Global Journal of Science Frontier Research: I
Interdisciplinary
Volume 20 Issue 4 Version 1.0 Year 2020
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

The use of the Neural Network in Predicting a Number of Diseases of the Gastrointestinal Tract Caused by Parasites

By U. N. Musevi, K. S. Pashayeva & N. T. Abdullayev
Azerbaijan State University

Annotation- Disorders of the functional state of the gastrointestinal tract associated with the influence of various parasites are considered. The symptoms of diseases caused by parasites and their location in the gastrointestinal tract are given. The possibility of using neural network technology in diagnosing diseases as a result of the influence of various parasites is estimated. The structure of the neural network is given, indicating the set of inputs and outputs, as well as the result of training the network. For the created neural network, test results for the corresponding symptoms and disease prediction results for these symptoms were obtained.

Keywords: gastrointestinal tract, parasites, symptoms, neural network, structure, testing, prediction, error.

GJSFR-I Classification: FOR Code: 170205

Strictly as per the compliance and regulations of:

The use of the Neural Network in Predicting a Number of Diseases of the Gastrointestinal Tract Caused by Parasites

U. N. Musevi [α], K. S. Pashayeva [σ] & N. T. Abdullayev [ρ]

Annotation- **Disorders of the functional state of the gastrointestinal tract associated with the influence of various parasites are considered. The symptoms of diseases caused by parasites and their location in the gastrointestinal tract are given. The possibility of using neural network technology in diagnosing diseases as a result of the influence of various parasites is estimated. The structure of the neural network is given, indicating the set of inputs and outputs, as well as the result of training the network. For the created neural network, test results for the corresponding symptoms and disease prediction results for these symptoms were obtained.**

Keywords: gastrointestinal tract, parasites, symptoms, neural network, structure, testing, prediction, error.

I. Introduction

Often, a violation of the functional state of the gastrointestinal tract (GIT) is associated with the influence of various parasites. Parasites have a more complex structure and have well-oiled defense mechanisms directed against the human immune system (encapsulation, antigenic mimicry, antigenic "drift", inactivation of enzymes and biologically active substances, etc.), which allows them to exist for a long time in various human organs and tissues ... In addition, there are objective difficulties in identifying, isolating and obtaining immunoreagent specific antigens of parasites. So, for example, the immune response in giardiasis is largely due not to the surface proteins of the parasite, but to antigens that enter the human body along with the products of their vital activity. Thus, in the laboratory diagnosis of many parasites, serological research methods are only of auxiliary value [1].

The World Health Organization has proven that 95% of humanity has a variety of parasites in the body. These living organisms are not as harmless and safe as it might seem in the first place. Most of them are localized in the organs of the gastrointestinal tract (the eggs of the worms get here along with contaminated water and food), but there are also so-called extra intestinal forms of invasion - parasites can live in the lungs, heart and even the human brain [2].

II. Immune Disorders and Disease Symptoms

Parasites weaken the immune system, lowering the release of immunoglobulin, and their presence constantly stimulates the system's response and, over time, can weaken this vital immune mechanism, opening the way for bacterial and viral infections to enter the body.

These symptoms are just a few of them. In reality, the symptoms of diseases caused by parasites in the digestive tract are more extensive. The most difficult thing about this is that these symptoms of different diseases are very close and require additional techniques to clarify the diagnosis.

Probable etiological factors of gastrointestinal tract dysfunction are mainly parasites: *Entamoeba, Giardia lamblia, Balantidium coli, Ascarislumbricoides, Enterobiusvermicularis, Taeniasolium (saginata), Strongyloidesstercoralis, Cryptosporidiumparvum* [3].

Table 1: Location of parasites in the gastrointestinal tract

Types of parasites	Habitat	Source
Entamoeba	large intestine	[4]
Giardialamblia	small intestine	[5]
Balantidiumcoli	large intestine	[6]
Ascarislumbricoides	small intestine	[7]
Enterobius vermicularis	cecum or appendix, small intestine, colon	[8]
Taenia solium (*saginata*)	small intestine	[9]

Author α: Postgraduate, Azerbaijan State University of Oil and Industry, Baku city. e-mail: ulker.musevi@mail.ru

Author σ: PhD., Baku Higher Oil School, Baku city. e-mail: is_kamalya@yahoo.com

Author ρ: Dr. Scientist, head of department "Biomedical Engineering" Azerbaijan Technical University, Baku city. e-mail: a.namik46@mail.ru

Strongyloides stercoralis	duodenum, lean intestine	[10]
Cryptosporidium parvum	small intestine	[11]
Echinostoma	small intestine	[12]

Colitis is an inflammation of the colon, observed in a number of diseases, namely, in chronic inflammatory bowel diseases, pseudomembranous colitis and infections caused by bacteria, parasitic protozoa (amoeba) and viruses. Irritable bowel syndrome, otherwise called mucosal or spastic colitis, is not associated with inflammation of the colon, although it has similar symptoms [13].

The causative agent of giardiasis in humans is *Lambliaintestinalis (Giardia intestinalis, Giardia lamblia)*. *Giardiasis* is a fairly widespread invasion throughout the world that affects all age groups, but children suffer from this disease more often than others. [14]

Balantidium coli is a type of ciliates parasitizing in the large intestine of some mammals: as a rule, in pigs, less often in rats, dogs, and also in humans. Causes a disease called balantidiasis, or ciliated dysentery. [6]

Ascariasis- intestinal invasion from the group of nematodes, the causative agents of which are roundworms (*Ascarislumbricoides*). *Ascaris* parasitizes in small intestine. [7]

Enterobiasis is an intestinal invasion by the pinworm Enterobiusvermicularis, usually found in children. [15]

Cysticercosis is the most common parasitic disease of the central nervous system. The invasion of the central nervous system by the larvae of the pork tapeworm *Taeniasolium* occurs when eating food contaminated with helminth eggs. [16]

Strongyloidosis is an invasion caused by *Strongyloidesstercoralis*. [15]

Cryptosporidiosis is a parasitic disease caused by protists of the genus *Cryptosporidium* from the Apicomlex type. *Cryptosporidiosis*, as a rule, manifests itself as an acute and short-term infection and is spread by the alimentary route, often through contaminated water. [17].

Echinostoma infect the gastrointestinal tract in humans, and can cause a disease known as *echinostomosis* [18].

Table 2: Symptoms and diseases associated with major gastrointestinal parasites

№	Symptoms	*Shortening*	Parasites of Gastrointestinal Tract								
			Entamoeba	*lamblia*	*Coli*	*lumbricoides*	*Enterobius vermicularis*	*solium(sagi)*	*sstercoralis*	*Cryptosporid iumparvum*	*Echinostoma*
1	Intensity invasions	II	+			+	+				+
2	Violations intestinal peristalsis	VIP	+				+				
3	Immunodeficiency	ID	+						+	+	
4	Fasting	Fast	+				+				
5	Stress	ST	+				+		+		
6	Perforation intestines	PI	+		+						
7	Intestinal bleeding	IB	+		+	+			+	+	+
8	Tumor overgrowth in the wall of the large intestine	TLI	+								
9	Amoebic intestinal structure	AIS	+								
10	Pain, bloating and rumbling in the stomach	PBRSt		+	+				+		+
11	Increased gassing	IG		+							
12	Vomiting, nausea	VN	+	+				+	+	+	

13	Magnification of the amount of undigested fat in feces	MFF		+						+	
14	Dysbacteriosis	DB		+							
15	Loss of appetite	LA		+		+	+	+	+		
16	Allergy	Aller		+			+		+		
17	Diarrhea	Diar			+			+	+		+
18	Spasm and soreness of the large intestine	SBLI			+	+	+				
19	Fever	Fev			+					+	
20	Slimming	Slim			+				+		+
21	Irritation peritoneum	IP			+			+			
22	Insomnia	Inso					+				
23	Stomach pains	StP								+	
24	Diarrhea	Diar								+	+
25	Disease associated with		Colitis	Giardiasis	Balantidiasis	Ascariasis	Enterobiasis	Cysticercosis	Strongyloidosis	Cyposporitosdiosis	Echinostomosis

III. A Neural Network Model for Predicting Gastrointestinal Diseases Caused by Parasites

Artificial neural networks are effectively used in the diagnosis of various diseases [19, 20]. Neural network technologies are also used for the diagnosis of diseases of the gastrointestinal tract, for example, for the differential diagnosis of liver diseases [21] and in predicting the development of abdominal sepsis in patients with severe acute pancreatitis [22,23].

Let us consider the possibilities of using the processing and analysis method in medical research using a neural network to improve the accuracy in diagnosing gastrointestinal diseases as a result of the influence of various parasites.

The experiment was carried out on a NeuroPro network emulator. NeuroPro0.25 beta version allows you to implement the following basic operations:

- creation of neuroprojects;
- connect data files with a neuroproject;
- adding layer architectures to neural projects from 1 to 10 layers, with up to 100 neurons in each layer;
- train a neural network to solve forecasting and classification problems;
- testing of a neural network based on database files, calculating the significance indicators of input signals;
- simplify the neural network;
- selection of learning algorithms, determination of forecasting for a given accuracy, etc.

Setting up an experiment

A neural network that determines the prognosis of diseases using the symptoms of diseases.

For the experiment, we select the symptoms of various gastrointestinal forgetfulness, progressing with parasites. 24 symptoms were selected (at the request of doctors, the number of symptoms can be increased, since these systems are open) and 9 diseases (it should be noted that the number of diseases created by parasites is quite large, the most common of them were selected) (table 2). For the experiment, a neural network simulator NeuroPro 0.25 was used.

The input parameters of the neural network are the symptoms shown in Table 2, the set of inflows includes 9 varieties, and the output of the network will be the solution of the neural network according to the training rules. Fig. 1 shows a neural network corresponding to the first variant of the experiment.
Input parameter.

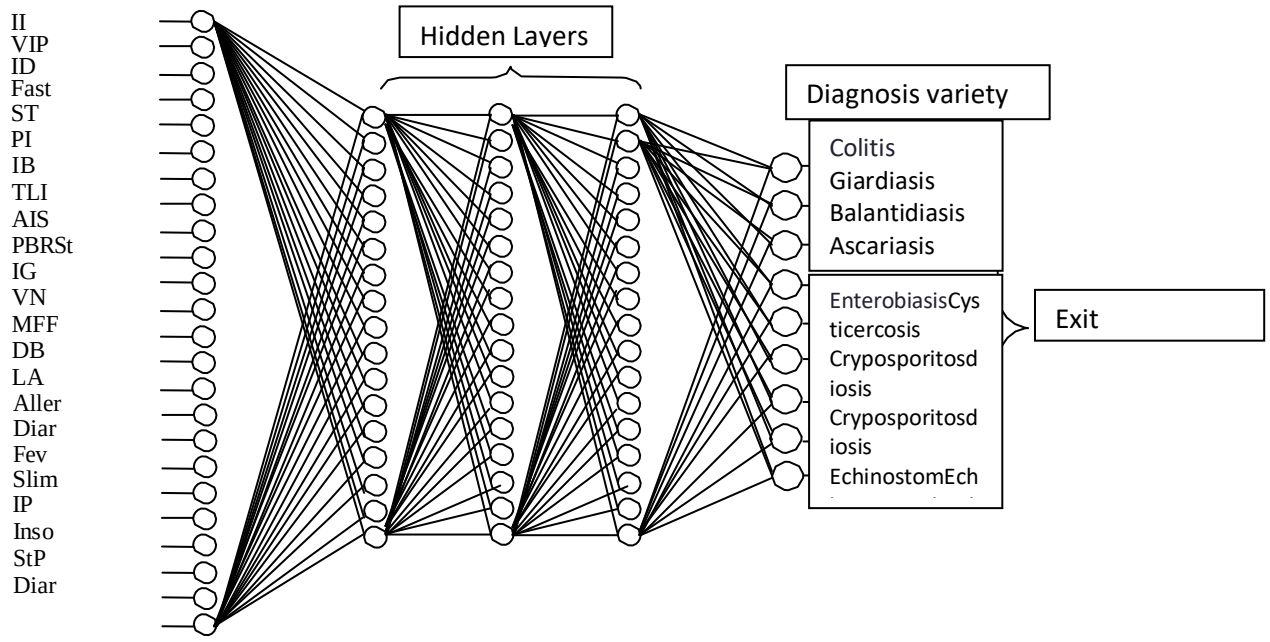

Fig. 1: Neural network corresponding to the first variant of the experiment

The preprocessing of the input database fields for feeding into the network are calculated with the following formula:

$$I=(I-a_i)/b_i,$$

where I is an input number, ai, bi are coefficients calculated for each input. Thus, preprocessing of input database fields, functional transformers and post-processing of final syndromes is carried out according to the formulas: Database fields (initial symptoms):

N1, N2, N3, N4, N5, N6, N7, N8, N9, N10, N11, N12, N13, N14, N15, N16, N17, N18, N19, N20, N21, N22, N23, N24

Database fields (end symptoms):

N25, N26, N27, N28, N29, N30, N31, N32, N33

Preprocessing of DB input fields for network feed:

N1=(N1-0,5)/0,5

N2=(N2-0,5)/0,5

N3=(N3-0,5)/0,5

N4=(N4-0,5)/0,5

N5=(N5-0,5)/0,5

N6=(N6-0,5)/0,5

N7=(N7-0,5)/0,5

N8=(N8-0,5)/0,5

N9=(N9-0,5)/0,5

N10=(N10-0,5)/0,5

N11=(N11-0,5)/0,5

N12=(N12-0,5)/0,5

N13=(N13-0,5)/0,5

N14=(N14-0,5)/0,5

N15=(N15-0,5)/0,5

N16=(N16-0,5)/0,5

N17=(N17-0,5)/0,5

N18=(N18-0,5)/0,5

N19=(N19-0,5)/0,5

N20=(N20-0,5)/0,5

N21=(N21-0,5)/0,5

N22=(N22-0,5)/0,5

N23=(N23-0,5)/0,5

N24=(N24-0,5)/0,5

The sigmoid function was chosen as the activation function.
Functional converters:

Sigmoid 1 (A) = A / (0,1+ | A |)

Sigmoid 2 (A) = A / (0,1+ | A |)

Sigmoid 3 (A) = A / (0,1+ | A |)

Post-processing of end-point syndromes:

N25=((N25*1)+1)/2)

N26=((N26*1)+1)/2)

N27=((N27*1)+1)/2)

N28=((N28*1)+1)/2)

N29=((N29*1)+1)/2)

N30=((N30*1)+1)/2)

N31=((N31*1)+1)/2)

N32=((N32*1)+1)/2)

N33=((N33*1)+1)/2)

Table 3 gives a set of network inputs with corresponding symptoms.

Table 3: Multiple network inputs with corresponding symptoms

№	Symptoms	Relevant network inputs
1	Intensity invasions	N1
2	Violations intestinal peristalsis	N2
3	Immunodeficiency	N3
4	Fasting	N4
5	Stress	N5
6	Perforation intestines	N6
7	Intestinal bleeding	N7
8	Tumor overgrowth in the wall of the large intestine	N8
9	Amoebic intestinal structure	N9
10	Pain, bloating and rumbling in the stomach of BWU	N10
11	Increased gassing	N11
12	Vomiting, nausea	N12
13	Magnification of the amount of undigested fat in feces	N13
14	Dysbacteriosis	N14
15	Loss of appetite	N15
16	Allergy	N16
17	Diarrhea	N17
18	Spasm and soreness of the large intestine	N18
19	Fever	N19
20	Slimming	N20
21	Irritation peritoneum	N21
22	Insomnia	N22
23	Stomach pains	N23
24	Diarrhea	N24

Table 4 shows the outputs of the neural network with the corresponding diseases.

Table 4: Outputs of the neural network with corresponding diseases

№	Symptoms	Relevant network outputs
1	Colitis	N25
2	Giardiasis	N26
3	Balantidiasis	N27
4	Ascariasis	N28
5	Enterobiasis	N29
6	Cysticercosis	N30
7	Strongyloidosis	N31
8	Cryposporitosdiosis	N32
9	Echinostomosis	N33

After displaying the input and output parameters of the network, the network is trained.

The analysis shows that the most optimal algorithm for learning a multilayer perceptron is the back propagation algorithm [24]. The corresponding learning outcomes, inputs and outputs, parameters are given in Fig. 2-6.

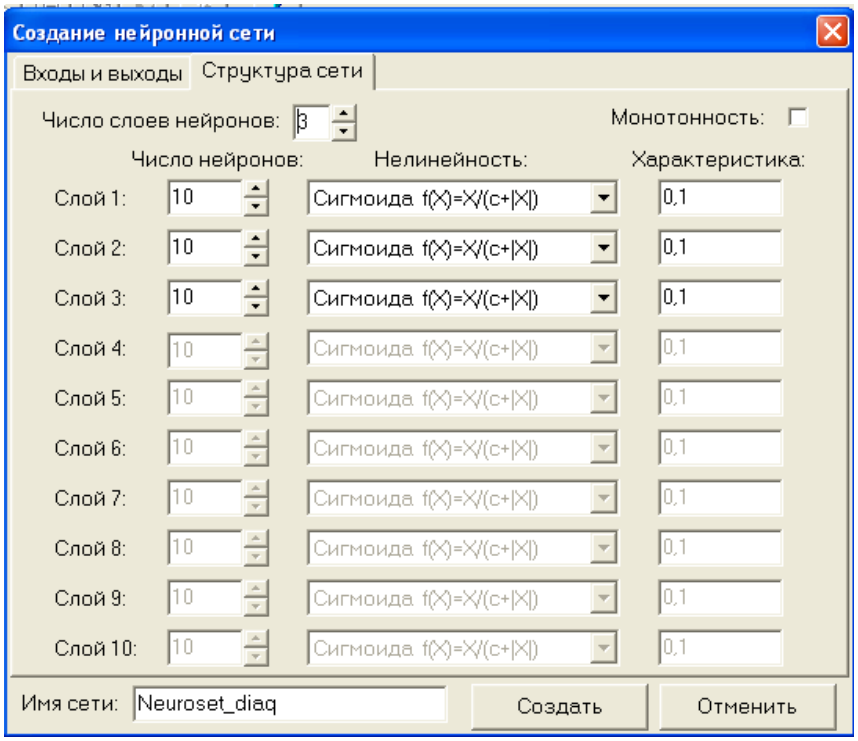

Fig. 2: The structure of the neural network

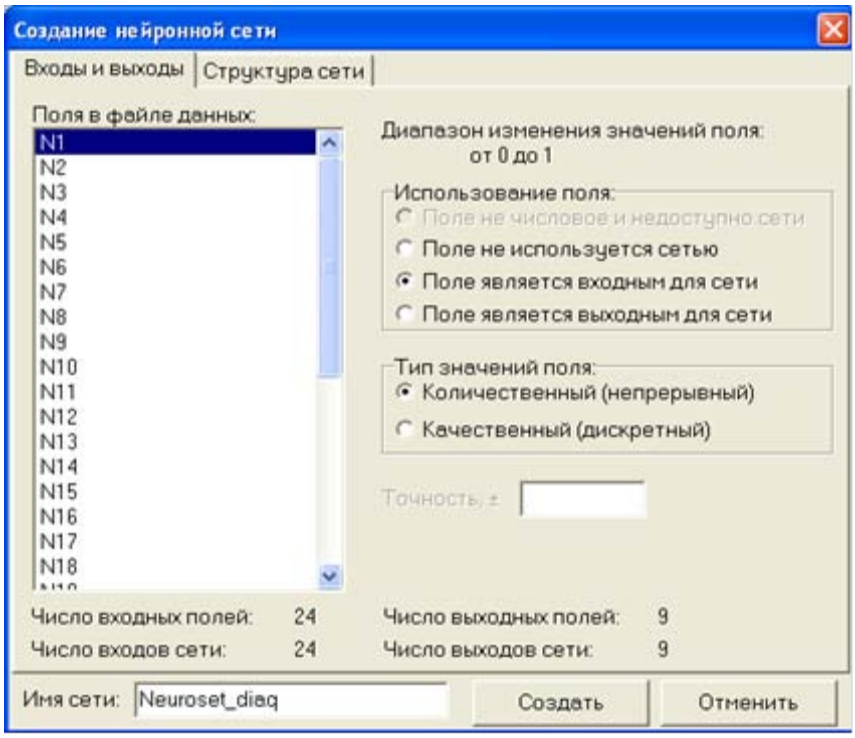

Fig. 3: Network inputs

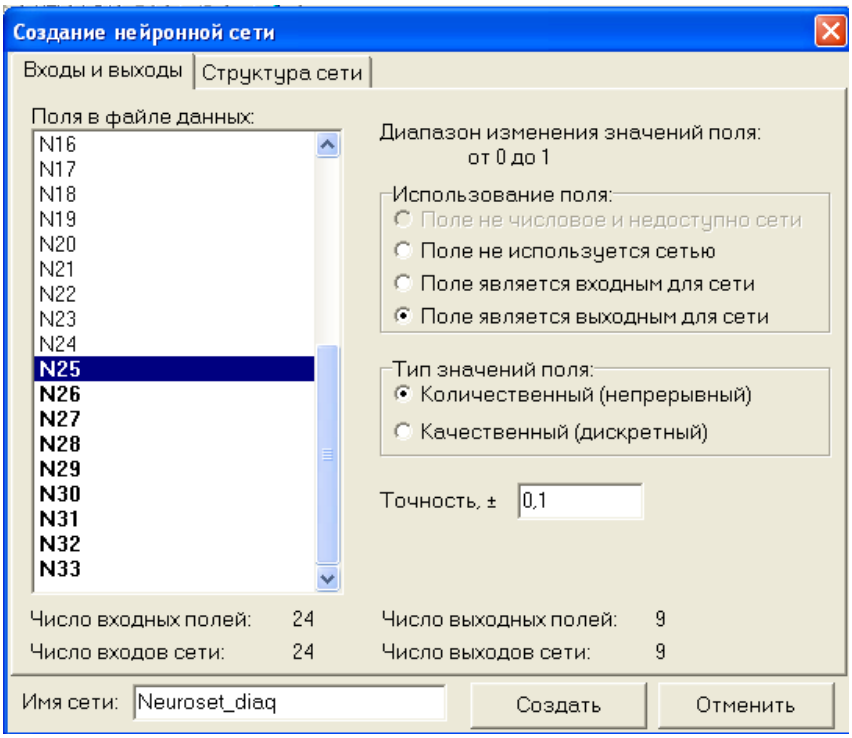

Fig. 4: Network outputs

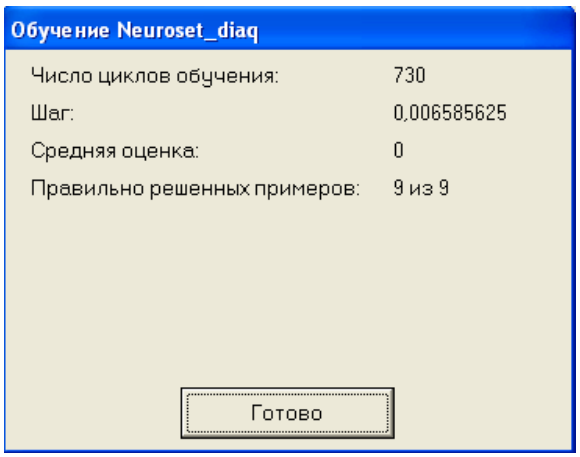

Fig. 5: Neural network training parameters

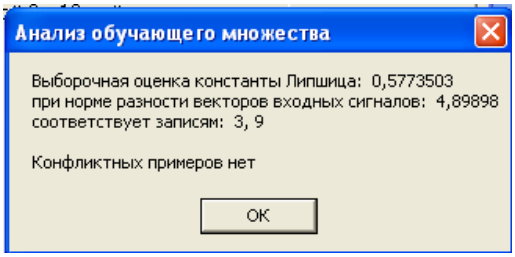

Fig. 6: Analysis of the training set

To test the created neural network, selected symptoms were selected (Table 5).

Table 5: Input symptoms for testing

Corresponding network inputs	Symptoms
N1	Intensity invasions
N5	Stress
N6	Bowel perforation
N7	Intestinal bleeding
N10	Pain, bloating and rumbling in the stomach
N11	Increased gassing
N14	Dysbacteriosis
N17	Diarrhea
N20	Slimming
N21	Peritoneal irritation

Fig. 7-9: Shows the network prediction results for the corresponding symptoms

№	N28	Прогноз сети	Ошибка	N29	Прогноз сети	Ошибка	N30	Прогноз сети	Ошибка
1	0	0,09344602	-0,09344602	0	0,0925135	-0,0925135	0	0,09490025	-0,09490025
2	0	0,03497162	-0,03497162	0	0,05648446	-0,05648446	0	0,09930319	-0,09930319
3	0	-0,09095228	0,09095228	0	0,08263764	-0,08263764	0	0,01090771	-0,01090771
4	1	0,9196365	0,08036351	0	0,05327278	-0,05327278	0	-0,09202719	0,09202719
5	0	0,0143829	-0,0143829	1	0,9450069	0,05499309	0	-0,0783869	0,0783869
6	0	0,08602086	-0,08602086	0	0,04222867	-0,04222867	1	0,9099151	0,09008491
7	0	0,01971248	-0,01971248	0	-0,09407657	0,09407657	0	-0,09986526	0,09986526
8	0	0,08959022	-0,08959022	0	0,03864676	-0,03864676	0	0,02319735	-0,02319735
9	0	0,08467203	-0,08467203	0	-0,05847192	0,05847192	0	-0,08407497	0,08407497
10		-0,1610576			0,1938157			-0,1561767	
		Правильно:	9 (100%)		Правильно:	9 (100%)		Правильно:	9 (100%)
		Неправильно:	0 (0%)		Неправильно:	0 (0%)		Неправильно:	0 (0%)
		Всего:	9		Всего:	9		Всего:	9
		Ср.ошибка:	0,06601243		Ср.ошибка:	0,06370282		Ср.ошибка:	0,07474975
		Макс.ошибка:	0,09344602		Макс.ошибка:	0,09407657		Макс.ошибка:	0,09986526

Fig. 7: Network forecast for outputs N25-N27

№	N28	Прогноз сети	Ошибка	N29	Прогноз сети	Ошибка	N30	Прогноз сети	Ошибка
1	0	0,09344602	-0,09344602	0	0,0925135	-0,0925135	0	0,09490025	-0,09490025
2	0	0,03497162	-0,03497162	0	0,05648446	-0,05648446	0	0,09930319	-0,09930319
3	0	-0,09095228	0,09095228	0	0,08263764	-0,08263764	0	0,01090771	-0,01090771
4	1	0,9196365	0,08036351	0	0,05327278	-0,05327278	0	-0,09202719	0,09202719
5	0	0,0143829	-0,0143829	1	0,9450069	0,05499309	0	-0,0783869	0,0783869
6	0	0,08602086	-0,08602086	0	0,04222867	-0,04222867	1	0,9099151	0,09008491
7	0	0,01971248	-0,01971248	0	-0,09407657	0,09407657	0	-0,09986526	0,09986526
8	0	0,08959022	-0,08959022	0	0,03864676	-0,03864676	0	0,02319735	-0,02319735
9	0	0,08467203	-0,08467203	0	-0,05847192	0,05847192	0	-0,08407497	0,08407497
10		-0,1610576			0,1938157			-0,1561767	
		Правильно:	9 (100%)		Правильно:	9 (100%)		Правильно:	9 (100%)
		Неправильно:	0 (0%)		Неправильно:	0 (0%)		Неправильно:	0 (0%)
		Всего:	9		Всего:	9		Всего:	9
		Ср.ошибка:	0,06601243		Ср.ошибка:	0,06370282		Ср.ошибка:	0,07474975
		Макс.ошибка:	0,09344602		Макс.ошибка:	0,09407657		Макс.ошибка:	0,09986526

Fig. 8: Network forecast for outputs N28-N30

№	N31	Прогноз сети	Ошибка	N32	Прогноз сети	Ошибка	N33	Прогноз сети	Ошибка
1	0	0,08795309	-0,08795309	0	-0,09518129	0,09518129	0	0,09196231	-0,09196231
2	0	0,09350526	-0,09350526	0	-0,09076416	0,09076416	0	0,04720494	-0,04720494
3	0	-0,08714956	0,08714956	0	0,09191668	-0,09191668	0	0,06026587	-0,06026587
4	0	-0,09295678	0,09295678	0	0,05985516	-0,05985516	0	-0,0613662	0,0613662
5	0	-0,07158798	0,07158798	0	0,09467661	-0,09467661	0	-0,09070551	0,09070551
6	0	-0,08079088	0,08079088	0	0,08758733	-0,08758733	0	0,0726791	-0,0726791
7	1	0,9438573	0,05614275	0	0,09416613	-0,09416613	0	-0,03318572	0,03318572
8	0	0,07193917	-0,07193917	1	0,9065436	0,09345639	0	0,04501843	-0,04501843
9	0	0,07772183	-0,07772183	0	0,09204635	-0,09204635	1	0,9151728	0,08482718
10		0,3709661			0,07566229			0,4827752	
		Правильно:	9 (100%)		Правильно:	9 (100%)		Правильно:	9 (100%)
		Неправильно:	0 (0%)		Неправильно:	0 (0%)		Неправильно:	0 (0%)
		Всего:	9		Всего:	9		Всего:	9
		Ср.ошибка:	0,07997192		Ср.ошибка:	0,08885002		Ср.ошибка:	0,06524614
		Макс.ошибка:	0,09350526		Макс.ошибка:	0,09518129		Макс.ошибка:	0,09196231

Fig. 9: Network forecast for outputs N31-N33

Table 6 shows the results of a neural network for predicting diseases by symptoms.

Table 6: Neural network results

№	Symptoms	Relevant network outputs	Network forecast
1	Colitis	N25	-0.1516073
2	Giardiasis	N26	0.1060389
3	Balantidiasis	N27	0.3889541
4	Ascariasis	N28	-0.160576
5	Enterobiasis	N29	0.1938157
6	Cysticercosis	N30	-0.1561767
7	Strongyloidosis	N31	0.3709661
8	Cryposporitosdiosis	N32	0.07566229
9	**Echinostomosis**	**N33**	**0.4827752**

IV. Conclusion

Thus, an effective type of structure of an artificial neural network designed to solve problems of medical diagnostics and prognosis is a perceptron with sigmoid activation functions, the input of which is information about the symptoms of a patient's diseases, and the output is a diagnosis of the disease. According to the results obtained by the neural network, it is possible to confidently clarify the disease that corresponds to the "Echinostomosis" output, created by parasites of the small intestine, which as a result leads to a violation of the functional state of the gastrointestinal tract.

References Références Referencias

1. S.S. Kozlov, V.S. Turitsin, A.V. Laskin. Diagnostics of parasitoses.Modern myths. Journal of Infectology, Volume 3, No. 1, 2011, pp. 64-68
2. https://www.looduspere.ee/ru/kishechnye-parasity/
3. Diagnosis of parasitic infections https://empendium.com/ru/chapter/B33.V.28.4.
4. http://www.iacmac.ru/iacmac/ru/pub/metod/amebiaz/
5. https: //helix.ru/kb/item/07-126
6. https://ru.wikipedia.org/wiki/Balantidium_coli
7. https: //ru.wikipedia.org/wiki/Human_askaris
8. https: //ru.wikipedia.org/Enterobiasis
9. https: //ru.wikipedia.org/Bull_chain
10. https://ru.wikipedia.org/wiki/Strongyloides_stercoralis
11. https://www.monographies.ru/en/book/section?id=9029
12. https: //ru.wikipedia.org/wiki/Human_parasite_list
13. http: //santegra-rus.ru/kolit.html
14. http://ngmu.ru/cozo/mos/article/text_full.php?id=1948
15. https: //www.msdmanuals.com/ru/
16. http://www.pirogov-center.ru/specialist/diseases/detail.php?ID=584
17. https: //ru.wikipedia.org/wiki/Cryptosporidioz
18. https://ru.qwe.wiki/wiki/Echinostoma
19. M.V. Vyucheyskaya, I. N. Krainova, A. V. Gribanov. Neural network technologies in the diagnosis of diseases // Journal of Biomedical Research. 2018, Vol.6, No. 3-p. 284-294.
20. I.G. Churyumov. Medical decision making system using a neural network. https://cyberleninka.ru/article/n/meditsinskaya-sistema-prinyatiya-resheniy-s-ispolzovaniem-neyronnoy-seti
21. Maclin P.S., Dempsey J. Using an Artificial Neural Network to Diagnose Hepatic Masses // Journal Medical Systems, 1992, V.16, No 5, p. 215-225.
22. Kazmierczak S.C., Catrou P.G., Van Lente F. Diagnostic Accuracy of Pancreatic Enzymes Evaluated by Use of Multivariate Data Analysis // Clinical Chemistry, 1993, V.39, No 9, p. 1960-1965.
23. P.I., Mironov, I.I. Lutfarakhmanov, I.Kh. Ishmukhametov, V.M.Timerbulatov. Artificial neural networks in predicting the development of sepsis in patients with severe acute pancreatitis // Annals of Surgical Hepatology. 2008, T.13, No. 2, p. 85-89.
24. S. Khaikin. Neural Networks: A Complete Course. - M .: Publishing house "Williams", 2006, -1104s.