

Testing & Analyzing Real Time Heart rate Variability and Pulse rate using NI-LabVIEW in Humans

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Abstract

Heart rate variability (HRV) analysis plays a significant role in health monitoring and it is used as a main parameter for detecting and controlling heart diseases which are causing death all over the world. According to the statistics, four people die of heart attack every minute in India. Twenty five percentages of heart attack deaths occur in less than 40 years old and nine hundred people under 30 years die due to heart diseases in India every month. Thus HRV is considered as a vital parameter for cardiac assessment. The main objective is the analysis of HRV using pulse signal. It is a noninvasive heart monitoring method, in which usage of electrodes for heart rate measurement is not recommended. BCG represents the mechanical activity of the heart. The pulse signals from some subjects are acquired by new sensor materials, such as the using blood pressure sensors, Arduino-uno and processed using National Instruments LabVIEW. HRV indices are calculated using HRV analyzer in NI Biomedical workbench

Key Words:Heart rate variability, LabVIEW, HRV analyzer.

1 Introduction

Blood pressure is the pressure of the blood in the arteries as it is pumped into the region of the body by the heart. It is a measure of power comes when our heart beats, it contracts and pumps blood through the arteries, this force creates pressure on the arteries. In general Blood pressure includes two components, namely systolic blood pressure (SBP) and diastolic blood pressure (DBP) [1]. Blood pressure is a significant parameter for early on detections of cardiovascular diseases. According to the statistics, four people die of heart attack every minute in India. Twenty five percentages of heart attack deaths occur in less than 40 years old and nine hundred people under 30 years die due to heart diseases in India every month. The World Health Organization (WHO) guesses that by 2025 about 1.56 billion people will live with cardiovascular disease [2]. Thus monitoring blood pressure at residence is essential for many people. Towards this there have been many related technological advances to review blood pressure, such non-invasive method and invasive method. Among the two methods, the invasive blood pressure method is familiar and easy to measure blood pressure exactly, but is very painful to implement [3]. On the other hand, the noninvasive methods are less painful as it uses cuff. The method is quite promising and useful for the future studies and enhancement on continuous BP monitoring. Blood pressure does not stay the same all the time. It changes to meet your bodys needs. It is affected by various factors including body position, breathing or emotional state, exercise and sleep.

Authors in [4] proposed a method, consists of both hardware and software parts. The hardware includes piezoelectric sensor, National Instruments data acquisition card (DAQ) and instrumentation amplifier. The LabVIEW software is used for doing software parts. This method includes three steps as the first is acquiring data from the system and then by pre-processing collect the information from the DAQ and then next analyse it. This is taken as the reference and here instead of using data acquisition card we

use Arduino as an interface to the LabVIEW software and send the information through serial port. All recordings were performed in a hospital bed which was instrumented by BCG system. A different approach is followed in [5], where the both BCG and reference ECG signals acquired continuously. The mean length of the individual recordings visualizes the state of the patients cardiac rhythm throughout the procedure. Here the procedure is carried out in the hospital. This is also useful as a reference to acquire signals and to analyse them using a blood pressure sensor.

David M. D.et.al [6] proposed a technique that there can be wearable ECG equipment in which we can continuously monitor the blood pressure too. So taking this as reference we also had a wearable material such as blood pressure sensor in which we can keep it as a wrist watch. Authors in [7] proposed that the hypertension is the leading health problem all over the world. To this end authors developed a blood pressure monitoring device to know the hypertension diagnostic using oscilometric method. [8] N V Panicker et.al proposed about the physiological parameter monitoring scheme which is helpful in monitoring the blood pressure and pulse rate mostly in elderly people. This is also taken as one of the references to make our system successful. On the other side authors in [9][10] also proposed about the automatic blood pressure monitoring system for continuous flow rotatory in humans and demonstrated about a real time biometry system for monitoring BP and electromyogram parameters. This is also done by oscilometric technique. LabVIEW is involved in this technique. The another system represents strategy and development of a Non-invasive wireless blood pressure data acquisition instrument for remote monitoring based Micro-controller and Bluetooth transmission kit [11]. The above all strategies surveyed about the monitoring of blood pressure system employed electrodes which causes pain to wounded and aged people. Thus we propose noninvasive heart monitoring method, in which usage of electrodes for heart rate measurement is not recommended. Further more proposed method uses LabVIEW workbench, Arduino interface and ESP8266 Wi-Fi chip, allows user to send the information to the cloud and know the heart beat variability and its properties.

The rest of the paper is structured into different sections as follows. Proposed work is summarized in section 2. Section 3 gives

the simulation results and finally section 4 concludes the work.

2 Proposed method and Materials

This section describes proposed work with the help of block diagram. Fig.2.1 consists of different blocks such as Blood pressure sensor is used to measure human blood pressure.

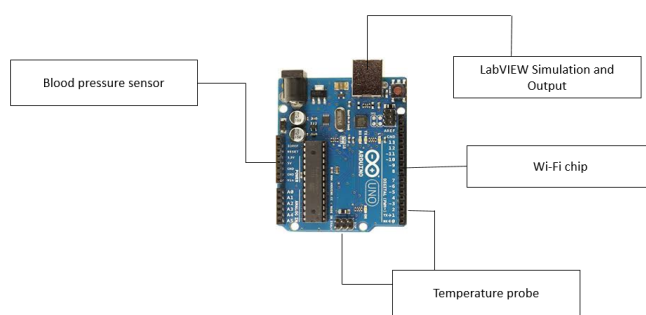


Fig 2.1 Block diagram of HRV analyzer.

i. Blood Pressure sensor:

This sensor consists of a display unit and also an instrumentation amplifier and a micro controller. The usage of this sensor is it reads the signals directly from the heart and records the values of our blood pressure. It contains systolic and diastolic values as well as pulse rate. Systolic and diastolic values are the measures of blood pressure. The normal blood pressure of a human being is 80/120. If there are drastic changes in this value, then it can be noted as high or low blood pressure.

ii. Arduino UNO:

It is actually a micro controller based component. It is basically used in many operating devices and also in communications. It consists of ATMEGA328 micro controller which has 28 pins. In those, 14 pins are input/output pins, 6 analog pins and 16 MHz crystal oscillator, power jack and, an ICSP header, and a reader. Its function is to transfer the data that is received from blood pressure sensor and a temperature probe and transfers it to LabVIEW workbench through serial port communication.

iii. Temperature probe:

Usable with 3.0 V to 5.5V power/data. Stainless steel tube 6mm diameter by 35mm long with $\pm 0.5^{\circ}\text{C}$ accuracy from -10°C to $+85^{\circ}\text{C}$. Uses 1- Wire interface- requires only one digital pin for communication. This probe helps us in measuring the temperature of a person. Thus these recordings are given to Arduino-uno

The Pulse Rate is also reported by the Blood pressure sensor with a response time of 1 millisecond. Instrumentation Amplifier is used to amplify the signals of Blood Pressure sensor to the required extent. Micro Controller takes the part of collecting the raw inputs from Blood Pressure sensor and submitting that data to LabVIEW using Arduino UNO. In LabVIEW the outputs of Blood pressure sensor are virtually analysed and presented. Also the measured values are also sent to the cloud by using ESP8266 Wi-Fi chip. In this method we can also find out the temperature values using the temperature probe, this information is also sent to Arduino Uno and by then serial port communication it is sent to virtual bench LabVIEW.

Proposed method also includes an online module in which we can store the data online that is in the cloud using Wi-Fi chip. In pre-processing the signal is amplified by using an instrumentation amplifier with gain as 10. Data acquisition for this analysis is taken from the people of age 20 to age 60 in which it includes both the male and female as well as other categories too. The flow of the proposed work is illustrated in fig.2.2.

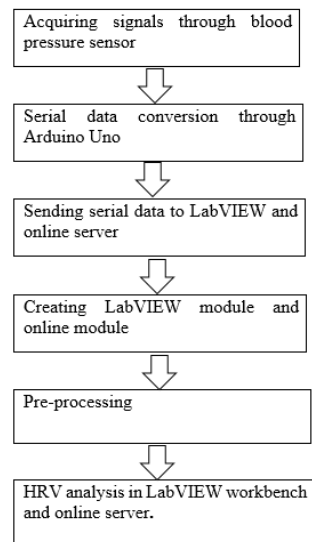


Fig.2.2 Flow of the work

3 Results and analysis

This section demonstrates the performance of HRV analysis through LabVIEW based schematic.

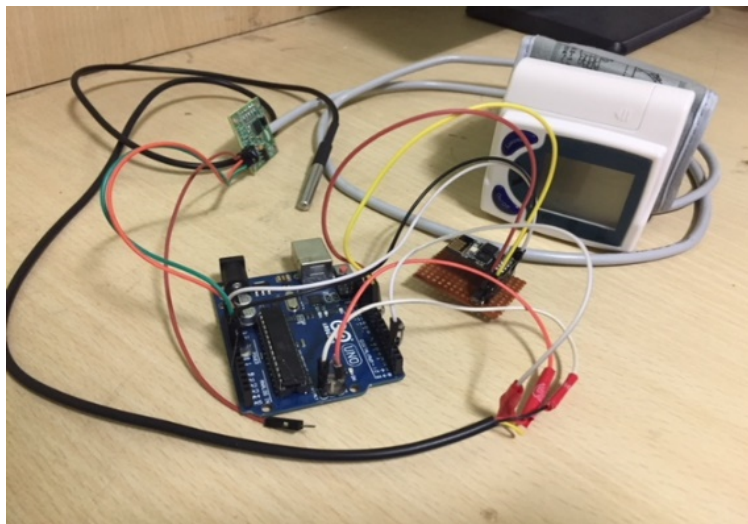
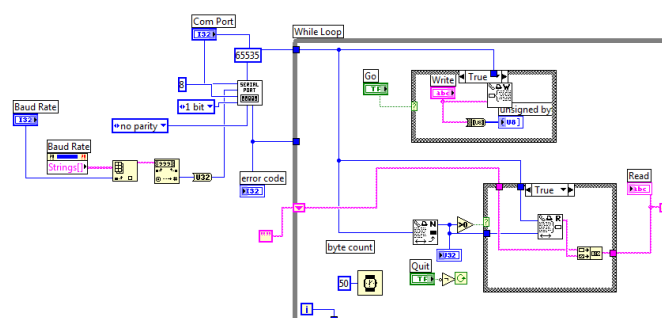


Fig 3.1 LabVIEW schematic

Fig 3.1 represents the labVIEW based schematic diagram, gives output by serial communication. The information is received by serial port block and the data is read in serial data read block. It goes in a loop until we give a certain byte code. Thus this is the simpler way to gain the result. Using these data values we can send it to online module and we can analyse the values of blood pressure using a graph.

Table 3.1 General parameter values



The above table represents the high, low and general blood pressure and also the pulse rate and temperature parameters. With these values we can know the blood pressure as is it high, low or perfect.

Fig.3.2 represents LabVIEW simulation output. The output is obtained by receiving the readings from the sensors and then it gives a message as waiting. Each reading consists of 15 bytes at 9600 baud rate. The reading packet's last byte is always enter key character (0x0A in hex and 10 in decimal) , thus helps in can view each reading on new line. Also this character can be used to sync in microcontrollers after reach readings. The output reading is 8bit value in ASCII format fixed digits, from 000 to 255 Thus the data is printed as above. The port also should be given and baud rate is given as 9600 baud/sec. These output values also are sent to the online server where we can look up the graph of obtained values.

parameters	Low blood pressure	High blood pressure	General range
systolic	≤ 90 hg	≥ 130 hg	120hg
diastolic	≤ 60 hg	≥ 85 hg	80hg
Pulse rate	≤ 60 bpm	100bpm	60bpm
temperature	≤ 94 F	100.4F and above	96.4F

Fig 3.2 LabVIEW simulation output

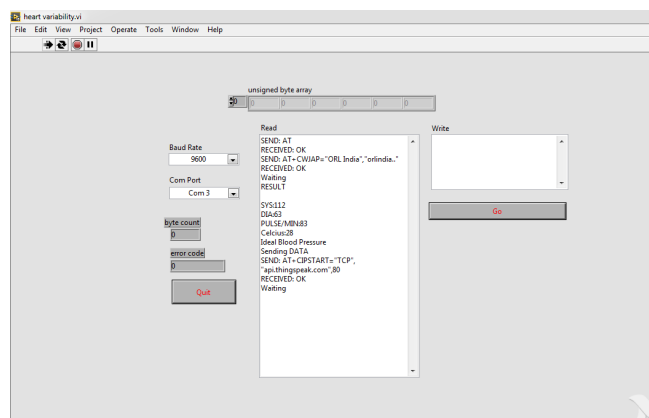


Fig 3.3 Variation of Systolic and Diastolic values.

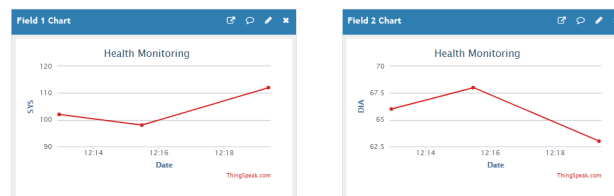


Fig 3.4 Variation of Pulse rate and temperature values.

Fig 3.3 represents Systolic and Diastolic graphs. The graph values changes accordingly with the values. This fluctuation helps us to know about the different kinds of blood pressure issues. Where as in fig 3.4 represents the graph of pulse rate and temperature. Indicates the values of fluctuating readings of pulse and temperature. By this also we can know our health conditions. These are appeared in the cloud. One can monitor the patient from any location.

4 Conclusion

Thus the blood pressure values are calculated with accurate range. Thus this method is very simpler with sensors, Arduino and Esp8266 Wi-Fi chip. This will help to diminish the death due to heart ailments. Accuracy can be improved by added investigation of pulse wave analysis by obtaining more variables from the waveform and its relation to blood pressure. These issues are open to further research.

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