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Labview based ECG Monitoring System

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Abstract—

The design and implementation of a portable PC based ECG system is discussed in this paper. ECG recording normally uses three-electrode – two for the differential inputs of the ECG amplifiers and the third for ground. Hence, low cost, low power, portability, and ease of use are factors that are considered at every stage of the design. This system explores a low power microcontroller MSP430, manufactured by Texas Instrument. For signal processing and sending digital format to PC with serial port and then displayed in PC through labview software. This is a compact system capable of acquisition, amplification, filtering, and interpretation of ECG signal. The proposed device intended to be placed in the intensive care unit (ICU).

***Index Terms*— ECG, MSP430, Labview Software.**

I. INTRODUCTION

An electrocardiogram (ECG) is a recording of the electrical activity on the body surface generated by the heart. ECG measurement information is collected by skin electrodes placed at designated locations on the body. The ECG signal is characterized by six peaks and valleys labelled with successive letters of the alphabet P, Q, R, S, T, and U .This article suggests some ideas for a low-cost implementation of an ECG monitor. Its configuration is envisaged for use with a personal computer (PC). Although this article is written with patient safety in mind, any ideas presented are not by themselves necessarily compatible with all system safety requirements; anyone using these ideas must ensure that, in a particular design, the design as a whole meets required safety criteria.[1]

PC-Based Patient Monitoring System provides essential information of person heart in order to detect various heart related disease. However, most of commercial ECG monitoring system has complicated function. Therefore, the problem to be studied is to design and implement the user -friendly system, attractive and can save time. Other problem is patient's vital signal measurement and data acquisition module. Besides that, the problem to be studied is the setup for interfacing ECG circuit to PC by using specific software. Other than that, is to prepare the coding that can be calculated the heartbeat rate. The patient monitoring system is developed especially for hospital usage, so the system needs to have a database for patient's data and confidentiality.

The goal of this project is to design and implement a PC-Based Patient Monitoring System. The system can acquires signals and displays ECG signal on the PC screen. Besides that, it also has a function to calculate the number of heart beats per minute based on ECG waveform obtained .

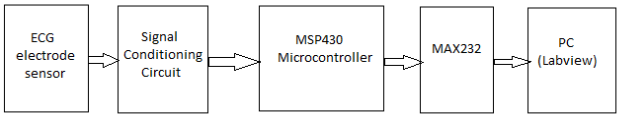

Fig. 1 Block diagram of the system

II. ECG SIGNAL AND SOURCES OF NOISE IN ECG SIGNAL

ECG is a graph showing electrical activity of the heart. It is a trace of voltage generated by the cardiac muscle during a heartbeat as shown in fig.1.The heart generates an electrochemical impulse that spreads out in the heart in such a fashion as to cause the cells to contract and relax in a timely order and thus gives the heart pumping characteristics. This electrochemical action can be measured at the surface of the body. An actual voltage potential of approximately 1 mv develops between various body points.

ECG signal from electrodes is very low amplitude signal nearly 0.8 to 1.2 mv which is amplified and filtered by signal conditioning circuit. Basics of ECG signal and different sources of noise in ECG signal are discussed in this section.

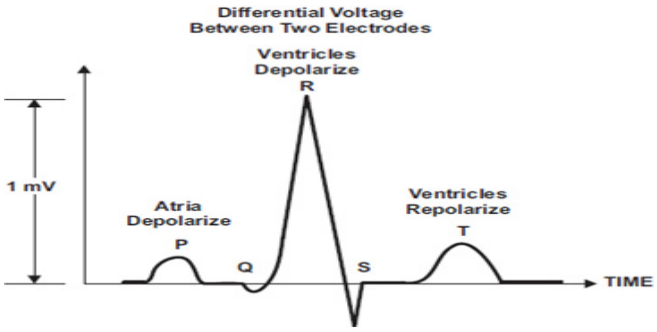

Fig. 2 ECG Waveform

ECG signal is corrupted due to various types of artifacts as follows:

1. Power line interference.
2. Electrode contact noise.
3. Motion artifacts.
4. Muscle contraction.
5. Base line drift.
6. Instrumentation noise generated by electronic devices.

For getting the accurate ECG signal we need some signal conditioning circuit.

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III. SIGNAL CONDITIONING CIRCUIT

ECG has a very low amplitude signal nearly 0.8 to 1.2 mili-volts. This raw signal of ECG must be amplified and its voltage level is increased with the standard instrumentation amplifier. ECG electrodes are directly connected to the differential inputs of instrumentation amplifier. This instrumentation amplifier has high gain and CMRR (AD620) which has low input bias, offset currents and fast slew rate. A high pass filter with cut-off frequency of 0.5 Hz is used to remove baseline wandering (BW). After removing this noise, design has three stages of amplification using LM324N.As we have also added a notch filter with cut-off frequency of 50Hz, power-line interference has been diminished completely. The highest frequency component in ECG is 150Hz so, an active filter is designed to have cut-off frequency of 150Hz. After some basic filtering this ECG signal is transmit to the Microcontroller MSP430.

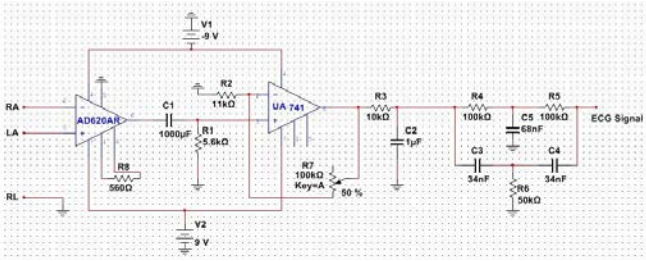


Fig.(CKT Diagram of signal conditioning circuit)

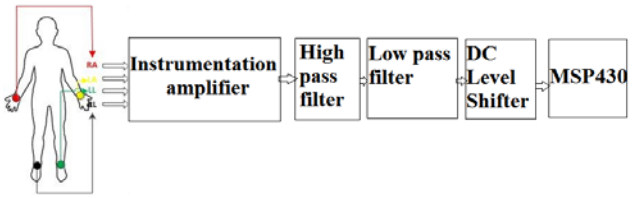
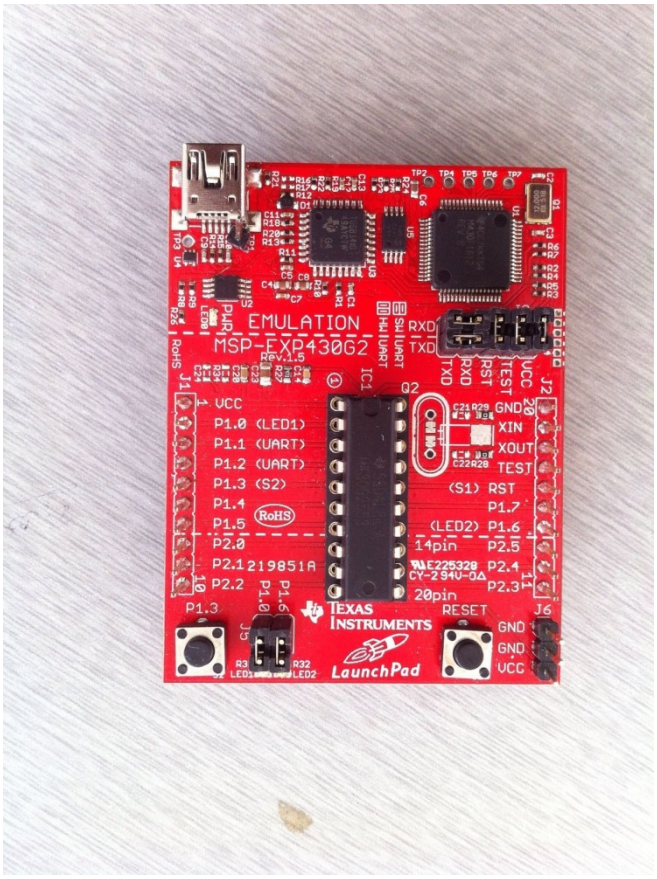


Fig. 3 Block diagram of Signal conditioning circuit

High pass filter is used for removing low frequency noise like line baseline drift, it also removes dc offset from the signal and provides required gain to the signal .Low pass filer is used to remove higher frequencies from the signal and provides gain. The notch filter is used for removing power line interference present in ECG signal. Lastly the dc level shifter is used to shift the signal above the ground level so that we have the positive values of the signal.

IV. MICROCONTROLLER MSP430

Once we obtained the properly amplified and filtered ECG signal we have to send this signal to the microcontroller for analog to digital conversion. A high-performace10-bit analog-to-digital converter embedded on the microcontroller (MSP430G2553), the ADC10 module, is used to convert the ECG signal coming from the front end circuit and then digital data is transferred to the UART module for serial communication and wireless transmission. In the system MSP430G2553 microcontroller is used. This is the 16-bit ultra-low power microcontroller by Texas Instruments is based on RISC architecture. It operates on very low voltage ranges from 1.8V to 3.6V.



The architecture, combined with five low-power modes, is optimized to achieve extended battery life in portable measurement applications. This digital data obtained from MSP430 is transferred to the PC by using MAX232 IC. Serial communication works by sending one byte of information after another through one wire and a ground. The ECG uses a serial communication format called RS-232 as shown in figure 8. This is the format used by all serial ports on IBM PC's as well as many other devices. The main difference between normal serial communication and the RS232 format is that the normal voltage range for TTL is +5 to 0 VDC; the voltage range of the RS-232 format has been increased to +10 to -10 VDC. The ECG uses the MAX232 IC to convert the serial data from the microprocessor to the RS-232 format.

V. SOFTWARE DESIGN

LabVIEW (Laboratory Virtual Instrumentation Engineering Workbench) is a platform and a development environment for a visual programming language from National Instruments. The purpose of such programming is to automate the usage of decision making and measuring equipment in a laboratory setup. The graphical language named "G" was originally released for the Apple Mac systems, LabVIEW is commonly used for data acquisition, complex processing, instrument control, industrial automation etc.. on a various platforms including Microsoft Windows, UNIX, Linux, and Mac OS X. The recent versions of LabVIEW provides more features and interface modules.

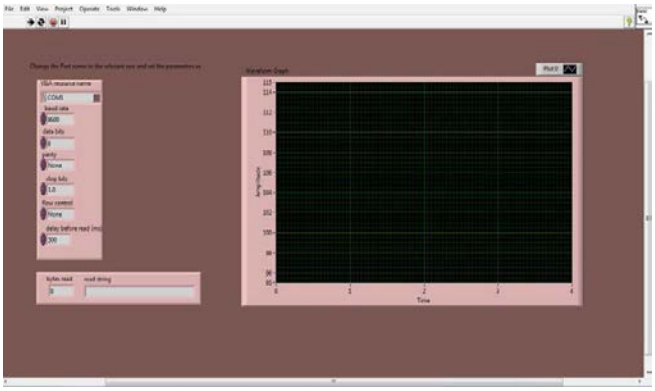


Fig. 5 Designed of Labview GUI

VI. RESULTS

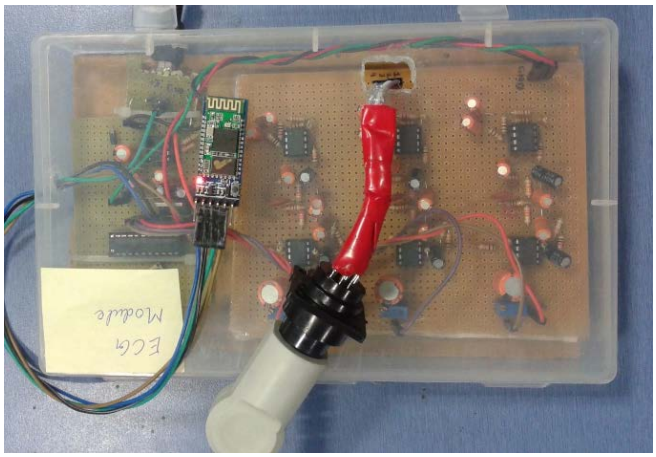


Fig. 6 Hardware of the system

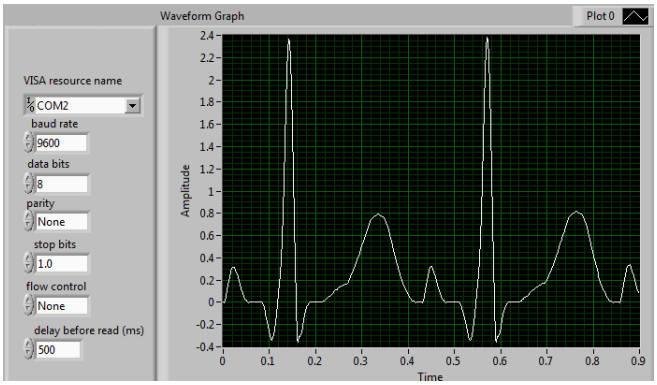


Fig. 7 Received ECG Signal through GUI

VII. CONCLUSIONS

The goal of this project is to design a PC Based ECG that will provide an accurate reading of ECG signal from patent and display this signal in PC throw LABVIEW VI. Good results are achieved despite the simplicity of the electronic hardware used.

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