Design of Non-invasive Techniques for Blood Pressure Monitoring

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Abstract:-This paper present design and development of non invasive digital blood pressure monitor meter. The real time blood pressure values are obtained from the blood pressure sensor with analog output. With the help of Arduino UNO board and PLX data logger the readings of blood pressure variations are noted in an excel sheet. A program is written in MATLAB to form a GUI where we can see the graphical representation of the blood pressure values. Software of Arduino UNO and PLX DAQ is required. The obtained waveforms of the patient or subject can be compared with the other healthy patient for any abnormality.

Keywords: - Blood Pressure, Non-invasive, Compare, MATLAB, PLX-DAQ, Arduino UNO board

I. INTRODUCTION

This paper demonstrates the implementation of a basic digital blood pressure meter. Blood pressure (BP) is the pressure exerted by circulating blood upon the walls of blood vessels, and is one of the principal vital signs. Arterial pressure is most commonly measured via a sphygmomanometer and values are reported in millimeters of mercury (mmHg), which needs expertise to come to conclusion. The proposed noninvasive measurements using digital meter is based on oscillometric method which is simpler and quicker than invasive measurements, require less expertise, have virtually no complications, are less unpleasant and less painful for the patient.

Systolic arterial pressure is the higher blood pressure reached by the arteries during systole (ventricular contraction), and diastolic arterial pressure is the lowest blood pressure reached during diastole (ventricular relaxation). In a healthy young adult at rest, systolic arterial pressure is around 120 mmHg and diastolic arterial pressure is around 80 mmHg. However, it is known that manual recording of data is error-prone and leads to even well-trained clinical staff can overestimate blood pressure or miss critical BP-related events [8, 9]

II. BP MEASUREMENT TECHNIQUES

Blood pressure measurement techniques are generally put into two basic methods; namely direct and indirect i.e. invasive and non-invasive. Invasive techniques provide continuous and much reliable information about the absolute vascular pressure from probes or transducers inserted directly into blood stream.

But the additional information is obtained at the cost of increased disturbance to the patient and complexity of the equipment. Non-invasive techniques are used in most cases, maximizing patient comfort and safety. Currently available devices for non-invasive measurement are manual devices that use auscultatory techniques, semiautomatic devices which use oscillatory techniques and automatic devices whereas most of these devices use oscillatory techniques.

In the oscillometric technique, high environmental noise levels such as those found in a busy clinical or emergency room do not disturb the measurement. The oscillometric technique operates on the principle that as an occluding cuff deflates from a level above the systolic pressure, the artery walls begin to vibrate or oscillate as the blood flows turbulently through the partially occluded artery and these vibrations will be sensed by the transducer system that monitoring cuff pressure. The cuff pressure at the point of maximum oscillations usually corresponds to the mean arterial pressure.

III. SYSTEM DESCRIPTION

It is observed from the work of various researchers that different techniques were proposed for blood pressure measurement. Though all these methods can solve the problem of monitoring the blood pressure of the patient but there is need to combine the existing method and try to develop a new hybrid method for monitoring the real time blood pressure which will give the better result. The system is divided into hardware and software part. The hardware consists of blood pressure sensor with analog output, Arduino UNO board, PC or laptop along with software installed. Software of Arduino, PLX data logger and MATLAB is required.

Below figure demonstrate the idea of monitoring technique where initially we have to fix the blood pressure sensor device at our wrist tightly with due care to avoid the measurement errors. Before starting the BP measurement, program must be dumped into the Arduino UNO microcontroller board so as to read the BP readings in real time from the analog output of the BP sensor mounted on the wrist of the patient or subject.

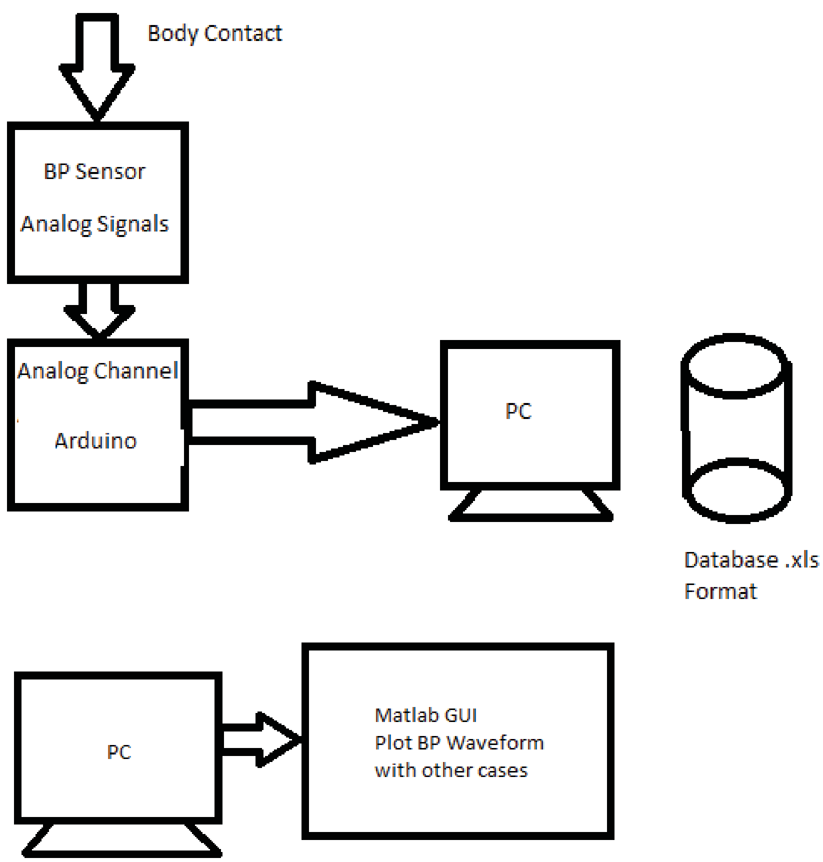

Fig1:- Idea of proposed BP measurement technique

IV. FLOW CHART

Here we need to initialize the sensor and Arduino first by uploading the program. The cuff which is tightened on the wrist is inflated when the BP sensor is switched ON and BP reading is recorded. The flow chart is divided into two parts as these are two separate procedures. The first procedure is to collect the BP readings in the excel format and the second procedure is to plot the readings against the time and analyze the observed waveforms. After getting the BP reading the same is plotted in the form of waveforms with the help of MATLAB GUI.

The plotted current patient waveforms can be comparing with the other patients with different case history in the GUI from which we can easily differentiate between the healthy patient and the patient who require medical assistance. Also we can save the real time systolic and diastolic values along with the waveforms for the future purpose if doctors need to check the patient's previous history.

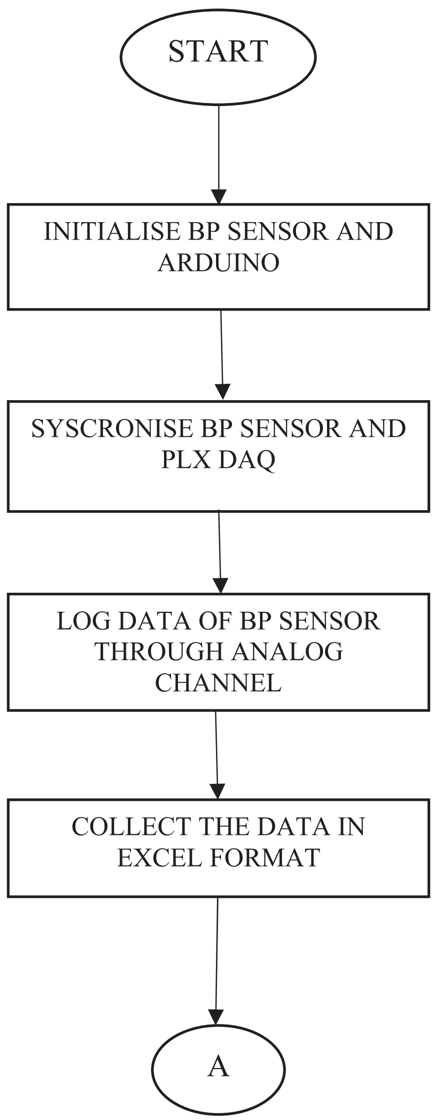

Fig. 2:- Flowchart for initializing the sensor and collecting the data

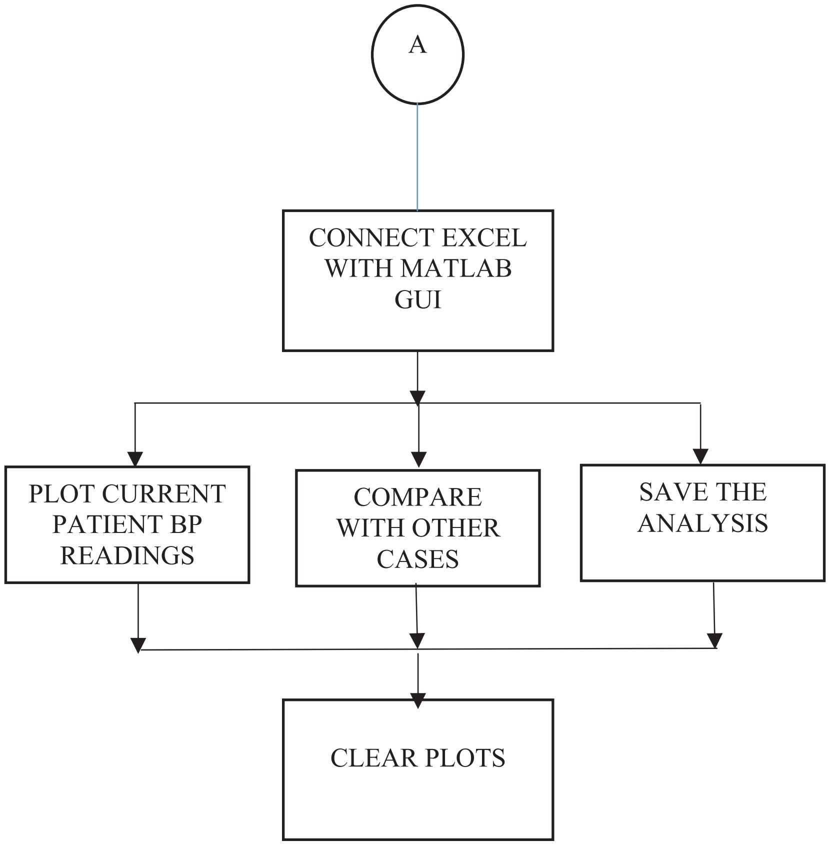

Fig.3:- Flowchart for plotting the waveforms and comparison

V. RESULT

Here we compare the waveforms of current patient with Case I. For that we have to select the current patient first and plot the waveforms. After that select Case I and click on the plot blood pressure push button for comparison.
Here BP waveforms of current patient are represented in blue colour while BP waveforms of Case I am in Green colour. Below graphical representation is useful for the doctors so that they can treat the patient accordingly Similarly we can compare the current patients BP waveforms with the Case II and Case III and other cases.

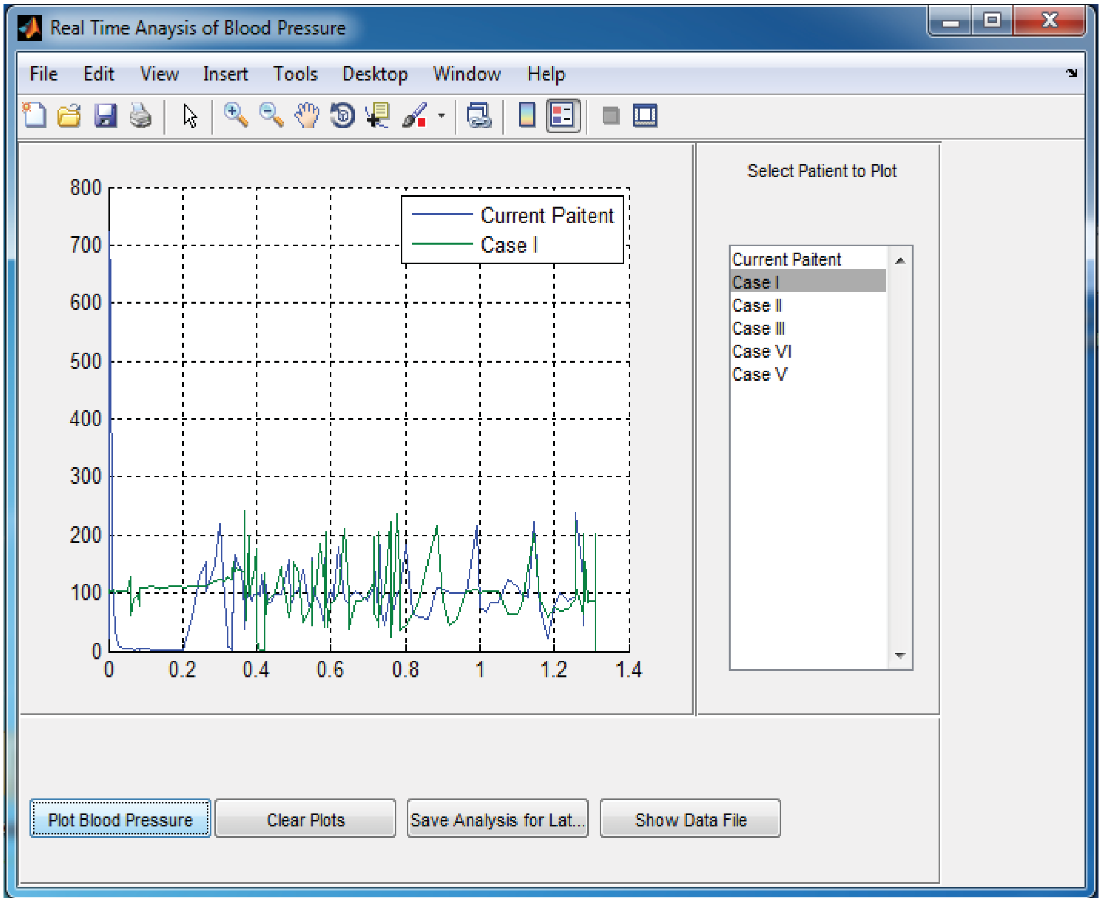

Fig.4:- Comparison Waveforms of Current Patient and Case I

VI. CONCLUSION AND FUTURE DEVELOPMENT

The traditional method of measuring the blood pressure are inadequate for continuous blood pressure monitoring, not easy to use and have to be managed only by qualified operators, which makes them unsuited for personal use and domestic applications. With this proposed system the blood pressure can be measured continuously for a long period of time and also remotely monitored. The main aspect of this is to transmit the BP values of the patient to the remote PC and compare the waveforms with the other patients and save the same for the proper diagnosis of the disease. By implementing this project we can keep the records that help a medical professional to determine which times of the day, which foods, and which activities make a patient most vulnerable to rise in blood pressure, and this in turn can be relevant to what type of and how much medicine to prescribe as well as to ascertain if certain food or activities should be limited.

Further work includes implementing the same model by transmitting the BP values on Android phones and comparing them with the several other patients. Also after comparing the BP waveforms the diagnosis and the treatment to be taken should be known to the patient initially by means of installed software without taking the guidance of the doctor and nearby hospital or doctors address must be displayed for any suggestion.

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