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Neuron Network Approach to the Solution of the Medical-Psychological Problems and in Diagnosis Process of Persons with Disabilities (Literature Review)

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The article is devoted to the problem of automating the process of biomedical diagnostics. Currently, the life sciences practice is totally inadequate use of standard methods of statistical data. Therefore, special importance is the theory of neural networks and its application to the automation of scientific research and applied problems.
Neural network technology – a tool that is quite effective, efficient, versatile in solving biomedical problems.
They can be considered as an aid for medical-biological and medical-psihological, as a system of improving the diagnosis and treatment of diseases of the cycle.
The article describes the use of neural network approach in various fields, such as medicine and psychology.

Keywords: diagnostics, neural networks, biomedical research, mathematical model.

During the last decades the neural networks find more and more wider usage in scientific research automation, applied tasks solution, persons with disabilities diagnostics (Malanchuk, 2010, p. 115).

Neural networks are the mathematical models, built by the principle of the biological neural networks arrangement and functioning – networks of nervous cells of living organism. One of the main advantages of the neural networks- is the learning ability. During the learning process the neural network is able to reveal the complex dependences between the input and output data as well as to make generalization (Lorenz, 2011, p.63; Lorenz, Gavrilyukov, Khlebopros, 2012, p. 93). This advantage importance is hard to overvalue in the light of the constantly growing information volume in the already well researched fields.

Neural networks approach doesn't require the detailed information formalization as the system based on the strict logic what is

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especially valuable on the initial work stages. That' s why the neural networks are used for information identification and classification in cases of the limited, incomplete data sources, are distinguished by the versatility, one and the same program ensures the work possibility in various spheres of knowledge (Bozhenko et al., 2004, p. 28). Currently the neural networks are successfully used by many specialists in various weakly formalized problems where the classical methods of mathematics and statistics are little efficient.

Many specialists (Popov E.V., Fominykh E.B., Rybina G.V., Waterman D.) assume that neural networks system approach is important for to avoid the cognitive deformations characteristic for human memory (Popov et al., 2000, p. 46).

The more and more attention is paid to neural networks usage for biomedical problems solution as well as for persons with disabilities diagnostics process (Shiozhev, 2004, p. 18; Zhukov, 2000, p. 10; Solomakha et al., 2010, p. 112; Ruanet, 2007, p. 129; Evdokimenko, 2005, p. 278; Gorban, Rossiev, 1996, p. 45).

In diagnostic process for the decision adoption the various data are used- anamnesis, clinical examination, laboratory tests and complex functional methods results (Lazarev, Sviridov, 2011, p. 56)

Neural networks systems find application in cardiovascular diseases diagnostics: for electric cardio signal analysis (Istomina et al., 2010, p. 13); in myocardial infarction diagnostics (Prasolova, 2008, p. 17; Uskov, 2006, p. 18); arterial hypertensia (Medintsev, 2005, p. 10; Zhernyakov et al., 2011, p. 47); cardiovascular pathology process and myocardial infarction complications prediction (Gorban, Rossiev, 1996, p. 167) et al.

William Buckst from the University of California used the neural network for myocardial infarction diagnostics of the patients coming to accident ward with sharp pain in the chest (Zharko et al., 2008, p. 3).

The neural networks find more and more usage in oncological diseases diagnostics as well for: immune status evaluation of the patients with the sharp non- lymphoblast leucosis (Manchuk et al., 2010, p. 77); patients treatment with mammary gland cancer remote results prediction (Khusainova, 2010, p. 27); thyroid gland tumors differential diagnostics (Poloz et al., 2006, p. 8); laboratory blood indexes analysis for diagnostic information reception in experimental and clinical oncology (Bozhenko et al., 2004, p. 28); primary glaucoma early diagnostics (Komarovskikh et al., 1999, p. 72), in China the employees of the Institute of atomic energy taught the neural network to distinguish patients with mild and serious diseases of gastro enteric tractepithelium from those who suffer the gastro enteric tractcancer on the base of nails element analysis (Dyuk, 2003, p. 374). In the Troitsk institute of innovative and thermonuclear research there have been developed the neural network program which chooses the skin basal cell carcinoma treatment method on the base of the long-term back-set development (Tarkhov, 2005, p. 35)

There is the neural technologies usage experience in gastrointestinal tract pathologies (Loktyukhin et al., 2009, p. 21), endogenic intoxication syndrome (Uskov, 2006, p. 19), virus hepatitis (Artyukhin, 2007. p. 12), as well as stroke types diagnostics and liver cancer and arthritis differential diagnostics(Masalov et al., 2010, p. 18, Lazarev et al., 2011, p. 67). There has been tested the neural network model for the hemoglobin level prediction for the patients after surgery (Milova, 2018, p. 30).

Many specialists describe the neural networks usage in ophthalmology. The Italian authors (Salvi et al. 1999, p. 45) used the neural network model for thyroid-linked ophthalmopathy development prediction. The group of authors from the Great

Britain (Tailor et al., 1999, p. 22), developed the neural network able to diagnose glaucoma. The German ophthalmologists have developed the neural network diagnostics model for "deaf eyesight" syndrome detection by the data about the tear electrical element protein composition (Paul et al., 1995, p. 18). There has been presented the method of eye arteries state evaluation, which is based on the blood flood pressure model through the eye analyser artery and neural network model for eye arteries state prediction, adjusted by genetic algorithm (Fedorov et al., 2011, 84). There has been described the algorithm of the complete multitude construction for the artificial neural network adjustment, based on the three-layer perceptron on the base of the expert system for ophthalmology (Dolinina et al., 2011, p. 81.).

There has been described the neural network models usage in diagnostics of the persons with hearing disorders: the company "Neuroproject" developed the objective hearing diagnostics system for breast- fed children (Ezhov et al., 2007, p. 34). The group of specialists in the Research Institute of Nuclear Physics after D.V. Skobeltsyn of the Moscow State University made attempts to use the neural network for the hearing organs diseases (Zolin et al., 2005, p. 56.)

The number of works describes the experience of the neural networks usage in screening, diagnostic, treatment and prediction stages optimisation of the medical practice. The neural networks introduction into each stage of the medical practice makes it possible to accurately estimate the research volume and necessity, promotes the rational use of the diagnostics and treatment means, the more individualized planning and carrying out of the appropriate treatment of the persons with disabilities (Solomakha et al., 2010, p. 23; Loktyukhin et al., 2009, p. 21; Acciani et al., 1993, p. 454). There is discussed the problem of the neural network classifier- advisor, assigned

for application as the part of the applied software for the medical extremely high frequencies equipment DKM-01. There has been shown that for to get the required classification amount the original cascade artificial neural network can be used (Avshalumov, 2011, p. 321).

Lately the research in the area of biology is the mostly developing neural networks application direction. Biologists involved in the research in the area of the neural informatics made the conclusion that many systems in the living organisms work by the principles similar to neural networks algorithms (Shiozhev, 2004, p. 56; Zhukov, 2000, p.6; Ruanet, 2007, p. 45; Evdokimenko, 2005, p. 346). The neural networks usage for research in the area of neurophysiology is built on the like principles of neural networks and nervous structures functioning in the living organisms (Yankina, 2005, p. 14). With the neural network aid there has been done the attempt of the simplest nervous system modeling (Palyanov et al., 2009, p. 216), associative memory (Korotky, 2002, p. 256) and intracerebral links (Lazarev, 2011, p. 32). There have been conducted schizophrenia neural network research and Dofaminum shortage in its development (Pyatokovich et al., 2010, p. 59; Tailor et al., 1999 p. 21).

Neural network technologies are used in pharmaceutical industry for medicaments interaction working out, drugs direct and side effects simulation (Hussain et al., 1999, p. 1249).

Despite all the above mentioned these methods and algorithms are used not often for the biomedical problems solution and diagnostics process of the persons with disabilities.

However, such works in the area of psychology are extremely scarce. I.O. Dubynin (2004) described the neural network structures usage in psychological practice. He showed the neural network usage opportunity for students IQ estimation on the base of answers for personalized questionary (Dubynin, 2006, p. 5).

M.A. Berebina and S.V. Pashkova (2006) developed the neural networks for differential diagnostics and psychological adaptation disorders prediction of defense and law enforcement agencies employees (Berebin, 2006, p. 42).

There has been offered the neural network usage for psycho-diagnostics data processing. Here, the simple neural network has been developed with direct signal transmission and back error propagation. The neural network structure was strictly linked with initial analysed data and its teaching was made with their usage. The network teaching and its work check was done on the basis of junior teenagers testing data. It has been shown that the offered algorithm makes it possible to efficiently single out the psychological marks, important for the gender differences estimation of the testees (Slavutskaya et al., 2012, p. 4)

D.N. Levanov considered (2013) the program implementation of Holland psychological test for personality professional orientation estimation and offered the alternative models on the base of neural networks technologies and fuzzy expert systems (Levanov, 2013, p.8).

There has been described the neural network approach usage for the inclusive education quality evaluation in the university, making it possible to predict the competence level achievement by the disabled students in dependence on the educational process organization quality. Also, using the neural network approach, the university staff have the possibility to predict the competence values level which the disabled students will get in vase of the changes introduction into some university work direction. Herewith, there is the opportunity to consider the various variants of work change and to select the one which makes possible to develop the highest competence level (Kondratieva, 2010, p. 22)

Currently we are developing the neural network software set for Attention deficit hyperactivity disorder (ADHD) diagnostics of primary school children. The diagnostics process for this pathology is complicated, time-consuming and requires high skill, that's why in our research the parameters set construction for neural network teaching was made on the base of the large- scale testing of children with ADHD. For the neural network teaching there have been selected criteria which, according to the modern viewpoint are mostly often met in children with this pathology (Kropotov, 2005, p. 67). The research first stages results showed the promising outlook of the tested diagnostics system usage. The further software development on the base of neural network approach will help to increase the diagnostics efficiency not only for Attention deficit hyperactivity disorder but for many other children brain disfunctions (Reznichenko et al., 2012, p. 72)

Thus, the neural network approach usage for medical- psychological problems solution showed the high diagnostics and recommendations for specialists for work with disabled persons efficiency. The neural networks are regarded as the universal tool for various weakly formulated tasks where the classical mathematics and statistics methods are ineffective.

The further software sets on the base of the neural network approach will help to increase the diagnostics efficiency not only in the area of biomedical problems solution, but in various areas of psychological science as well.

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Нейросетевой подход в решении медико-психологических проблем и в диагностическом процессе у лиц с ограниченными возможностями здоровья (обзор литературы)

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Статья посвящена актуальной проблеме автоматизации процесса медико-биологической диагностики. В настоящее время в медико-психологической практике уже совершенно недостаточно использования стандартных наборов статистических методов обработки данных. Поэтому особенную значимость приобретает теория нейронных сетей и ее применение для автоматизации научных исследований и решения прикладных задач.

Нейросетевые технологии – это средство, которое является достаточно эффективным, действенным, универсальным при решении медико-биологических проблем. Их можно рассматривать как помощь специалистам медико-биологического и медико-психологического профиля, как систему совершенствования процесса диагностики и лечения цикла заболеваний.

В статье описано применение нейросетевого подхода в различных областях знаний, таких как медицина и психология.

Ключевые слова: диагностика, нейронные сети, медико-биологические исследования, математическая модель.