ARTIFICIAL NEURAL NETWORK FOR THE EVALUATION OF VITAL SIGNS

Franyelit Suárez[1], Luis Rosales[2], Jaime Sayago[1]
frangelits@gmail.com, Luis.rosales2@gmail.com, Jaime.sayago@pucese.edu.ec
[1]Pontificia Universidad Católica del Ecuador, Sede Esmeraldas, Ecuador
[2]Universidad Nacional Experimental Politécnica Antonio José de Sucre, Puerto Ordaz, Venezuela

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Abstract: This paper research the influence of vital signs on the percentage of stress in people, in the context of artificial intelligence, specifically artificial neural networks. Currently there is an increasing interest in studying the conditioning factors of stress in people, process that has come to affect workers in the productive sectors in recent years. However, there is an interest in the percentage of stress of people and how it affects on the mood of the same, as a fundamental element in the individual's work performance. The central axis of this work is to evaluate the vital signs of pulse and respiration to estimate the percentage of stress present in the patient, in such a way as to allow an a priori assessment for a future medical diagnosis. The values of pulse and respiration are taken into account and an artificial neural network is executed to estimate the percentage of stress through a Bayesian process of processing medical variables.

Keywords: Stress, vital signs, artificial intelligence

I. INTRODUCTION

The vital signs in the evaluation before the consultation, is the basic processes in the health centers, this constitutes the main phase for the future diagnosis. The study of the factors that condition stress has been the reason for many researchers in recent times [1]. The results show that stress, despite having been considered as a condition of the patient, is also a pre-condition of the diseases [2], being then the reason of some clinical pathologies difficult to diagnose or difficult to attend.

Stressful stimuli cause a physiological reaction in the body, causing physical and psychological changes, which affect the levels of protein, glucocorticoid, androgens that influence infectious processes, as well as increased coagulation and increased heart rate [3] - [4]. These changes can produce positive or negative reactions in people, depending on an individual factor of each person. A positive reaction could trigger a staff with high potential for work, but a negative reaction, which is the most frequent, could cause delays in work, discouragement in the work and in the worst cases accidents at work.

In this paper a tool is developed to estimate the percentage of stress in people, from the vital signs of pulse and respiration. This tool will serve as an initial condition for preventive medical diagnosis. It was developed in Matlab © using the toolbox of neural networks simulink and allows to determine the percentage of stress with a reliability of 82%.

In fig. 1 presents the form of information acquisition and the simple process to obtain the results, which can be administered by the medical staff without major complications. With a friendly and simple user interface, for a fast handling without complications, that is included in the obtaining and valuation of the vital signs previous to the medical consultation.

Figure 1. Vital signs evaluation system

The associated neural network is of Bayesian character, the relations between the variables of the model are represented intuitively by means of directed graphs, that codify the marginal and conditioned dependencies existing in the different variables, allowing to explore visually the relationships that may exist in the set of data (1)

$$P\left(x_1,\dots,x_n\right) = \prod_{i=1}^{n} P\left(x_i|padres\left(x_i\right)\right) \qquad (1)$$

In the model generated through the Bayesian Networks, as shown in fig. 2, it is shown that stress depends mainly on variables related to its symptoms, rather than external factors properly.

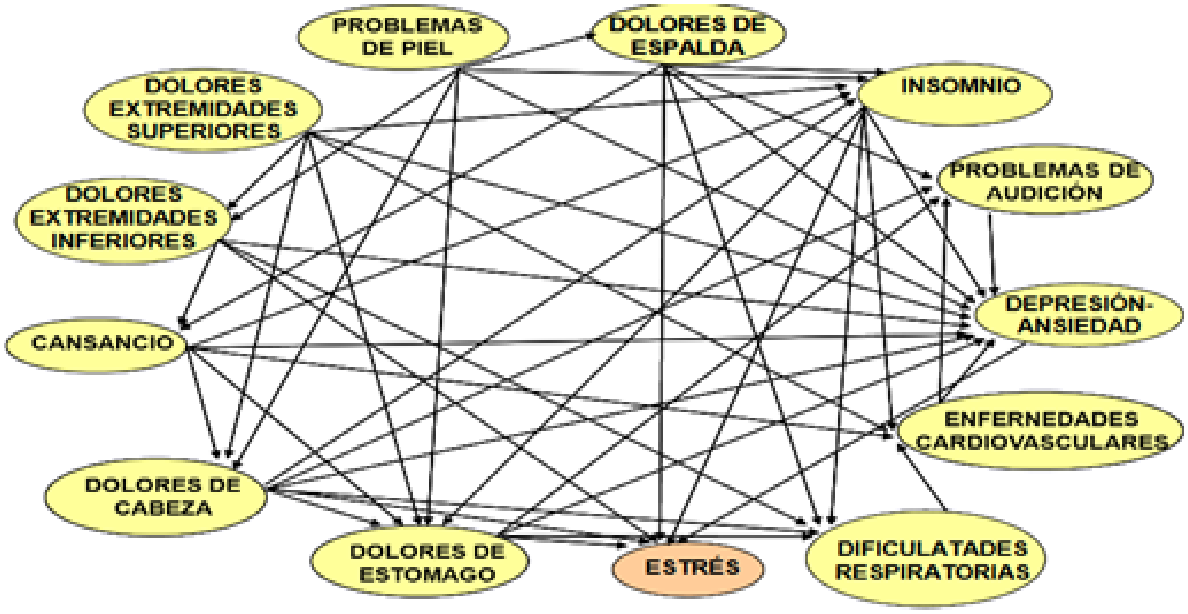


Figure 2. Bayesian network of categorization of stress symptoms.

The network allows to know the probabilities of occurrence of these symptoms associated with stress. With this statistic it is possible to specify that the variables that are associated with the most relevant symptoms are pulse and respiration.

In this paper, a bay-type network has been developed to statistically estimate the probability that the patient's mood is affecting the patient's vital signs.

II. CHARACTERISTICS OF SOFTWARE DEVELOPMENT

Currently, there are computer packages that allow the generation of artificial intelligence tools, from applications with neural networks to those with fuzzy logic. However, the design of intelligent models is not so simple, it is necessary to know the systems and variables and knowledge in addition to these intelligent tools, which may or may not have a high degree of complexity depending on the expertise of professionals who wish to use it. for your designs.

MatLab© software has incorporated a very broad artificial intelligence Toolboox© [5], which includes a wide variety of models and examples explained in a didactic way to carry out the process of system creation, training, simulation and verification. The MatLab© tool offers a toolbox set for different purposes associated with artificial intelligence, with a guidance and help system that can be understood and used by non-experts. Other commercial alternatives (NeuralPlanner [6], NeuroSolutions [7]) and non-commercial alternatives (Lens Neural Network Simulator [8], PDP ++ [9]) exist, but they are of more advanced structures that can only be implemented by experts and do not have a guide didactic

In this paper, MatLab® software is used for the creation, training, simulation and validation of a model for the evaluation of human vital signs. In this tool, we have taken into account a neural network of the Bayesian type, which is nothing but a probabilistic algorithm with conditional dependencies in an acyclic graph. This network allows to classify the probability of incidence of a symptom that produces affectation in the emotional state of the people.

The network was worked with twelve symptoms that can affect the vital signs of the patient and consequently their state of emotional health. The probabilistic analysis of the Bayesiana Network, revealed a set of factors associated with mood changes, which lead to situations of depression. These variables can be discriminated by obtaining a greater incidence in the pulse variables, associated with cardiac situations and the variable respiration, associated with a variety of respiratory problems, even those that are not pathological.

Figure 2 suggests the design, training and validation diagram of the artificial neural network, taking the data of origin, vital signs, as inputs to the network, and obtaining a classification network model based on the probabilities found.

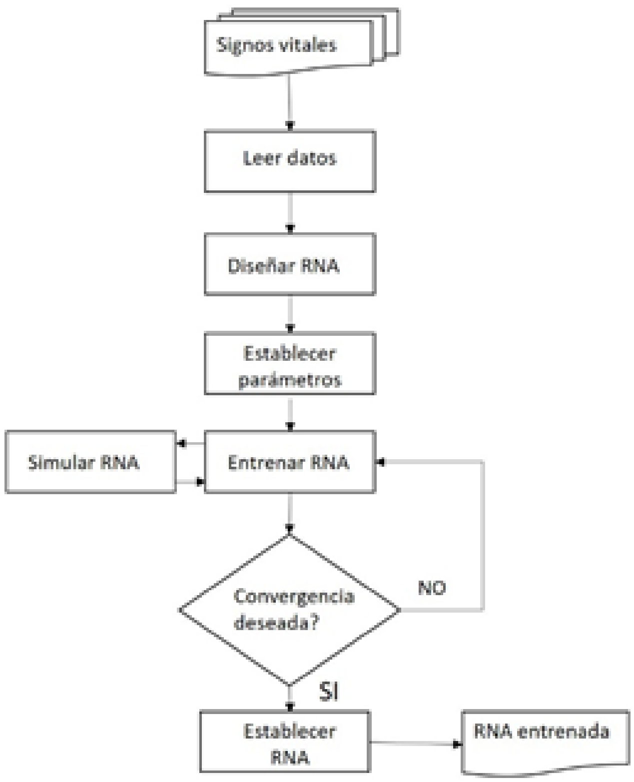


Figure 2. Diagram of the artificial neural network model; design, training and validation

III. IMPLEMENTATION

The implementation was made considering the normal levels of the variables, which in turn were validated by the health specialist. Thus, the complementary neural network was of Backpropagation type, which was responsible for the classification of data.

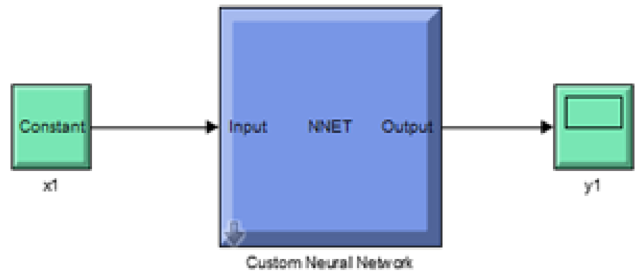


Figure 3. Neural network block

Basically, the intelligent system is composed of a block with the neuronal structure, as shown in fig.3. This block contains the basic layers; Input, intermediate adjustment and output. This description is found in Figure 4, where the number of neurons has been specified by each fragment.

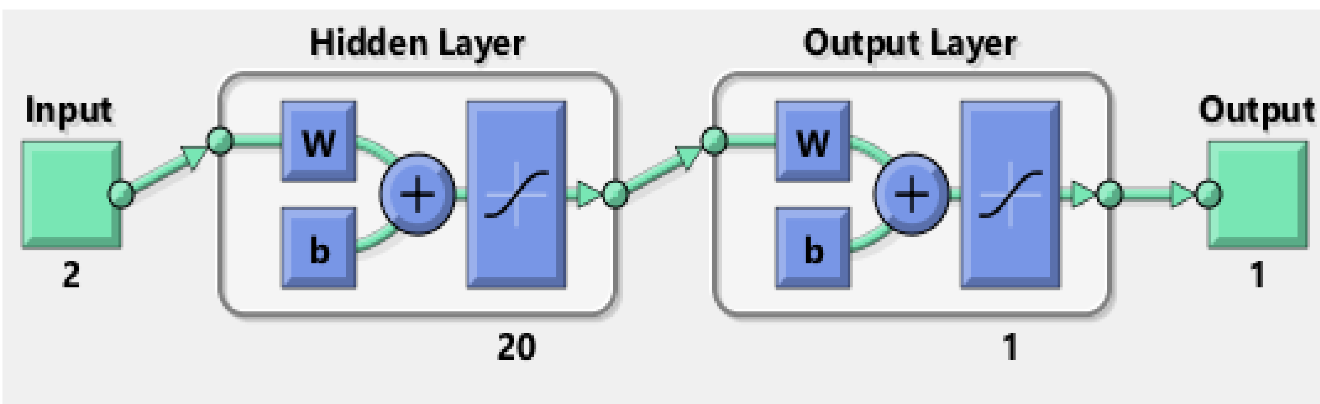


Figure 4. Diagram of the Neural Network, with specification of layers and functions

The network was configured with some elementary characteristics and necessary to establish an adequate classification of the variables. It was not necessary to include delay layers, however 81 weight elements were obtained with a sampling time of one second.

For training, the tansig function was used, which is a hyperbolic tangent transfer function, which performs the output layer with each element located between -1 and 1. FIG. 5 shows the relationships of the tansig function used in the selection of the output elements of the network.

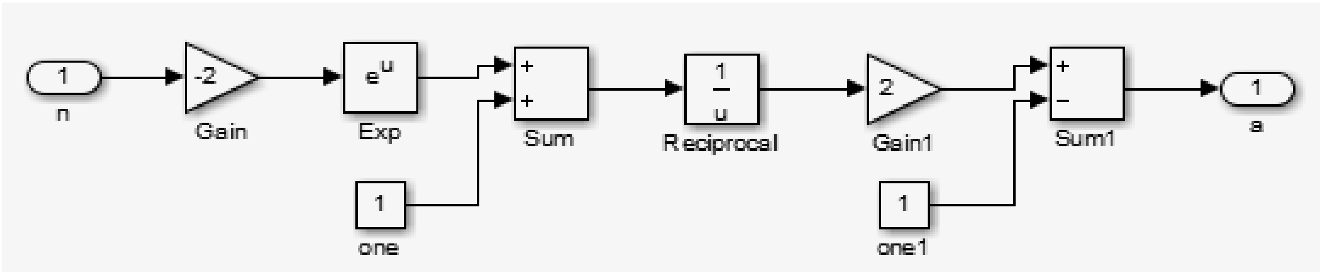
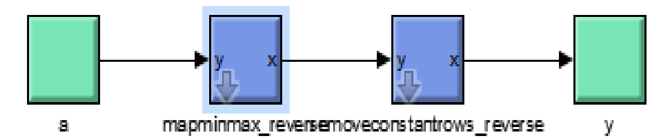
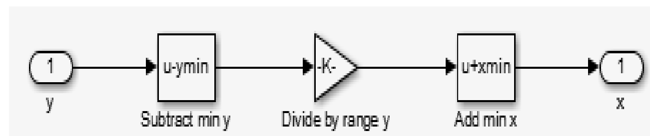


Figure 5. Hyperbolic function for the training of the output layer

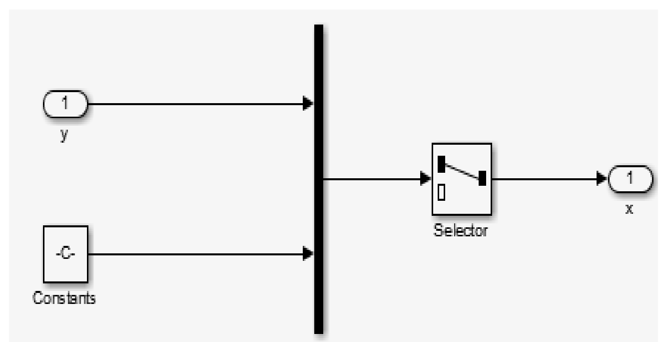
The input parameters for the network training consisted of the pulse and breathing of 50 adult patients, with a similar lifestyle, with teaching profession and without significant antecedents.



(a)



(b)



(c)

Figure 7. (a) Diagram of the exit process. (b) Diagram of determination of the minimum values. (c) Output selection diagram

IV. RESULTS

Once trained the Bayesian network for the determination of probabilities associated with the most outstanding symptoms that influence the level of stress of people, it was possible to use this information as starting arguments for the backpropagation network responsible for the classification. Being able to define if the current state of the person is stable or is altered.

Figure 6. Classification system

The backpropagation network offers an average square error of 0.001%, considering that the supplied data correspond to non-linear characteristic values, the error presented is acceptable.

For the medical specialist, an altered patient can develop diseases or health situations that require attention. This development of pathologies is self-produced by the level of stress in the person, which being recurrent can alter other parameters in your body.

The output process of the neural network backpropagation is determined by fig.7 where it is observed that it is related to layer two of the network.

V. CONCLUSIONS

In this paper, we have presented the creation of a system based on intelligent computing for the evaluation of vital signs in patients.

The developed system allows to evaluate the normal values of vital signs and depending on the result obtained take into consideration the level of emotional anxiety that may be presenting the person, which can be of great importance for the future diagnosis of the patient. One of the main advantages of this tool is that it can help to improve the emotional situation of people, to better cope with their state of health.

VI.REFERENCES

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