

Patient monitoring using bioimpedance signal

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Abstract. The paper presents the development of prototype system for measurement of vital functions using the transthoracic bioimpedance. The measurement of the bioimpedance is a non-invasive method providing the information about the body composition, hearth rate, blood flow, breathing etc.

The design and realization of a simple four electrode system have been done. The device is designed as a combination of a signal generator with stabilized current output and a measuring amplifier based on the AD620 amplifier.

The output signal includes information about the basic vital signs and could be used as a part of telemonitoring system for the elderly and persons after the organs failure. The device will be used for research and educational purposes in the Smart Home facility at the Czech Technical University in Prague.

Keywords: bioimpedance, vital functions, cardiac output, blood flow

1 Introduction

The paper presents the design and realization of prototype system for patient monitoring using transthoracic bioelectric impedance signal (frequently shortened as bioimpedance).

Bioimpedance is a response of a human body (generally of any living organism) to an externally driven electric current. Based on the Ohm law the current pass through the body evokes the decrease of the voltage on the body. From the known values of the current and the voltage the bioimpedance could be determined. The bioimpedance measurement is a non-invasive method that provides information about the body composition, hearth rate, blood flow, breathing etc. In medicine the bioimpedance signal is often used for the non-invasive measurement of the cardiac output (or minute volume) and for the determination of the blood flow (without Doppler sonography).

Based on the information above the bioimpedance measurement could substitute many other measurements, for example the electrocardiography (ECG) measurement of heart activity, the plethysmography (PPG) measurement and the measurement of cardiac output (CO) in one way. Regardless in the field of a patient monitoring, telemonitoring of vital signs, ambient assisted living and smart homes the bioimpedance is wrongfully omitted.

2 Realization

The paper presents the simple four electrode system for the bioimpedance measurement fully capable to give the information about the basic vital functions. The device is designed as a simple combination of the driven signal generator and the measuring amplifier. The signal generator consists of the sinus generator and the voltage/current converter with an operational amplifier. It means the generator has the stabilized current output. The measuring amplifier is based on the AD620 amplifier from Analog Devices. The output of the device is used as an input signal for our own telemonitoring system, the signal is then preprocessed by the system and wirelessly transferred to the PC.

3 Results

The basic hemodynamic parameters like hearth rate and the information about the cardiac output is determined based on the measured signal. The outputs could be used as a part of vital signs telemonitoring system for elderly and persons during the convalescence after the organs failure (hearth failure, brain stroke). It will be used both for research and education in the Smart Home facility at the Czech Technical University in Prague.

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