NOVATEUR PUBLICATIONS
International Journal of Research Publications in Engineering and Technology [IJRPET]
ISSN: 2454-7875
VOLUME 3, ISSUE 7, July-2017

DESIGN OF ECG ACQUISITION AND HEART RATE MONITORING USING WIRELESS STEERING SYSTEM

MR. RAJESH RATNAKAR KHISTE
M. E. Student, Department of Electronics Engineering, Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

PROF. R. T. PATIL
Asst. Prof. Department of Electronics Engineering, Tatyasaheb Kore Institute of Engineering and Technology, Warananagar

ABSTRACT:

Prevention is especially critical for cardiovascular diseases and electrocardiogram (ECG) is the most undisputed and widely accepted tool to detect and diagnose them. Apart from their enormous impact in older people life expectancy, cardiovascular diseases are also the main cause of death for the population among 44 and 64 years and detecting their symptoms in time is critical to avoid irreparable damages or death. Never the-less, methods and systems to acquire an ECG signal with good enough quality in a fast and easy-to-use manner, so that they can be used in domestic or other non-clinical environments, are nowadays far from common. This is mainly because traditional ECG acquisition systems usually require the use of several cables and electrodes attached to the body, sometimes with conducting gel to increase the contact, making them embarrassing and difficult to use.

KEYWORDS: Plastic steering wheel, Heart rate monitoring, ECG analysis etc.

INTRODUCTION:

A model photograph of the wireless type steering based ECG monitoring device is shown in fig.1. In the system shown in fig.1. Four dry type electrodes is used as it has so many advantages when compared to wet type of electrode. All the four electrodes will be assembled on stainless steel electrodes and they are mounted in pair fashion on a plastic wheel, considering dual ground configuration. This configuration technique used a ground electrode very close to each of the two electrodes. This configuration is used to avail the advantage of reduced 50/60hx interference with respect to the typical three electrodes configuration for lead I ECG. In lead I ECG signal uses one of the ground electrode to be placed at right leg. Furthermore in this configuration possess the major advantage to allow acquiring the ECG signal very easily by placing the left and right hands on the electrodes with no right-leg electrode and without any previous preparation procedure, as required for the easy-to-use method presented.

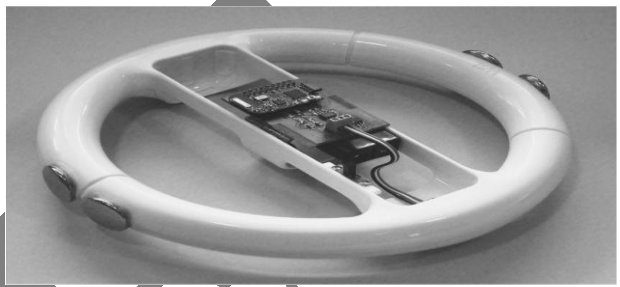

Fig. 1. Steering wheel wireless node prototype

EXPERIMENTAL WORK:

In this work, we present a novel wireless system to perform fast short-term ECG acquisition and heart rate monitoring intended to be easy-to-use for non-technical users. The system uses dry electrodes placed on a plastic steering wheel, so that the Lead I ECG signal is acquired in monitor mode simply by placing the hands on it. Although dry electrodes minimize preparation time, they can suffer from a higher level of power line 50/60 Hz interference compared to other types of electrodes, especially when used in short-term measurements [4].To overcome this drawback, we have used the dual ground configuration [5] in which two signal and two ground electrodes are placed symmetrically in the battery-supplied steering wheel. This configuration has the advantages of both reducing the 50/60 Hz interferences [6] and also of avoiding the use of an electrode in the right leg. The steering wheel has been designed as a wireless node that acquires and transmits the ECG signal to an access point connected to a personal computer. The PC is in charge of processing and displaying the ECG with the possibility of transmitting it through Internet to a medical center. In order to obtain the heart rate from the ECG signal, then system implements a novel algorithm based on the continuous wavelet transform (CWT), which has been designed and tested to offer a robust performance against electromyography (EMG) noise and baseline wandering, which are the most common noise and interference sources when acquiring the EGC in the hands.

Fig. 2 shows the block diagram of the system. The minimal configuration consists of one steering wheel wireless node and one access point connected to a personal computer. In the wireless node, there are two pairs of electrodes connected using the dual ground configuration to measure the Lead I ECG in the hands. The ECG signal measured is band-pass filtered and amplified prior to be acquired with the analog-to-digital converter (ADC) of a low-power microcontroller and to send it to the access point by means of a RF transceiver. The access point transmits the data to a PC which is in charge of displaying the ECG signal and of implementing the novel heart rate detection algorithm. Next sections are devoted to provide extended details of each constitutive part of the system.

The steering wheel will be designed as a wireless node that acquires and transmits the ECG signal to an access point connected to a personal computer. The PC is in charge of processing and displaying the ECG with the possibility of transmitting it through Internet or text message to a medical center. In order to obtain the heart rate from the ECG signal, a novel algorithm based on the continuous wavelet transform (CWT) will be used, which will be designed and tested to offer a robust performance against electromyografic (EMG) noise and baseline wandering, which are the most common noise and interference sources when acquiring the EGC in the hands.

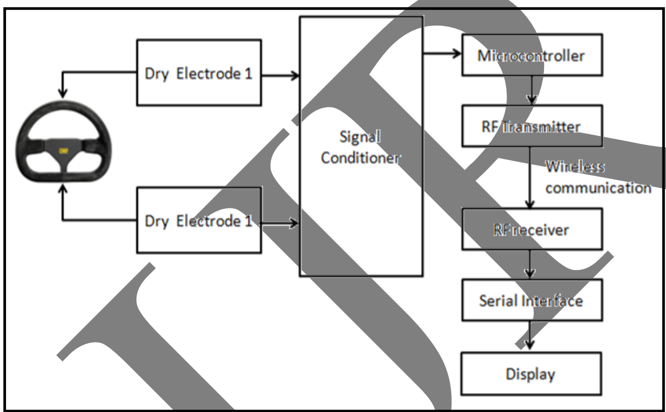

Fig.2. Block diagram of implemented system

DRY ELECTRODE:

Four dry stainless steel electrodes are to be mounted in pairs on a plastic wheel according to the dual ground configuration. In this configuration, a ground electrode is to be placed very close to each of the two recording electrodes. This configuration has the advantage of a reduced interference with respect to the typical three electrodes configuration for the Lead I ECG, which uses one ground electrode placed in the right leg. Furthermore, this configuration has the key advantage of allowing us to acquire the EGC signal simply by placing the left and right hands on the electrodes with no right-leg electrode and without any previous preparation procedure, as required for the easy-to-use method presented. The proposed system is intended to acquire the Lead I ECG signal in monitor mode (frequency bandwidth between 0.5 Hz and 40 Hz [6] and to achieve this; the analog front-end employs several consecutive stages to filtered and to adapt the Lead ECG signal level to that of the ADC.

SIGNAL CONDITIONER & FILTER:

Signal conditioner is the amplifier used to improve the signal strength of the output signal coming from ECG Dry Electrodes. This amplifier will be single stage or multistage amplifier as per signal capacity & potential level. Two buffers with OP-AMP 324 or INA122, are needed first to reduce the interferences that could enter into the system due to the impedance mismatch between the electrodes. Then by using differential amplifier configuration we will improve the potential level of signal. After the buffers, a first order high-pass differential filter is needed to achieve the lower 0.5 Hz limit of the desired monitoring bandwidth [7] and to reduce baseline wandering. The differential amplifying block is implemented using the low power instrumentation amplifier INA122 or OP-324 with the gain set limit of the monitoring mode is achieved by a Sallen-Key cell with a low-power OPA336 Op Amp, designed for battery powered applications. The common-mode-rejection-ratio (MRR) for the total circuit in the desired frequency range is about 80 dB, mainly due to the relatively low values of CMRR of this low-power instrumentation amplifier, optimized for portable devices, compared to those usual in general purpose instrumentation amplifiers.

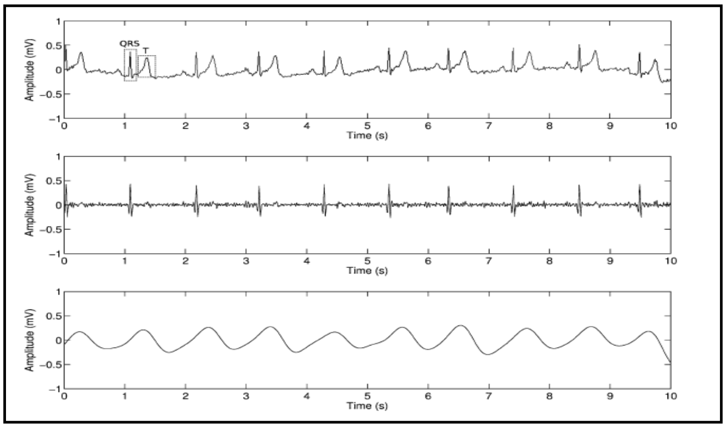

Fig. 3 Lead I ECG signal

HEART RATE ALGORITHM IMPLEMENTATION:

The heart rate detection algorithm will be implemented based on the use of the CWT. Wavelet analysis, continuous or discrete, has been applied to ECG signals, among many other purposes, to obtain the heart

NOVATEUR PUBLICATIONS
International Journal of Research Publications in Engineering and Technology [IJRPET]
ISSN: 2454-7875
VOLUME 3, ISSUE 7, July-2017

rate. The more recently developed wavelet based algorithms overcome some of the drawbacks of the classical detection algorithm such as the differences on QRS frequency bands between users and the overlap of noise on the same frequency bands of the signal. The new algorithm proposed is specially suited to the particularities of acquired signal in the wireless steering wheel, which is an EMG noise and baseline wander levels higher than in traditional systems. The proposed algorithm takes profit on the fact that the different scales of a CWT show different features of the signal, and uses two different scales to detect separately the QRS complex of the ECG overlapped with electromyographic noise at one scale, and the T wave of the ECG in the other.

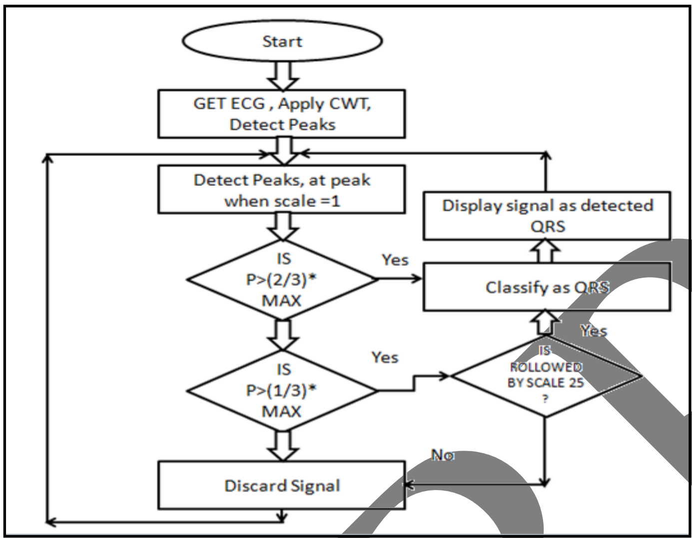

Fig. 4. flow chart of heart rate implementation technique.

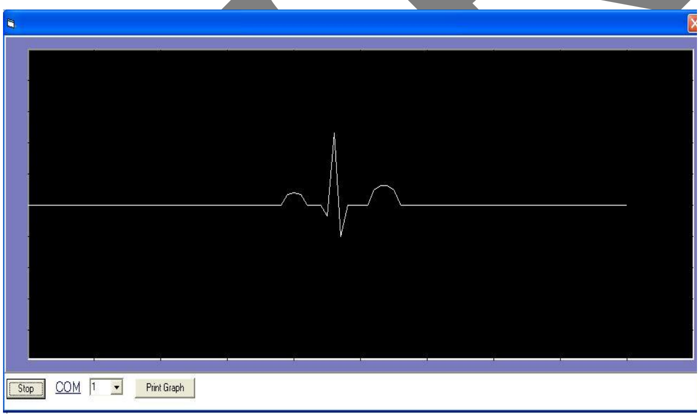

Fig.5. Sample of received ECG signal from implemented system

CONCLUSION:

In the presented paper, a new and unique approached has been developed which will help to monitor the health of elderly people. Two important parameters of health are respiratory system and ECG heart rate. The author has developed wireless system to transfer a ECG signal to a longer distance using wireless mode of transmission. In this paper heart detection is accomplished by the CWT. Continuous and discrete wavelet analysis is been used for detecting ECG signal for obtaining heart rate.

REFERENCES:

1) EU Ageing Working Group, Brussels, Belgium, *"The 2009 Ageing Report: Economic and budgetary projections for the EU-27 Member States (2008–2060)—ECFIN—European Commission," 2009.*
2) I. Korhonen, J. Parkka, and M. Van Gils, *"Health monitoring in the home of the future,"* IEEE Eng. Med. Biol., vol. 22, no. 3, pp. 66–73, May/Jun. 2003.
3) M. Ishijima, "*Unobtrusive approaches to monitoring vital signs at home,"* Med. Bio. Eng. Comput., vol. 45, pp. 1137–1141, 2007.
4) A. Searle and L. Kirkup, *"A direct comparison of wet, dry and insulating bioelectric recording electrodes," Physiol. Meas.*, vol. 21, pp.271–283, 2000.
5) J. C. Huhta and J. G. Webster, "*60-Hz Interference in Electrocardiography,"IEEE Trans. Biomed. Eng.*, vol. 20, no. 2, pp. 91–101, Mar.
6) D. Díaz, . Casas, and R. Pallàs-Areny, "*Interference reduction in ECG recordings by using a dual ground electrode,"* in *Proc. XIX IMEKO World Congr. Fundam. Appl. Metrology*, 2009, pp. 1695–1700. and U. Fidan, "*Wireless transmission of ECG signal,"* J. Med. Syst., vol. 30, pp. 231–236, 2006.
7) D. Bansal, M. Khan, and A. K. Salhan, "*A computer based wireless system for online acquisition, monitoring and digital processing of ECG waveforms,"* Comput. Biol. Med., vol. 39, pp. 361–367, 2009, 4.