Unobtrusive cardio-respiratory monitoring based on microwave Doppler radar

Publisher: IEEE

Octavian Postolache ; Pedro Silva Girao ; Eduard Lunca ; Paul Bicleaknu ; Mihai Andrusca All Authors

Abstract: Detection and monitoring of vital signs is an important task namely in rescue missions. It requires the use of biomedical devices that permit to acquire the vital signs i... **View more**

Metadata

Abstract:
Detection and monitoring of vital signs is an important task namely in rescue missions. It requires the use of biomedical devices that permit to acquire the vital signs information in an unobtrusive and even remote way, which represents an important challenge in the design and implementation of systems for vital signs detection and monitoring. At the same time, the usage of non-mechanical and non-electrical contact systems for vital signs monitoring in home-tele-healthcare applications increases the user comfort and significantly reduces the stress associated with measurement procedures. The article presents the design and implementation of an unobtrusive cardio-respiratory assessment module based on microwave Doppler radar and dual channel conditioning circuit including 4th order analog active filters and programmable gain amplifiers. The module testing was done using an automated measurement system based on a PXI acquisition platform and LabVIEW software. An advanced digital signal processing software component expressed by wavelet algorithms for denoising, detrending and peak-detection was designed and implemented in order to extract information such as heart rate, heart rate variability and respiration rate. A practical approach concerning the system performance is included in the paper.

Published in: 2012 International Conference and Exposition on Electrical and Power Engineering

Date of Conference: 25-27 Oct. 2012 **INSPEC Accession Number:** 13326228

Date Added to IEEE *Xplore*: 19 February 2013

DOI: 10.1109/ICEPE.2012.6463869

Publisher: IEEE

ISBN Information:

Conference Location: Iasi, Romania

Contents

The development of reliable health telecare systems, including unobtrusive cardio-respiratory sensors, continues to be an important challenge for biomedical research groups. Wearable solutions, including dry electrodes ECG devices [1], capacitive-coupled ECG devices [2], impedance plethysmography and photoplethysmography devices [3] [4] for cardiac and respiratory activity assessment are reported in the literature. All these solutions are non-invasive but require the sensing part to be in contact with or very close to the human body. This represents a drawback that can be overcome by the utilization of microwave Doppler radars. Different implementations are known in this field [5] [6], usually obtained through the utilization of transmit and receiving antennas and desktop equipment for signal generation and signal acquisition and analysis. This kind of implementations satisfy the main requirements regarding remote monitoring of the vital signs; however is less interesting for pervasive healthcare systems where the small size and low power are required. In this context, our team developed a microwave Doppler radar based ubiquitous health status monitoring system characterized by increased flexibility [7] [8]. The article reports the design, implementation, and testing of an unobtrusive cardiac and respiratory assessment module based on microwave Doppler radar. The radar is part of a smart wheelchair that also houses acquisition and communication modules. This implementation aims at unobtrusive healthcare monitoring for people with reduced mobility such as wheelchairs' users. The radar sensor can be also considered as part of other daily used physical objects (beds, chairs) in a pervasive healthcare scenario. Elements related to the acquisition, digital signal processing, including wavelets detrend and denoise functions for accurate heart and respiration rates extraction from radar signals that are modulated by the respiration and cardiac motion are included in the present work.