International Journal Of Advanced Research In Engineering Technology & Sciences ISSN: 2394-2819

Email: editor@ijarets.org March- 2015 Volume 2, Issue-3 www.ijarets.org

ECG Using a Real Time Embedded System and MATLAB

Piyush Mudgal, Dhruv Rajan Saxena, S. Kaushik Ranganathan, Ivank Kapur
B.Tech Students
Department of ECE
SRM University NCR Campus
Modinagar

Mr. M. Vinoth Kumar
Assistant Professor
Department of ECE
SRM University NCR Campus
Modinagar

ABSTRACT—
The Electro Cardio Gram (ECG), is a set of graphs of electrical heart activity, it is the principle tool used in diagnosis of different heart conditions. This paper illustrates the design and implementation of a low-cost ECG monitor using microcontroller and MATLAB. The objective of this system is to acquire the analog ECG signal in digitized form which is observed on a PC for storage and further analysis. This is achieved by a embedded system based hardware acquisition unit synchronized with MATLAB software for automatic data storage in files. The ECG signal is captured using disposable ECG electrodes and the heart rate in beats per minute will be displayed on a LCD. The ECG signal is sampled at a rate of 941 KHz and after digitization, fed to a microcontroller-based embedded system to convert the ECG data to a RS232 formatted serial bit-stream. This serial data stream is then transmitted to a Personal Computer at a rate of 9600 kbps. In addition to this the ECG signal can also be viewed on a digital storage oscilloscope (DSO).

Keywords- Cardiogram, Electrocardiograph, Arrhythmia,

I. INTRODUCTION

About 35 percent of deaths in India are due to cardiovascular diseases and majority of them die due to heart attack because they cannot reach hospital within an hour. One of the leading developments in telemedicine is the monitoring of patients with cardiac disorders within the home or rural hospitals . Early detection of heart disease sign has important significance for heart disease prevention and timely treatment. Wireless technologies are developing very fast and medical devices also use wireless connectivity to maintain a connection to monitoring systems. There are different wireless technologies that are used to transmit ECG signals such as Bluetooth, Zigbee Wi-Fi and GSM. This work is an extension of the earlier works of the authors. Bluetooth low energy technology is used in the existing ECG monitoring system eliminates the wired connection and also reduces the power consumption of long term monitoring system. Bluetooth technology enables low power and short range wireless connection. In the wireless ECG monitoring system the microcontroller and Bluetooth module serves as an intermediate node between ECG acquisition module and smart phone. Wireless ECG transmission using Wi-Fi technology is developed which consist of a single chip ECG signal acquisition module, Wi-Fi module and a smart phone. An internet based ECG Tele monitoring in which communication between the patient and doctor is done through client-server architecture. In this work ECG signal from the acquisition module is transmitted to the Laptop using Bluetooth module.

.

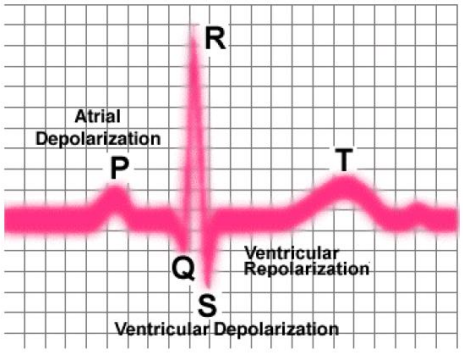
II. ECG WORKING

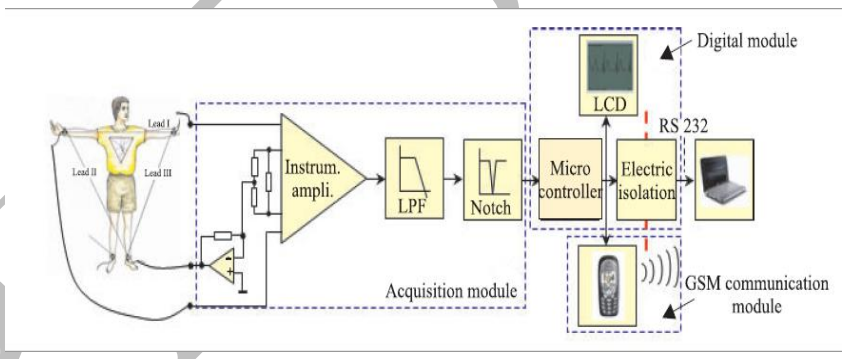
When cell membranes in the heart depolarize, voltages change and currents flow. Because a human can be regarded as a bag of salt water (with bad attitude), in other words, a volume conductor, changes in potential are transmitted throughout the body, and can be measured. When the heart depolarizes, it's convenient (and fairly accurate) to represent the electrical activity as a dipole --- a vector between two point charges. Remember that a vector has both a size (magnitude), and a direction. By looking at how the potential varies around the volume

conductor, one can get an idea of the direction of the vector. This applies to all intra-cardiac events, so we can talk about a vector (or axis) for P waves, the QRS complex, T waves, and so on.

In the above picture, the schematic ECG lead on the right `sees' the (red) vector moving towards it, shown as a positive deflection in the ECG trace; the lead at 90 degrees to this sees nothing

III Cardiac Cycle

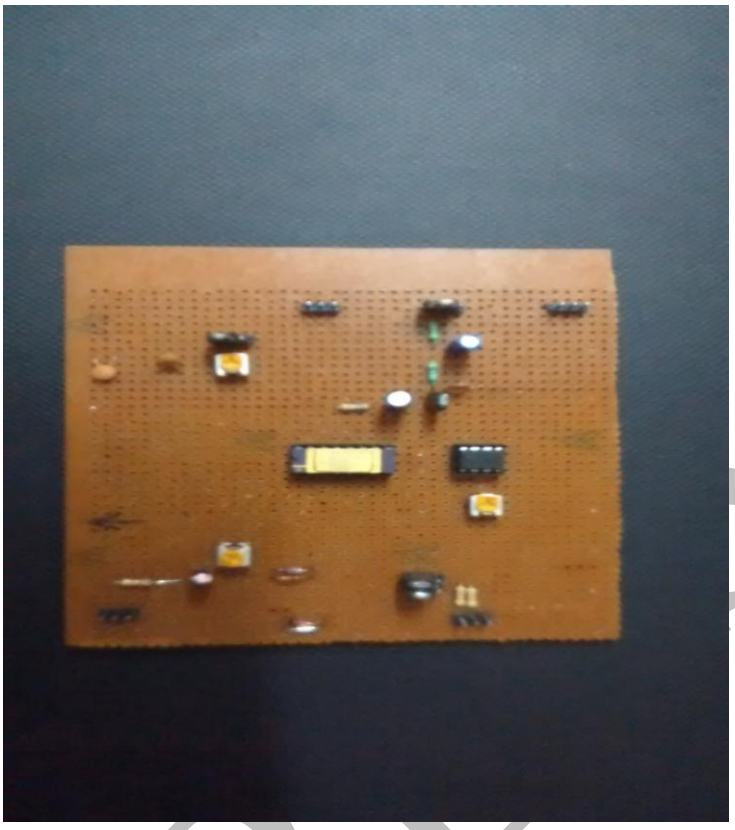




P Wave = contraction of atria
PQ Wave = signal arrives at AV node slowing down a bit to allow ventricles to fill with blood
Q Wave = signal moves to Bundle of His and divides into the bundles and Purkinje fibers
R Wave = contraction of left ventricle
S Wave = contraction of right ventricle
T Wave = ventricles relaxing

IV.Various Events

We assume some knowledge of heart anatomy. The normal heart has, electrically speaking; only two chambers, an atrial and a ventricular `chamber'. Propagation of electrical activity spreads freely within atria and ventricles, but communication between these two chambers is limited to the AV node. Everyone knows that the P wave corresponds to atrial depolarisation, the QRS complex to ventricular depolarisation, and the T wave to repolarisation of the ventricle.



A. As per the diagram, three electrodes are attached to the human body. These electrodes are conductors which act as the bio-sensors; left one is for calculating the heart beats, right one is for reference and the bottom one is for ground. Electrodes take the analog signals from body , as these signals are very low power signals, they need to be amplified. So we have applied instrumentation amplifier with low pass filter to remove the noise. The second part of the module consist of microcontroller ATMEGA 168 which process the digital signals and display the BPM on LCD and ECG on PC or DSO.

V.DSO OUTPUT

VI. ECG SIMULATION RESULT

After acquiring the ECG signal from the electrode and amplifying the input using a differential amplifier the input is given to ATMEGA 168 which samples the wave at a suitable rate and the samples are transmitted wirelessly to the Matlab GUI in our Laptop which plots the against time obtained samples to generate the ECG Waveform and calculates the Heartrate.

Once the waveform is obtained, the image Processing tools in Mat lab are used to detect various cardiac conditions by comparing the obtained waveform with the waveforms of various cardiac problems. If any Problem is detected it will give out the diagnosis/ and give out alerts if necessary in an alert window

CONCLUSION

In this study , the implementation of an embedded system based on a microcontroller for real time analysis of ECG signal and then simulation of these ECG signal in MATLAB has been investigated. The system has been tested successfully on simulated ECG signals. A wireless ECG transmission system, using Bluetooth device, is able to transmit, record and real time display the ECG signal. This work introduces the wireless communication electrocardiogram detection system with the use of ATMEGA 168 microcontroller and the communication module. Here we use blue-tooth device for the wireless telemedicine. So with the help of blue-tooth transmission and reception we can monitor the ECG signal of patient in the central place in any hospital.

REFERENCE

1. Nivedita Daimiwal, Asmita Wakankar, J. Instrum. Soc. India **37**(4) 243-248, Cummins College of Engineering for Women, Pune – 411 052, Maharashtra.
2. Journal of Engineering Research and Studies, E-ISSN0976-7916, Swati Y.Gaikwad, Prof. Ms. Revati Shriram "Blood pressure and ECG monitoring system based on internet " Cummins college of Engg. Pune, Maharshtra, India .
3. S. haddab , M .laghrouche measurement science review, volume 9, no.5, 2009 "microcontroller -based system for electrogastrography monitoring through wireless transmission " department of electronics, mouloud mammeri university .
4. Mohamed Fezari, Mounir Bousbia-Salah, and Mouldi Bedda The international arab journal of information technology, vol 5 no. 4 oct 2008 "Microcontroller Based Heart Rate Monitor " Department of electronics, University of Badji Mokhtar, Annaba .
5. C.-N. Chien, H.-W. Hsu Proceedings of the 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference Shanghai, China, September 1-4, 2005.