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Education of Labor Protection and Environmental Engineering Specialists Based on Neural Network Data Processing Technology

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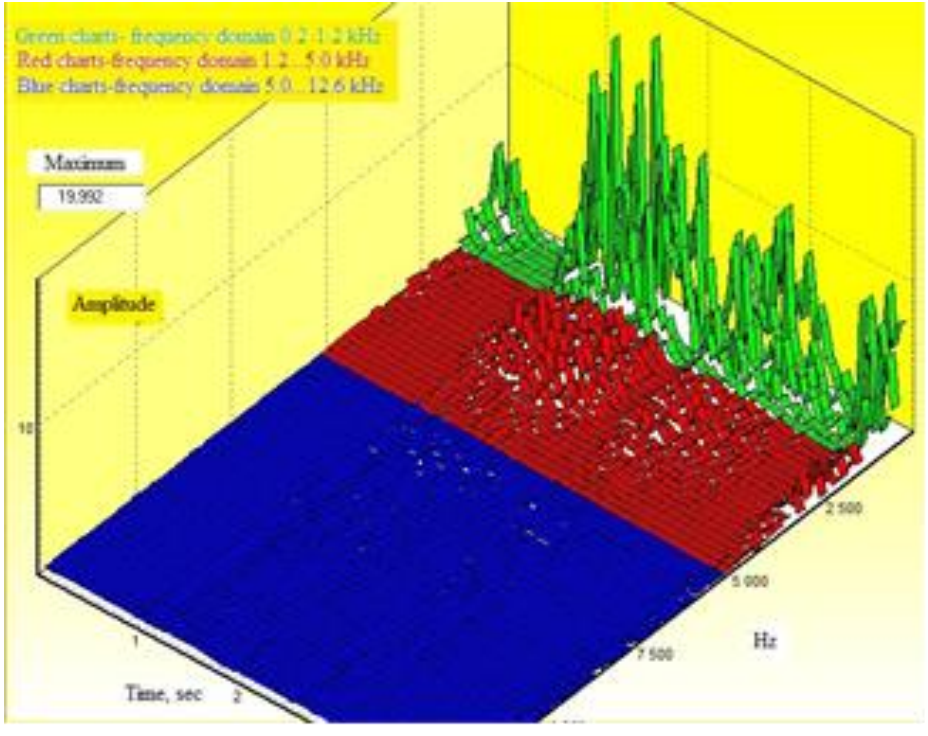

Fig. 1 Example of a bronchophonogram (pattern)

Bronchophonogram

- low-frequency range 0.2-1.2 kHz (green)
- mid-range 1.2-5.0 kHz (red)
- high-frequency range of 5.0-12.6 kHz (blue)

Education of Labor Protection and Environmental Engineering Specialists Based on Neural Network Data Processing Technology

Fig. 2. Appearance of the device

The diagnostic complex includes:

- the hardware part intended for recording a specific acoustic phenomenon that arises from a change in the turbulence of the airflow during breathing;
- a package of applied programs that includes Pattern programs processing and visualizing the results of recording a specific acoustic phenomenon.

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Fig 3. Patient data form

CDC "Pattern" allows you to conduct the following procedures:

- receive a mapping of all blocks that form the respiratory cycle acoustic portrait for detailed quantitative analysis of individual instantaneous pattern realizations,
- conduct a visual comparison of the two patterns and their quantitative characteristics.

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In a quantitative representation, the characteristics of the selected 4-second interval in absolute values are represented by the ACRD parameter (nJ) in each frequency range (A (1.2-12.6), A (5-12.6), A (1.2-5 , 0), A (0,2-1,2)), and in relative units - the so-called pattern coefficients K1, K2, K3, which represent the values of ACDR in the corresponding frequency range in relative units.

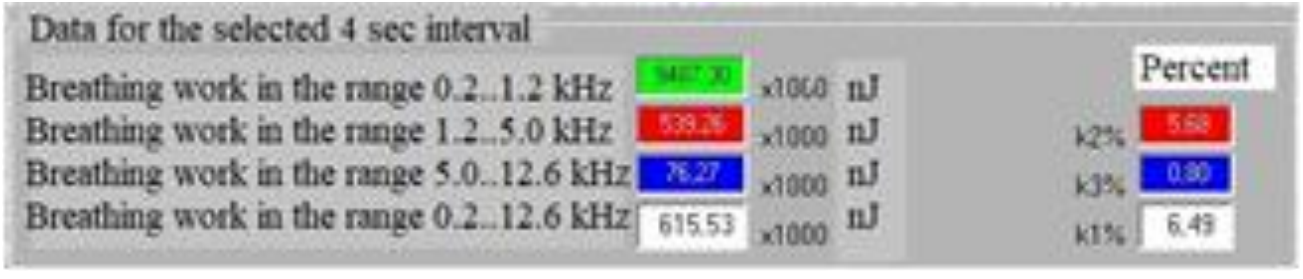

Fig. 4. Absolute and relative results of recording the respiratory cycle

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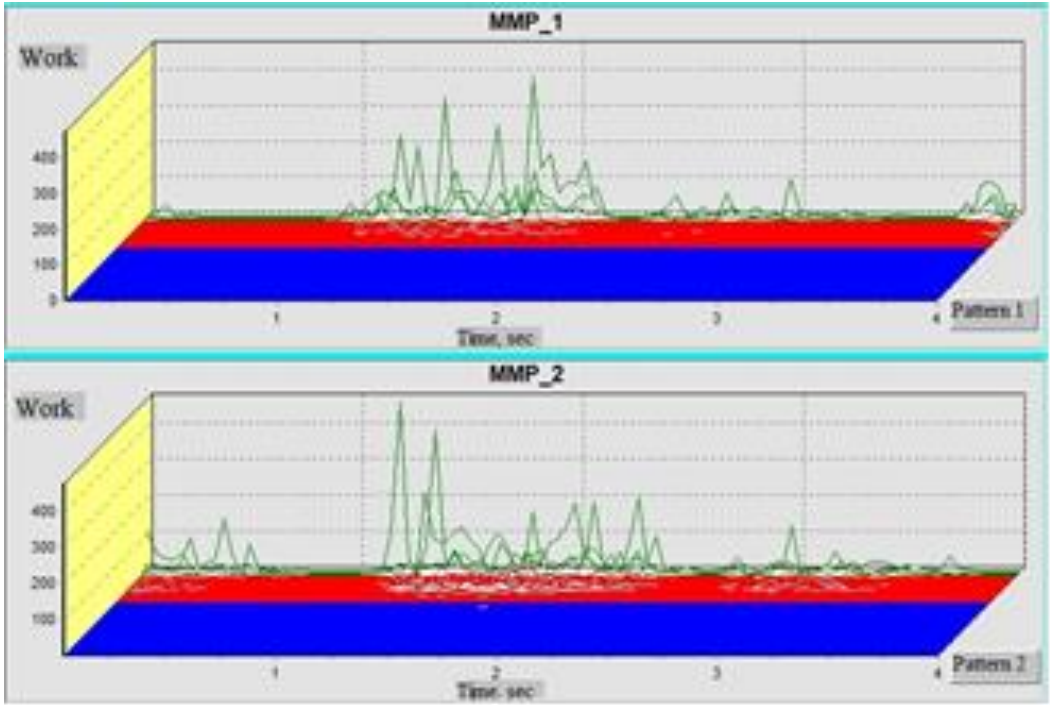

Fig. 5. An example of graphical representation of the results of pattern comparison in the entire frequency range (0.2 kHz -12.6 kHz)

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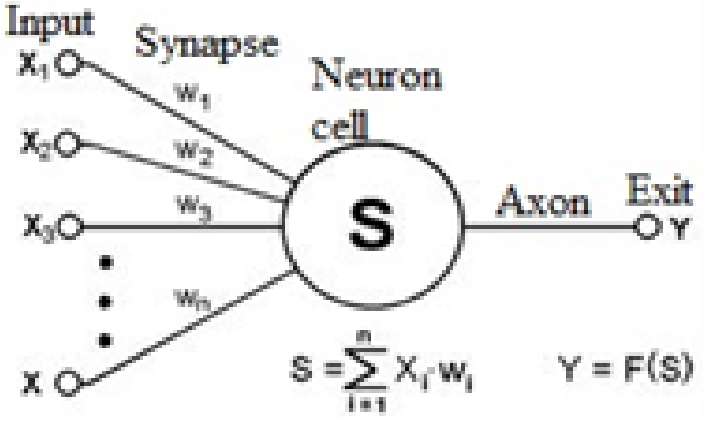

Fig. 6. Technical neuron scheme

To train the network on the basis of medical organizations in Moscow and the Department of EE and LS MPEI, 354 patient breathing patterns were obtained, among which half - 177 have various respiratory diseases (bronchial asthma, silicosis, pneumoconiosis, chronic dust bronchitis, etc.).

According to the preliminary analysis of the patterns, 7 training parameters reflecting the respiratory function of the workers were selected as the initial information-the work of breathing in three frequency ranges: 0.2-1.2 kHz; 1,2 - 5, 0 kHz; 5,0 - 12,6 kHz; 1,2 - 12,6 kHz (absolute values) and coefficients K1, K2, K3 reflecting the value of the work of respiration in relative values.

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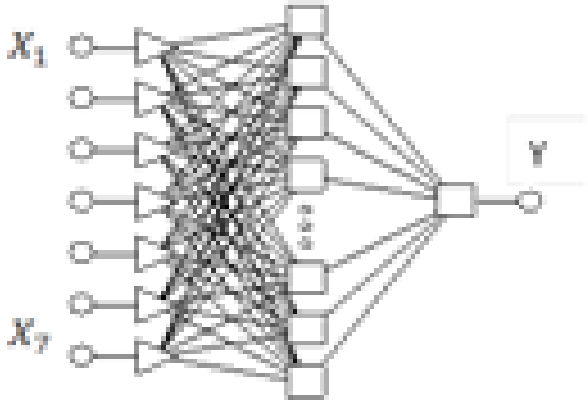

Fig.7. The structure of a multi-layer perceptron with seven inputs, twelve neurons in the hidden layer, and one output layer neuron

Based on the results of testing the obtained initial data, the reliability of classification was 92.85%, it was estimated as the ratio of the total number of network responses pointing to this class to the correct answers of the same class. Sufficiently high operational characteristics, revealed during clinical approbation, indicate the promise of the proposed diagnostic method and the adequacy of the model considered above.

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CONCLUSIONS

In the process of teaching students the subject "Physiology of Man" is used to develop artificial decision support systems based on the CDC "Pattern", which simulates the system for detecting the pathology of the respiratory system.

An algorithm, software and information support is proposed that allows to objectively differentiate the workers working under the influence of harmful production factors on the relevant groups and to assess the degree of reliability of the deduced conclusion.

Detection of the deviation in the breathing patterns and characteristics from certain norms should become a prerequisite for an in-depth analysis of production factors, lead to the need to use personal protective equipment by a specific employee, and also to further examination by pulmonary physicians. The technology for rapid analysis of the respiratory organs functional state with the help of the "Pattern" can be realized without the workers being separated from production.

It should be emphasized that mastering the method of neural network technology will allow students to use it to solve complex multifactor tasks in the field of labor protection and environmental safety, both in the process of training and in further independent work.

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Thank you for attention!

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