DISTRIBUTED SYSTEM BASED ON NEURAL NETWORKS TO FAULTS DIAGNOSIS

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Abstract: *In this paper we present a diagnosis model of the faults of systems based on neural networks and the results obtained for a system composed from four functional blocks. This work has a concrete presentation of a distributed system to faults diagnose that can be extended also to diagnose a system composed from many functional blocks.*

1. INTRODUCTION

The faults diagnosis supposes the precise determination of failure blocks in an electronic system [1]. The major approaches from the quantitative diagnosis field of the faults in the electronic systems have been developed between 1980 and the beginning of the 1990th years.

2. DIAGNOSIS MODEL OF ELECTRONIC SYSTEMS FAULTS BASED ON NEURAL NETWORKS

It is considered that a system is functioning when it accomplishing the functions that it was created. A serial system is functioning properly if all its components must to accomplish the functions [5].

In practical it is considered that a block of an electronic system is functional, if it is applied a signal at its entrance a proper signal according to a good functionality, and at the exit it is measured a signal with parameters established in the checking table.

In the figure 1, one considers an electronic system, which in the way of diagnosis of failures is composed from N functional blocks:

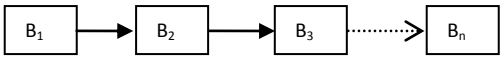

Fig. 1 The block scheme of an electronic system composed from n blocks

Each functional block is characterized by a pair of parameters λ and p, λ meaning the failure rate of the block, and p represents the probability of failure of the same block [3].

The model presented in this subchapter supposes that the failure rate corresponding to each block is known, and it is determined the probabilities p_i by the relation (1).

$$p_i = \frac{\lambda_i}{\sum_{j=1}^{n} \lambda_j} \quad (1)$$

In the table 1 are presented the parameters used to evaluate the state of diagnosis of a serial system composed from n functional blocks.

Table 1 Parameters used in the algorithm of determination of a state of diagnosis

Parameter λ_i $[hours]^{-1}$	λ_1	λ_2	λ_3	...	λ_n
Parameter p_n	p_{B1}	p_{B2}	p_{B3}	...	p_{Bn}

The diagnosis algorithm for a system composed from n blocks:

Step 1: It calculates the failure probabilities after the formula (relation (1)).

$$p_i = \frac{\lambda_i}{\sum_{i=1}^{n} \lambda_i}$$

Step 2: The system is ordinate in decreasing order of failure probabilities.

$$p_{B_1} >= p_{B_2} >= p_{B_n} \quad (2)$$

where p_{B_i} represents the fault probability of the block i

Step 3: It is grouped the last two blocks with the smallest probabilities, in one block, called r_1 that has the probability

$$p_{r_1} = p_{b_{k-1}} + p_{b_k} \quad (3)$$

Step 4: It repeats the steps 2 and 3, until the system is formed only from two elements.

Step 5: It builds the checking table

Step 6: It realizes the diagnosis tree

Step 7: Function on the checking table and the diagnosis tree, the operator makes the measurements and localizes the failure block.

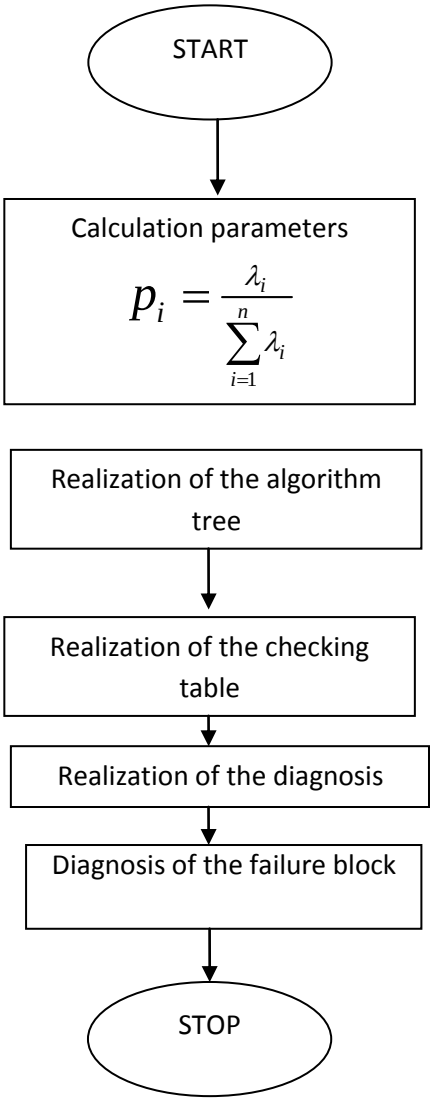

Fig. 2 Logical scheme of a diagnosis model based on structural division of electronic systems

3. THE ORIGINAL MODEL OF FAULTS DIAGNOSIS BASED ON NEURAL NETWORKS.

To improve the performances of the diagnoses of the faults of the diagnosis model based on the structural division of the electronic systems can be used neural networks [4][6].

The purpose of using neural networks is that based on the historical of the parameters λ_i while a long period of time, it can be predicted the future values of these parameters, such as the previous model of diagnosis of faults being improved. Practically we add the prediction part to the previous model. Such as the algorithm will become:

Step 0: It predicts the parameters λ_i by the meaning of neural networks.

Step 1: It calculates the failure probabilities after the formula

$$p_i = \frac{\lambda_i}{\sum_{i=1}^{n} \lambda_i}$$

Step 2: The system is ordinate in decreasing order of failure probabilities.

$p_{B_1} >= p_{B_2} >= p_{B_n}$, where p_{B_i} represents the fault probability of the block i

Step 3: It is grouped the last two blocks with the smallest probabilities, in one block, called r_1 that has the probability

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Step 7: Function on the checking table and the diagnosis tree, the operator makes the measurements and localizes the failure block.

Logical scheme of the diagnosis model based on neural networks is illustrated in the figure 3.

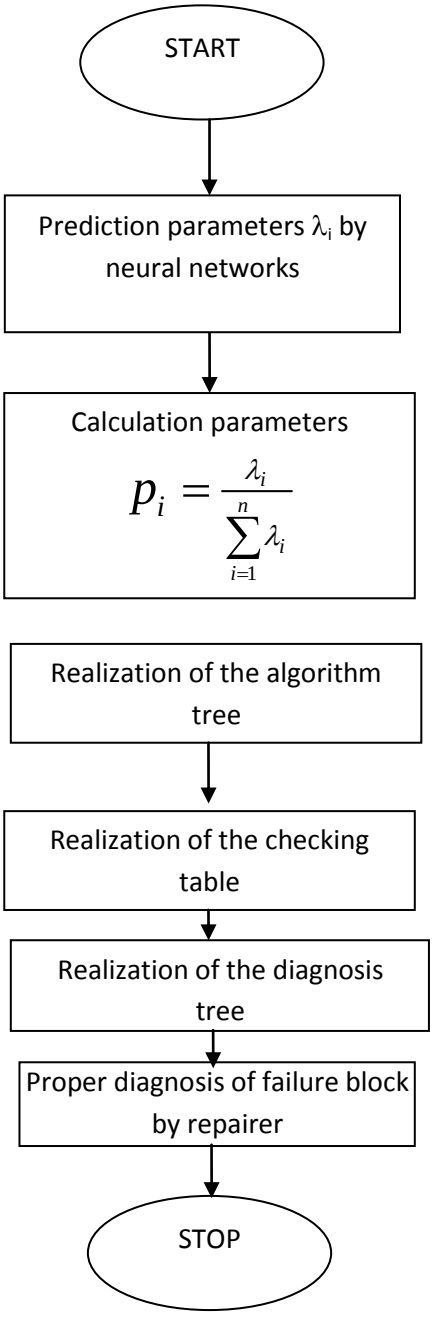

Fig. 3 Logical scheme of the diagnosis model based on neural networks

It was realized a distributed system for fault diagnosis using the diagnosis model based on neural networks.

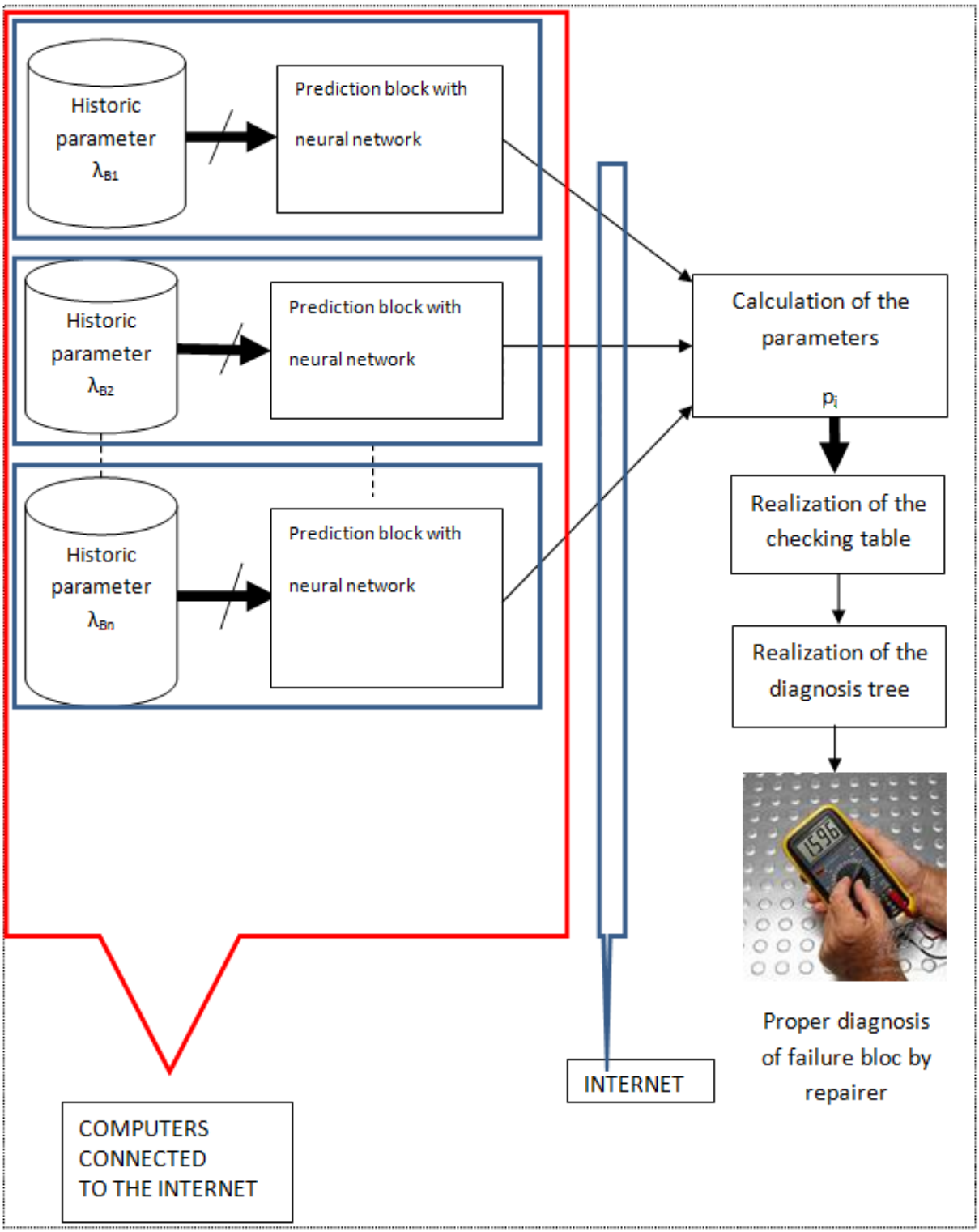

Fig. 4 Distributed system to fault diagnosis.

4. THE PRACTICAL RESULTS FOR A RADIO RECEPTION SYSTEM.

To exemplify the elaborated model and method it was chosen an electronic system of radio reception composed from four functional blocks: B1-radio aerial, B2-feeder, B3-amplifier of radio aerial, B4-receiver.

Below we applied the presented methods on the same radio reception system composed from four functional blocks:

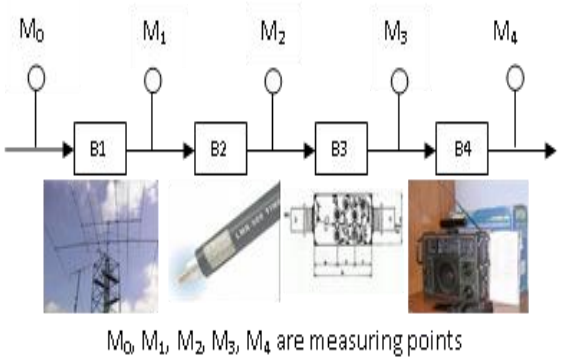

Fig. 5 Scheme block of radio reception system composed from four blocks

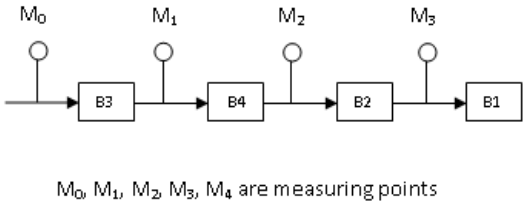

Fig. 6 Measuring points in the blocks scheme of the radio reception system composed from four functional blocks

Table 2 Checking table

Verification	Input	Output
V_1	M_0	M_1
V_2	M_0	M_2
V_3	M_2	M_3

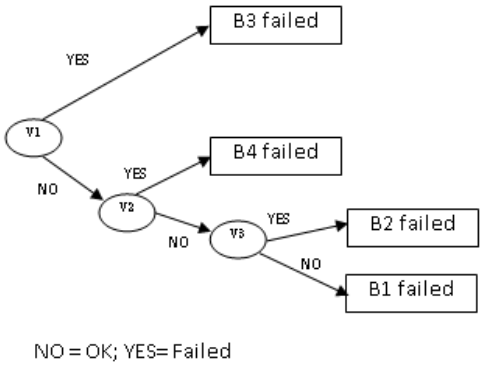

Fig. 7 Diagnosis tree [2]

5. CONCLUSIONS

This paper had like purpose the problematic of the diagnosis of the faults electronic systems by the helping of neural networks. This fact is very important in the industry, because it allows effectively the application of the predictive maintenance, such as the equipment to be maintained in the functioning state. On the other hand the reparation time is reduced to a great extent. To put in practice the diagnosis model we beneficiate of experimental data from the military technique reparation workshop.

It this work one highlights the following aspects:

-The estimation and prediction of the used parameters at the diagnosis of the electronic systems.

-The mathematical modeling to evaluate the diagnosis parameters of the faults electronic systems.

-the structural modeling of neural networks used in diagnosis, and also a learning algorithm of them; the presentation of the feed forward neural networks, trained by backpropagation algorithm that are easily implemented.

-The problematic of the using of neural networks in the localization tests of the faults.

-The presentation of the proposed model and method was made by the authors with the purpose to make a diagnosis of the faults electronic systems.

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