Monitoring Vital Physiological Parameter Using LabVIEW: A Review

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Abstract - **In today's world, due to change lifestyle of the people there is needed to check the health issue continuously. Monitoring system referred as a continuous measurement of various physiological parameter of the patient. In these paper by using the LabVIEW which is graphical programming language. physiological parameter such as a Temperature, Electrocardiogram, SPO2, Heart Rate Variability, HEART RATE are obtained processed and display in Graphical User Interface, then the algorithm is evaluated the ECG signal and measure the HRV and HEART RATE with different techniques and find out related disease. Then we can display the physiological parameter related disease in LabVIEW with different techniques such as a neural network, wavelet transform, fuzzy logic and the different rule based algorithm.**

Index Terms - **LabVIEW, Electrocardiogram, Spo2, Temperature, Heart Rate, Heart Rate Variability, Patient Monitoring System**

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I. INTRODUCTION

Now a days due to change life style of people there will be need to check the health issue is continuously. Monitoring system is referred to as a continuous measurement of vital physiological parameter. In medicine, monitoring is observation of disease, condition or one or more several parameters over time to find out their performance. It can be performed by the continuously measurement using a monitoring system included a Temperature, SPO2, ECG, Heart rate, HRV etc. In the case of emergency in highly influenced by the time taken for reaching care giving point. In order to increase the chances of survival, time constraint has to be eradicated. Emergency cases need to immediate surgical intervention and intensive monitoring and ICU have for prepared accordingly. For this need to monitoring a vital parameter of patient do quick diagnoses for choosing treatment procedure for the patient. For monitoring the time utilising for procedure preparation, it would be convenient if patient with VI, engineers used graphical programming software to create a user defined solution that meet their specific needs, which is fixed functionality instrument.

In this paper we used a various parameter such as temp, spo2, ECG, etc. then it is designed various parameter related block diagram in LabVIEW. In LabVIEW there is used a various function of them and used a such biomedical toolkit. In these biomedical toolkit it has a various functional block to be used as a filtering, processing, programming, analysis, and diagnoses various parameter's disease in LabVIEW. In LabVIEW we can design a functional block diagram of various physiological parameters and find out their abnormality. In order to alert the patient's caregivers are characterised based on the signal characteristic such as a ECG, attributes like R-R intervals, peak detection, HRV and for other parameter their normal range sets the alarm system.

National instruments LabVIEW is industry-leading software tool for designing test, measurement and control systems. By using a LabVIEW environment to interface with real world signals, analysis data for meaningful information and share results. LabVIEW programs are called Vis, because their appearance and operation imitate physical instruments, such as such as oscilloscope and multimeters. LabVIEW contains a comprehensive set of tools for acquiring analysing, displaying, and storing data, as well as tools to help you troubleshoot our code in LabVIEW.

II. LITERATURE REVIEW

A. Signal Acquision

The signal acquired here are ECG, Temperature, SPO2. These signal acquired through sensor connected to PC having a LabVIEW platform through DAQ device interfaced through an ELVIS prototyping board having analog and digital input/output channels. The acquired signals are made available by the DAQ user interface in LabVIEW for further analysis that can be designed in block diagram panel. The graphical software is also designed to be used with a standard signal acquisition process.

B. Signal Processing And Analysis

LabVIEW contains over 850 built-in analysis functions to simplify development for a broad range of applications.

Some commonly used libraries include: Probability and Statistics, Optimization, Linear Algebra Curve Fitting, Signal Generation, PID Control Algorithms Fuzzy Logic, Bode Plot.

C. System Representation

The design of this system consisted of three parts: sensors, signal processing circuits, and a user-friendly graphical user interface (GUI). The first part included selection of appropriate sensors. For ECG, disposable Ag/AgCl electrodes; for temperature, Thermistor and LM35 precision temperature sensor were selected.

The second part consisted of processing the signals obtained from these sensors. This was achieved by implementing suitable amplifiers and filters for the vital parameters. The final part focused on development of a GUI to display the vital signs in the LabVIEW environment.
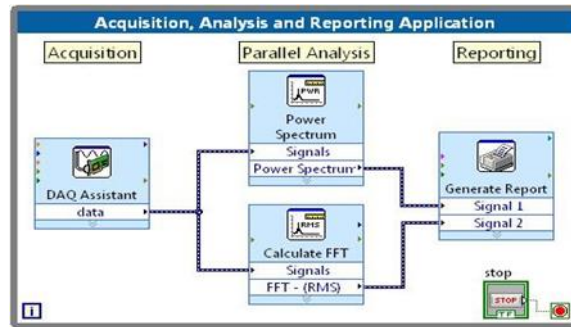

Fig 1 System Representation

The signal acquired here are Temperature and ECG. The acquired signals are made available to the DAQ card which is BNC 2120 board having analog and digital input/output channels interface in LabVIEW for further analysis that can be designed in the block diagram panel.

III. MEASUREMENT OF VARIOUS PHYSIOLOGICAL PARAMETER

A. Tempereture Measurement

For the measurement of temperature of patient's body here Thermistor is used which working on principle that the resistance changes with the changes in temperature. This gives temperature in Fahrenheit,

FARENHEIT [F] =[°C]*9/5+32
which was then converted into Celsius by the following formula as in

CELCIUS [°C] = [F]-32*5/9

B. Spo2 Measurement

Pulse Oximetry is a device used to measure the oxygen level in our blood. Our lungs have efficiency to diffuse oxygen into our blood hemoglobin to make it oxygenated hemoglobin (HbO_2) and after the exchange of oxygen with Carbon-di-oxide occurs between tissue and blood then the blood becomes deoxygenated hemoglobin (Hb).

Measurement techniques
Oxygenated hemoglobin
- Infrared LED
- 940nm wavelength
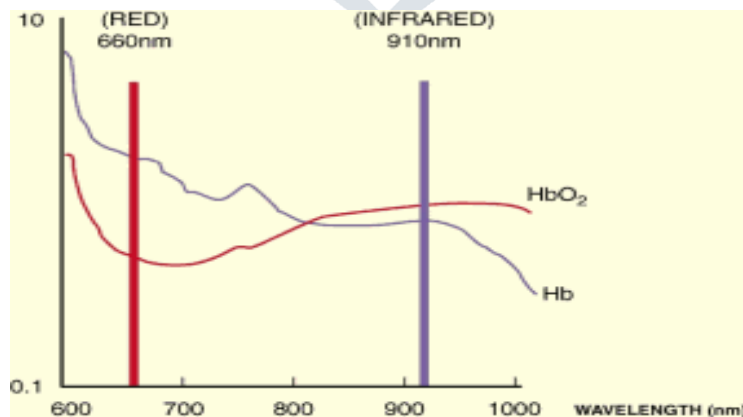Deoxygenated hemoglobin
- Red LED
- 660nm wavelength

Fig 2 Measurement techniques

Oxygen level (SpO_2)

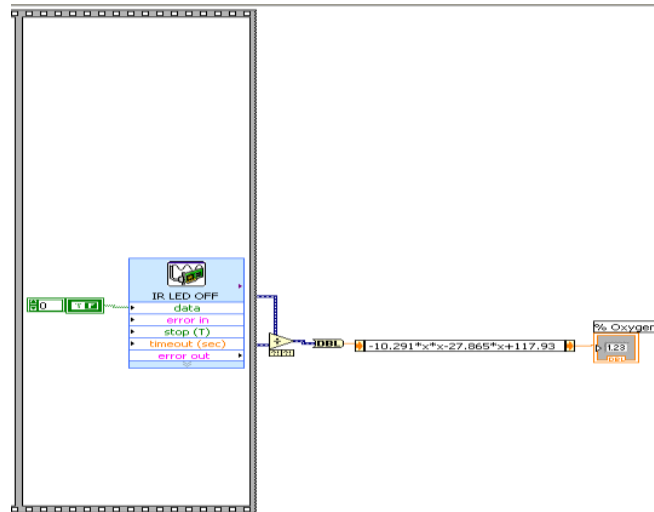$$R = \frac{[AC_{660} / DC_{660}]}{[AC_{940} / DC_{940}]}$$

Fig 3 VI Block diagram of Pulse Oximeter for calculating percentage of oxygen

C. ECG Measurement

Electrocardiogram (ECG or EKG) is a diagnostic tool that measures and records the electrical activity of the heart in exquisite detail. Interpretation of these details allows diagnosis of a wide range of heart conditions. These conditions can vary from minor to life threatening. An ECG is generated by a nerve impulse stimulus to a heart. The current is diffused around the surface of the body surface. The current at the body surface will build on the voltage drop, which is a couple of µV to mV with an impulse variation. Usually, this is very small amplitude of impulse, which requires a couple of thousand times of amplification. A typical ECG tracing of a normal heartbeat (or cardiac cycle) consists of a P wave, a QRS complex and a T wave. A small U wave is normally visible in 50 to 75% of ECGs.

1.   ECG Simulator

The aim of the ECG simulator is to produce the typical ECG waveforms of different leads and as many arrhythmias as possible. The ECG simulator enables us to analyze and study normal and abnormal ECG waveforms without actually using the ECG machine. One can simulate any given ECG waveform using the ECG simulator.

- *Significant features of ECG waveform*

A typical scalar ECG lead shown in fig.4, where the significant features of the waveform are the P, Q, R, S, and T waves. The duration of each wave, and certain time intervals such as the P-R, S-T, and Q-T intervals.

ECG signal is periodic with fundamental frequency determined by the heart beat. It also satisfies the Dirichlet's conditions. Hence Fourier series can be used for representing ECG signal. If we observe fig. 4. carefully, we may notice that a signal period of an ECG signal is a mixure of trangular and sinusoidal wave form. Each significant feature of ECG signal can be represented by shifted and scaled versions of these waveforms as shown below diagram.

- QRS, Q and S portion of ECG signal can be represented by triangular waveform.
- P.T and U portion can be represnted by triangular waveform.

Once we can generate each of these portions, they can be added finally to get the ECG signal. We will take heartbeat as 72, amplitude of P, R, Q, T waves as 25mV, 1.6mV, 0.025mV, 0.35mV respectively while the duration of P-R interval, S-T interval, P interval, QRS interval as 0.16s, 0.18s, 0.09s, 0.11s respectively.
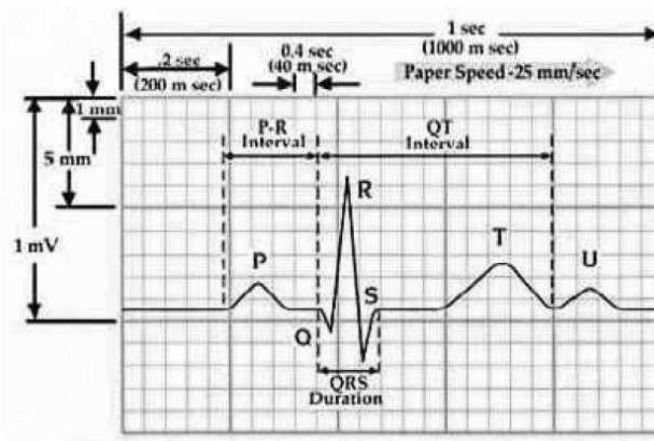

Fig. 4. Typical one-cycle ECG signal tracking

2. ECG Signal Acquisition

In LabVIEW, the data acquisition toolbox provides Simulink blocks for acquiring live data into Simulink models and for outputting live signal to the physical hardware. It uses the analog input blocks to acquired live analog data from a data acquisition system into Simulink. The acquired data is processed in Simulink and uses analog output block to output data to an analog data acquisition devices.

3. ECG Signal Processing

Generally, the recorded ECG signal is contaminated by noise and artifact within the frequency band of interest and manifest with similar characteristic as the ECG signal itself, in order to extract useful information from the noisy ECG signal, so we need to process the ECG signals.

ECG signal processing can be divided by two stages by functionally: preprocessing and feature extraction. The preprocessing stage removes or suppresses noise from the raw ECG signal and feature extraction stage extracts diagnostic information from the ECG signal.

We can use with LabVIEW and related toolkits, such as the advance signal processing toolkits and digital signal processing toolkits, one can conveniently build signal processing application for the both stages, including baseline wondering removing, noise cancellation, QRS complexes detection, fetal heart rate extraction.

In the LabVIEW we can measured the ECG signal which is a including with noise. So first processing with ECG signal to removing noise by different techniques and after removing noise to calculate the ECG signal normal condition to the patient, then we can find out their hear rate, heart rate variability on the basis of the ECG signal. There are using a various methods to calculating the heart rate from the ECG signal but we can uses a specify method to use in calculating ECG signal vary carefully and finally measured the heart rate form the ECG signal.

D. Heart Rate Variability Measurement

Heart rate variability is nothing but peak between to R-R interval. Heart rate variability represents one of the most promising such markers. As many commercial devices now provide automated measurement of HRV, the cardiologist has been provided with seemingly simple tool for both research and clinical studies.

Measurement of heart rate variability with mainly two types: one is time domain methods and second is frequency domain methods.

1. Time domain methods

Variable	Unit	Description
Statistical Measurements		
RR Mean & Std	S	Mean and standard deviation of all RR intervals.
HR Mean & Std	1/min	Mean and standard deviation of all heart rates.
RMSSD	Ms	Square root of the mean of the sum of squares of differences between adjacent RR intervals.
NN50 Count	N/A	Number of pairs of adjacent RR intervals differing by more than 50 ms in all the measurements.
pNN50	%	NN50 count divided by the total number of all RR intervals.
Geometric Measurements		
HRV Triangular Index	N/A	Total number of all RR intervals divided by the height of the histogram of all RR intervals.
TINN	Ms	Baseline width of the minimum square difference triangular interpolation of the highest peak of the histogram of all RR intervals measured on a discrete scale with bins of 7·8125 ms (1/128 s).

2. Frequency domain methods

I. Variable	Unit	Description
Peak Frequency	Hz	Peak frequencies of the power spectral density (PSD) estimate for the VLF, LF, and HF frequency bands.
VLF	ms^2	Power from 0 Hz to 0.04 Hz.
LF	ms^2	Power from 0.04 Hz to 0.15 Hz.
HF	ms^2	Power from 0.15 Hz to 0.40 Hz.
LF Norm	n.u.	LF power in normalized units: LF/(Total Power-VLF)*100.
HF Norm	n.u.	HF power in normalized units: HF/(Total Power-VLF)*100.
LF/HF Ratio	N/A	LF[ms^2]/HF[ms^2].

IV. CONCLUSION

The use of LabVIEW and data acquisition in biomedical makes the real time monitor systems with very high performance, low cost of development, more reliable and flexible. LabVIEW and the signal processing-related toolkits can provide us a robust and efficient environment and tools for resolving temperature heartbeat, spo2, and ECG signal processing problem. The graphical approach also allows non-programmers to build programs simply by dragging and dropping virtual representations of lab equipment with which they are already familiar. One benefit of LabVIEW over other development environments is the extensive support for accessing instrumentation hardware. The most advanced LabVIEW development systems offer the possibility of building stand-alone applications. Then using labview we can easily find out the types of disease and less burden of doctor to check out the patients, so labview is most important to find our and display of disease of various parameter. In future, we are going to provide SMS facility to the physician about patient health conditions using PDA module of LabVIEW platform.

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