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THE EKG SIGNAL MEASUREMENT AND THE INFLUENCE OF ALPINE CONDITIONS ON HEART ACTIONS

SHORT NOTE

This work presents the possibility of measuring heart action parameters in the alpine conditions as well as the measuring system, which helps to measure and transmit EKG signal with the aid of GPRS net. The GPRS transmission makes the estimation of heart action on – line possible. Thanks to it, it is possible to monitor the reaction of human organism being on a certain level of height. GPRS net application enables the measuring in the whole world. The charge for using this net is only dependent on the quantity of transmitted data which needs the signal compression. This work also mentions the possibility of compression use, which takes the advantage of temporal and frequency decomposition.

1. INTRODUCTION

A human organism, exposed to the alpine conditions reacts differently than on the lowland. The atmospheric pressure drops with the height increase and with its increase the oxygen content decreases. The temperature falls down, there are the weather changeability: unexpected rainfalls or snowfalls, strong winds and lightening.

Trekking in the mountains is more exhausting than walking on the lowland. Climbing, going down the hills, walking on dangerous grounds, climbing steep rocks, gullies, ridges cause physical and psychological exhaustion. Rock climbing belongs to a very challenging task, which needs not only the special equipment but also a perfect fitness.

The conditions on a given level of height evokes plenty of changes in a human organism. Such a process is called adaptation. It includes a gradual adaptation of physiological and biochemical organism parameters in the conditions of low atmospheric pressure and low oxygen content in the air. The whole process lasts some days or even some weeks.

The most important ones are: the changes in blood, circulatory system, nervous system, vascular system, lungs, central nervous system, as well as the changes in metabolism, muscles and hormonal system.

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People who are not immune enough are more susceptible to the acute alpine disease, which may appear at 2500m above sea level after 6 hours, whereas people who go in for sport or trek in the mountains at about 2500 – 4000m above sea level hardly ever face the risk of falling ill. It is worth mentioning that skiers are carried in cable cars to the certain level (above 3000m in the Alps), they leave the tops of the [mountains on the same day and do not suffer from this kind of disease, increased breathing is the only side effect of being high in the mountains.

The most common alpine disease symptoms are: Headaches, weakness, dizziness, heart beating, nausea and insomnia.

There may be more serious symptoms, which can even lead to death. These are: pulmonary edema (2,5% of tourists who climbed up to 4200m above sea level were diagnosed with this kind of illness) and cerebral edema (1% of tourists who climbed up to 2500m above sea level were diagnosed with that kind of illness).

A healthy man, who climbs the mountain up to a significant height level always experiences hypoxia, which reduces the oxygen content in the atmosphere. The measuring system, presented in the work, helps to estimate the influence of the height level on the efficiency of human circulatory system. Working on – line helps to detect the dangers of being in extreme conditions.

2. THE CONSTRUCTION OF MEASURING SYSTEM

2.1. SPECIFICATION

The primary focus of this project is to create a product that has a useful purpose. It is not a typical engineering project in that there are few hard specifications to be fulfilled. Many resulting specifications are self-imposed, the specification developing with increased familiarity of the unfolding problem. Factors directly affecting the quality of the device:

- Physical dimensions
- Power requirement
- Mass
- Price

Other desirable properties that the device should have:

- Robustness
- Aesthetics

The Figure 1 and 2 shows the prototype of mobile measuring. The system is composed of the module of the stored data cooperated with EKG sensor, the module of information compression and the transmission adjustment to the protocol of GPRS transmission in the cell phone. The mobile part of the system cooperates with the stationary device connected with the PC.

The single – chip 89c59 processor equipped with the external memory RAM with the capacity of 32 MB is the main element of the system. RAM memory is used for storing the data from the position sensors, the time and the date of the measurement.

2.2. DATA STORAGE

The memory component to be used should have the following characteristics:

- The device should be a serial interface device. Limited I/O pins will be available for the interface and it is not feasible to have address and data buses dedicated to the device.
- The device should be large enough to store multiple sets of data, or to implement any other feasible extension that may arise.
- The device must have a write and access speed fast enough that it does not become the limiting factor.
- The device must be capable of multiple write-cycles for a reasonable expected lifespan

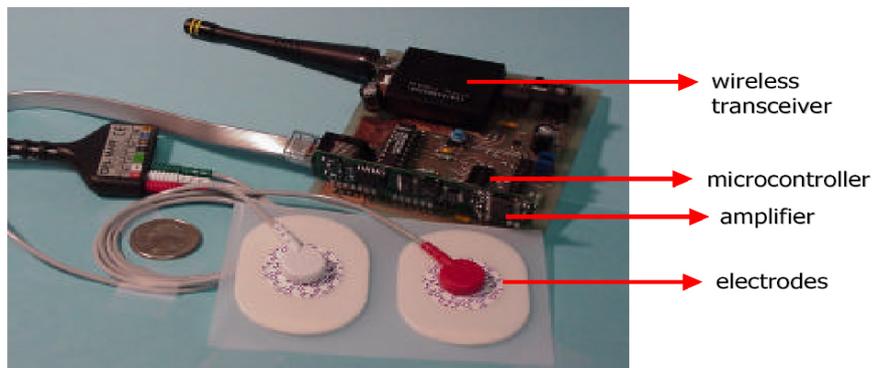


Fig. 1. Mobile measuring system



Fig. 2. Electrodes

3. THE WAVELET EKG SIGNAL.

The optimal representation of EKG signal needs the mapping which assures the minimum number of the data needed to transmit the information. The exponent of the representation quality is the similarity between the EKG signal and the base signal. The latter one analyses the former one. In the case of the wavelet transmission the base function (the mother function) having a good selectivity has a good time location. The folds P. T. and R. S. are fixed in regular distances to let the EKG signal process on

Transmitting EKG signal via GPRS net needs its earlier decomposition. The configuration of the system allows to choose the optional wavelet type. Choosing the wavelet has a decisive influence on the decomposition quality. The wavelet form should be parallel to the signal [3].

Besides, it is possible to choose a specific decomposition level, that is the product of one type of decomposition process. The higher decomposition level is the more details of analyzed signal can be obtained. However, this has a direct influence on the quantity of data needed to transmit the information. The decomposition occurs “on the fly”, then such information is transmitted via GPRS net. The opposite process called the signal reconstruction can be received by the receiver. Depending on the decomposition levels it is possible to choose one of the detailed levels [1]. The difference between the original and the reproduced signal is called the standard deviation (Fig. 3). It can be defined in a following way [2]:

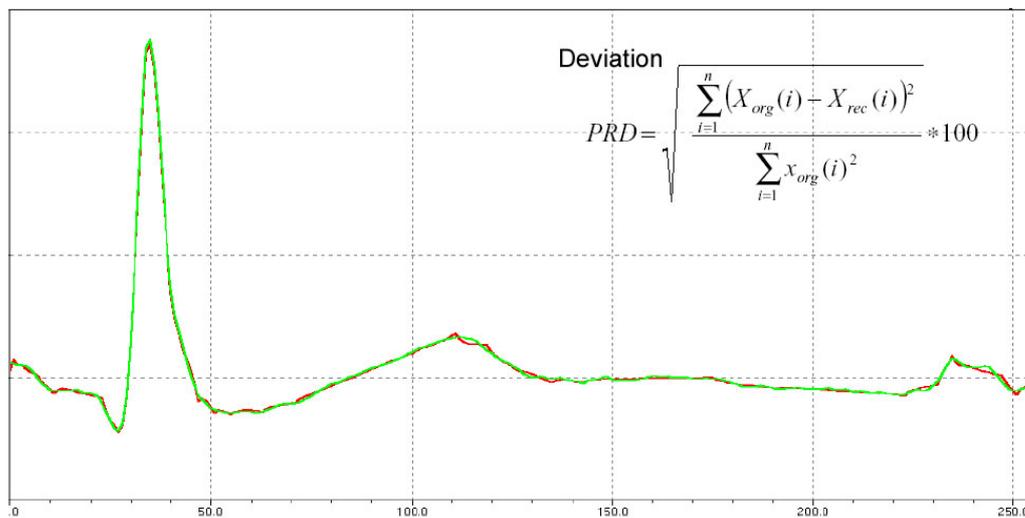


Fig. 3. Standard deviation original and the reconstructed signal

PRD- the standard deviation original and the reconstructed signal.

$X_{org}(i)$ – the i amplitude of the original signal sample

$X_{rec}(i)$ – the i amplitude of the reconstructed signal sample

The value of PRD coefficient is the determinant of the wavelet algorithm efficiency.

4. CONCLUSION

The aim of this work is to show that it is possible to transmit the EKG signal via GPRS net with the use of the wavelet compression. The wavelet compression enables the reduction of the information needed to the reflection of EKG signal. Thanks to GPRS net it is possible to transmit the information from every place of the world and the charge for its transmission is only dependant on the quantity of the transmitted data and thanks to the wavelet compression the cost of the study can be much reduced.

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