USING A 2.4 GHz RADIO MODULE FOR TRANSMITTING A SPIROMETER DATA

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According to the World Health Organization WHO hardware methods of diagnosis and determination of the patient`s condition use a wired connection to the human body. Standard methods, which use outdated equipment, circulated in low-income, including Ukraine. In addition, each electrode or sensor connected to the monitor via a single cable. All these factors lead to carrying out uncomfortable procedure and make medical devices cumbersome. [1]

Nowadays, modern information technologies are taking an increasingly active place in all spheres of human activity. Medical instrument making is no exception. Continuous and discrete parameters of the condition of patient is necessary to monitor in real-time and it is not always possible in a hospital. However, the development of wireless technologies implements miniaturization of medical devices, as well as increase the level of comfort in procedures. Monitoring the patient's condition is now possible even when he is at home, on a walk or at work. Therefore, medical devices are equipped with a radio, Wi-Fi and Bluetooth technologies units, which passed a diagnostic check according to the data transmission standards. The parameters, which are obtained from the patient's body could be transferred at any distance. [2]

That`s why, the aim of work is determining the effect of the radio module nRF24L01 on the condition of the patient according to IEEE Standard Std C95.1TM-2005 – IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz.

For the testing the radio module NRF24L01impact on the human body was created testing model, which shown in Figure 1.

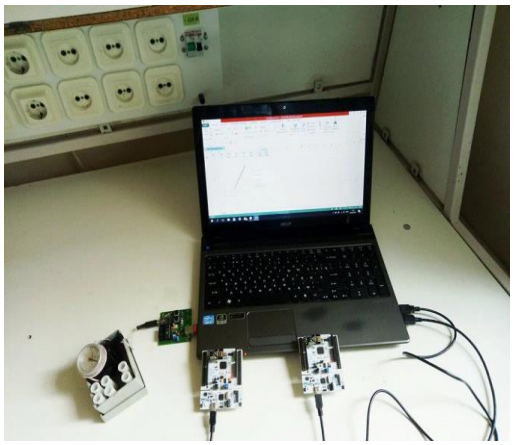

Figure 1 – Testing model

We are using spectral microvoltmeter B6-10 to determine the level of the electromagnetic field, the energy flux density and the level of propagation of the electromagnetic field during our researches.

The frequency range 3 kHz to 300 GHz belongs to extremely high-frequency radiation. Analysis of literature has shown that the level of the electromagnetic field of this frequency range must be less than 2,5 μW/cm^2.

Table 1. The results of experiments in the standard operating

Parameters	Value							
EMF, μW/cm^2	2.1	2.1	2.1	2.0	1.99	1.99	2	2.1
Time, s	15	30	45	60	75	90	105	120

According to the standards the level of electromagnetic field in the energy saving mode must be 0.5 μW/cm^2. Histogram, which showing the level of relative error is shown in Figure 2.

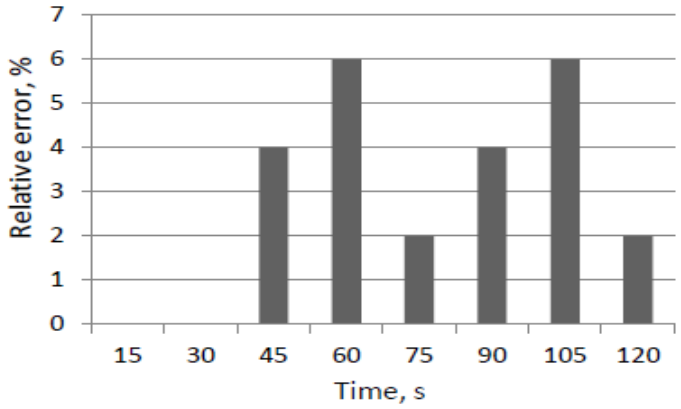

Figure 2 – The levels of relative error

Radio module nRF24L01 have passed all tests according to the IEEE Standartds 802.15 – IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture, IEEE 802.15g – IEEE Standard for Local and metropolitan area networks-- Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs) Amendment 3: Physical Layer (PHY) Specifications for Low-Data- Rate, Wireless, Smart Metering Utility, Std C95.1™-2005 – IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz and it is recommended in equipping in telemedicine devices.

Literature

1. https://www.who.int/en/
2. HTC S710 User Manual. High Tech Computer Corp. 2006. p. 2. Wi- Fi is a registered trademark of the Wireless Fidelity Alliance, Inc.