Neural Backpropagation System for the Study of Obesity in Childhood

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Abstract—This paper presents the development of a nutritional system using Backpropagation neural network, that is able to provide a clear and simple prediction problems of obesity in children up to twelve years, based on your eating habits during the day. For the development of this project has taken into account various factors, which are vital for the proper development of infants. A prediction system can offer a solution to several factors, which are not easily determined by convectional means.

Keywords—prediction system; Nutrition; Backpropagation Neural Network; Obesity

I. INTRODUCTION

The ENSANUT 2006 warning about the risk in which there are more than 4 million children enter between 5 to 11 years, as the combined prevalence of overweight and obesity occurs in one out of four children [6, 7], also revealing that on weight and obesity has continued to increase in all ages, regions and socioeconomic groups, which has led our country to take first place in the world in obesity.

In Mexico, based on information from two national sources, it was find one built in 1999 and another one in 2006, it is known that the combined prevalence of overweight and obesity has increased across the population, but particularly in the school-age population. During this period, obesity in children increased 33% and 53% children [7].

The adverse effect and risks to health obesity early in life include both short-term physical and psychosocial problems.

Longitudinal studies that childhood obesity suggest, after 3 years of age, long-term is associated with an increased risk of obesity in adulthood and with increased morbidity, persistence of associated metabolic disorders [6].

School age and adolescence are a crucial configuration steps eating habits and other lifestyles that persist in later, with repercussions not only at these stages as to the possible impact as a risk factor, but also in the even in adulthood and old age.

Nutrition is a vital issue, as vital body processes require the supply of materials and energy to provide the necessary elements for increase and repair of body tissues [8].

One should be aware that food is one of the pillars on which health is based. For better or worse, food is the mainstay of the formation and prevention of future disease and could be atherosclerosis, hypertension, mainly diabetic and different degrees of obesity that plague our society. Therefore, we must start from small, balanced meals, so our body will be healthy at the same time avoiding any childhood diseases [11, 12].

There are an important aspect to consider about the power system is that this can not be generalized since each individual has different nutritional needs, that is why the alimentation depend on the activities performed by an individual throughout the day, i.e., it has to be directly proportional to their activities cried otherwise fall into malnutrition.
In nowadays society, the objectives of the child alimentation have expanded and now not only aims to achieve optimal growth and prevent malnutrition and disease occurrence caracals, but also, through the same, optimizer maturational development, establish healthy habits to prevent the onset of nutritional base diseases affecting adults, trying to get better quality of life and longevity.

As will be seen later, to secure as soon raised, we will use the Backpropagation neural network [1-4] that has some differences from traditional logic as it defines the training and classification of data, if the theory of neural networks to predict as a data set to obtain a desired output approach, particularly the prediction data.

The structure of the article is in section 2 history of the work of research, mathematical basis, neuronal structure. In stage 3 the results of the simulations of the neural system for the study of obesity with the defined variables. Section 4 is the discussion of the system compared to conventional system; Finally, section 5 shows the conclusions of the research.

II. DATA COLLECTION (BACKGROUND)

A. Problem Statement

In Mexico, the overweight and obesity is a serious public health affecting school children because of all socioeconomic classes.

He believes that schools primaries National System of Educatio, which have registered more than 95% of school-age children, are a platform that can help reverse the serious problem of overweight if it is recognized that, for now, the school is closer to being an genetic obesity environment healthy, and that part of its mission is to promote, in various educational activities, the acquisition of styles of healthy eating and physical activity. While the building has to be an imed primarily at children, aslo to involve all social actors of change factors, such as parents, family, educational institutions, community authorities and, in particular, industry producing food and beverage processing, and by advertising industry print and online [14].

B. Justification

This research grew out of the need to consider one of the possible factors that cause overweight and obesity in children, and the relationship of these with the consumption of foods that are sold within the school cooperatives, hygiene, food handly, prepare hygienic measures, proper sanitation requirements and frequency of food consumption.

C. Hypothesis

The cooperative school meets the hygenic-Nutrient, where the food consumed within the school are a determining factor in the nutritional status of children, and applying neural network techniques can predict the behavior of infant obesity [9, 10, 13, 15].

D. Theoretical framework

We assessed the nutritional status of students using the criteria of the Official Mexican Standard NOM-008-SSA2-1993, Control Nutrition, Growth and Development of Children and Adolescents and evaluation form containing: Name, Grade and Group age, weighth, height, Hips (centimeters) Waist (centimeters), BMI and food intaje [6, 7].

We evaluated the school cooperative consider through a direct observation assessment tool designed to evaluate the conditions of this, both hygenically and nutritionally about text products that are sold at recess.

Also we identified the relationship between the consumption of foods that is sold in the Cooperative School with nutritional status of students, as it is a very impactor factor for the primary students. Finally, we developed a numerical prediction system with neural network artificial Backpropagation for prediction and reinforcement of the theoretical data acquired on the job, obtained comparative test with the results of observations made, based on a sheet of data and theory a biological neuron [13, 15], and subsequently implement the system of artificial neural network with Backpropagation learning algorithms characterized by the equation [1, 2]:

$$ a^4 = f^4(w^4f^3(w^3f^2(w^2f^1(w^1p+b^1)+b^2)+b^3)+b^4)+b^5 \) \tag{1} $$

E. Neural network [1-4]

Neural network consist of a simulation of the observed properties of the biological diversity of neural systems through mathematical models created through artificial mechanisms (an integrated circuit or a computer). The aim is to ensure that the mechanisms give similar answer to which are able to give to the brain.

A neural network consists of units called neurons, and each neuron receives a set of inputs through interconnections and makes an exit. This output is given by three functions:

- A propagation function, which generally consists of the sum of each input multiplied by but their interconnection. If we weight is positive, the connection is called excitatory, if negative, is called inhibitor.
- An activation function that modifies the former can not exist, being here the diffusion of the same function.
- A transfer function, which applies to the value returned by the output function of the neuron and generally is given by the understanding that we can give to the outputs.

F. Structure

Most scientist agree that an artificial neural network ANN [3] is very different in terms of structure of an animal brain. As brain, an ANN consist of a set of simple units massively parallel processing and connections between these units where the network intelligence.

Biologically the brain learns through the reorganization of synaptic connections between individual neurons. Similarly, RNA having a large number of virtual processors interconnected in a simplified manner to simulate the functionality of biological neurons Figure 1. In this simulation [4], the mechanism reorganization synaptic connections biological models with weights that are adjusted during the learning phase. An ANN trained, the weights determined set of knowledge of RNA and is capable of solving a problem.
Furthermore, each neuron is associated with a mathematical
t function called transfer function. This function generatesthe
signal output from the neuron input signals. The entry of the
function is the sum of all input signals but by the connection
associated with that signal (Figure 2).

**G. The multilayer perceptron [1-4]**

It basically consists of a layer of neurons with weights and
adjustable threshold; this neural system may be called a neural
network because the connections exist in its entirety the
Perceptron training is to determine the adjustment to be
performed each neuron weight to the output error is zero.

Backpropagation algorithm is a generalization of the LMS
algorithm; both algorithms perform its task of updating weights
and profits based on the means square error. The network
works under supervised learning and therefore requires an
array of workout that will describe each output and expected
output value. The structure Backpropagation neural network
was shown in Figure 3.

**III. RESULTS**

Data from the savannah of data (Table 1) should be reads as
described promptly: results output with a neural network [10,
13, 15] on equal 1.9119 and 0.9326 for girl children; regarding
this outcome data savannah Girls has a degree 3 of obesity and
the child would have an obesity grade 2; dependent on the age,
BMI, ICC and food intake [11, 12, 13].

<table>
<thead>
<tr>
<th>Ages</th>
<th>Girls</th>
<th>Boy</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1.8056</td>
<td>0.8640</td>
<td>Obese / moderately obese</td>
</tr>
<tr>
<td>7</td>
<td>0.1258</td>
<td>0.8645</td>
<td>Not Obese / moderately obese</td>
</tr>
<tr>
<td>8</td>
<td>0.8229</td>
<td>0.8647</td>
<td>Moderately obese / moderately obese</td>
</tr>
<tr>
<td>9</td>
<td>0.5027</td>
<td>0.8641</td>
<td>Not Obese / moderately obese</td>
</tr>
<tr>
<td>10</td>
<td>2.2126</td>
<td>0.8641</td>
<td>Obese / moderately obese</td>
</tr>
<tr>
<td>11</td>
<td>1.7740</td>
<td>0.8641</td>
<td>Obese / moderately obese</td>
</tr>
</tbody>
</table>

*Data Savannah of data obtained in the field.*

The following figures show numerical results of the
prediction system used.

Test performed for behaviour in Women
Test = [age, IMC, ICC, Food Intake]
Test 1 = [1;1;3;3]; target = sim (net, test 1)
Output = 1.2354
Test 2 = [12;2;2;3]; target = sim (net, test 2)
Output = 0.8142
Test 3 = [12;1;1;3]; target = sim (net, test 3)
Output = 0.3132
Test 4 = [2;1;3;2]; target = sim (net, test 4)
Output = 0.5377
Test 5 = [8;2;2;3]; target = sim (net, test 5)
Output = 0.7908

**Fig. 1.** A schematic drawing of biological neurons

**Fig. 2.** Entrance of a single neuron

**Fig. 3.** Architecture Multilayer Perceptron with Backpropagation Algorithm

**Fig. 4.** Prediction for women with different age, BMI, WHR and food intake
Test performed for behaviour in Men
Test = [age, IMC, ICC, Food Intake]
Test 1 = [6;1;2;3]; target = sim (net, test 1)
Output = 0.8665 Not Obese
Test 2 = [5;1;2;3]; target = sim (net, test 2)
Output = 0.8266 Not Obese
Test 3 = [6;2;2;2]; target = sim (net, test 3)
Output = 0.8942 Moderately Obese

Fig. 5. Prediction for men with different age, BMI, WHR and food intake

Test performed for behaviour in Men
Test = [age, IMC, ICC, Food Intake]
Test 1 = [1;1;3;3]; target = sim (net, test 1)
Output = 0.9610
Test 2 = [12;2;2;3]; target = sim (net, test 2)
Output = 0.5037
Test 3 = [2;1;3;2]; target = sim (net, test 3)
Output = 0.9505
Test 4 = [8;2;2;3]; target = sim (net, test 4)
Output = 0.5489

Fig. 6. Prediction for men with different age, BMI, WHR and food intake

The following figures shows the neural behavior prediction system.

Fig. 7. Training of the ANN-BP

Fig. 8. Performance of the RNA-BP in sampling error

Fig. 9. State of training of the ANN-BP characterizing the system output

Fig. 10. Training Regression-BP RNA
them results obtained with the network neuronal are of great contribution whereas a comparison of the exercise of the nutritionist without it tool and with the use of the tool increase is effectiveness, decreased the time of diagnostic of them data, reduction in the time of search in the table of nutrition to diagnose the obesity of the child school. This tool can be purchased with a system expert working group currently developing and shall submit to the test in 3 months.

V. CONCLUSIONS

The findings of the predictive system based on Backpropagation neural network is an effectiveness of about 99.99% of the comparative data, generating predictions on the prospects of effective school nutrition, dependent variables mentioned above characteristic. Authors and Affiliations

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