult, but is time consuming.

## 10. ACKNOWLEDGEMENT:

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