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The System of Medical Application System Application of the Difference between the Fuzzy Logic and the Neural Networks

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Abstract

Singled out for this research study the issue of fuzzy logic and use in the medical field to set the values estimated for the data thalassemiapatients, as well as the research involved a study hybridization fuzzy logic with artificial neural networks and the application form hybrid data and note the accuracy of the results between the two systems, which proved to form hybrid superiority large in the accuracy of results compared with the system fuzzy.

Keywords: Fuzzy logic; Artificial neural networks; Hybrid system

Introduction

Taken were 150 sample For each sample three features Each of which includes the true age of the disease and tumors and the number of red blood units While that represents the response variable age of the bone Also, the data that were used in the identification of patients with thalassemia is a numerical values Obtained from the Hussein Teaching Hospital in the city of Nassiriya, with an estimated rate of disease holders of 8% of the total members of the community Studies show that most holders of this disease is caused by inbreeding [1]. As can be defined as the basic factors that have been used increasingly effective on the bone marrow variables also comes [2].

- **Real-old-month (x_1):** Period as the persons susceptible to the disease since the prime of life Noting that the highest rate of the disease is in the age of 36-80 months and are concentrated in the age of 58-80 months
- **Stump red (x_2):** is a new red blood cells and are not mature container on the nucleus and are in the bone marrow produces frequent need it, so the outside of the bone for the injured, an indicator of the presence of the disease that the highest proportion of its kind in the 0-80.
- **Number of blood (x_3):** units are known that bone marrow makes red blood cells properly, but the pellets sick and weak then be broken quickly resulting in severe anemia needs to be compensated through blood transfusions As it gives blood units by weight, for example, the patient (20 million liters) per kilogram of weight of the child when the patient weight of 20 kg and more it gives in this case (450 ml).

The diagnosis masterly exact pattern recognition is one of the most important issues that need to be careful choice of diagnostic techniques, has been in this research use of the largest bone marrow influencing variables and applied to the fuzzy logic to classify the cases to a strong effect on bone cases and another with the effect of a weak and Figure 1 represents a longitudinal section of the bone marrow.
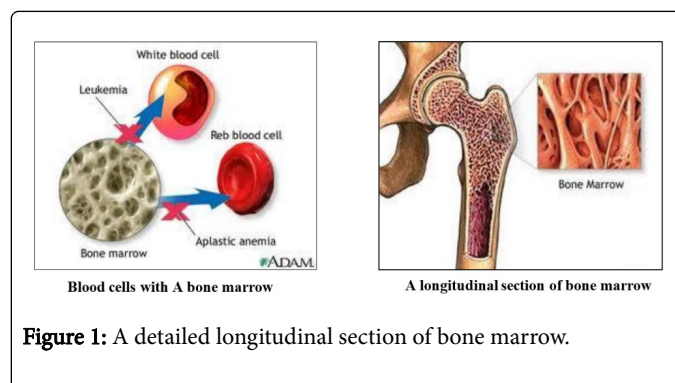

Figure 1: A detailed longitudinal section of bone marrow.

Fuzzy logic

Are the theories and techniques used, (Fuzzy set) which are groups with no definite limits as an adequate substitute for the classic sets that longer meet the requirements of the new understanding of mathematical and logical in contemporary scientific thought He was raised this subject in 1965 by the World Azerbaijani origin LutfiZadeh of the University of California [3]. It was developed to better address data in a way, by thinking more like humans in the programming data.

Membership functions

There are many organic functions used in the model Fuzzy recall, for example, the following functions [4,5].

- **Triangular-shape:** This can be expressed mathematically function through the following equation

$$\mu A(x) = \begin{cases} 1 - \dfrac{|x-a|}{c} & for\ a-c \le a+c \\ 0 & otherwise \end{cases} \qquad - Eq(1)$$

- **Trapezoidal-shape:** This can be expressed mathematically function through the following equation.

$$\mu A(x) = \begin{cases} \dfrac{(a-x)}{(a-b)} & for\ a \le x \le b \\ 1 & for\ b \le x \le c \\ \dfrac{(d-x)}{(d-c)} & for\ c \le x \le d \\ 0 & for\ otherwise \end{cases} \quad - Eq(2)$$

- These are called function Gaussian function and have the general shape her as follows

$$\mu A(x) = e^{-(x-a)^2/2b^2} \quad - Eq(3)$$

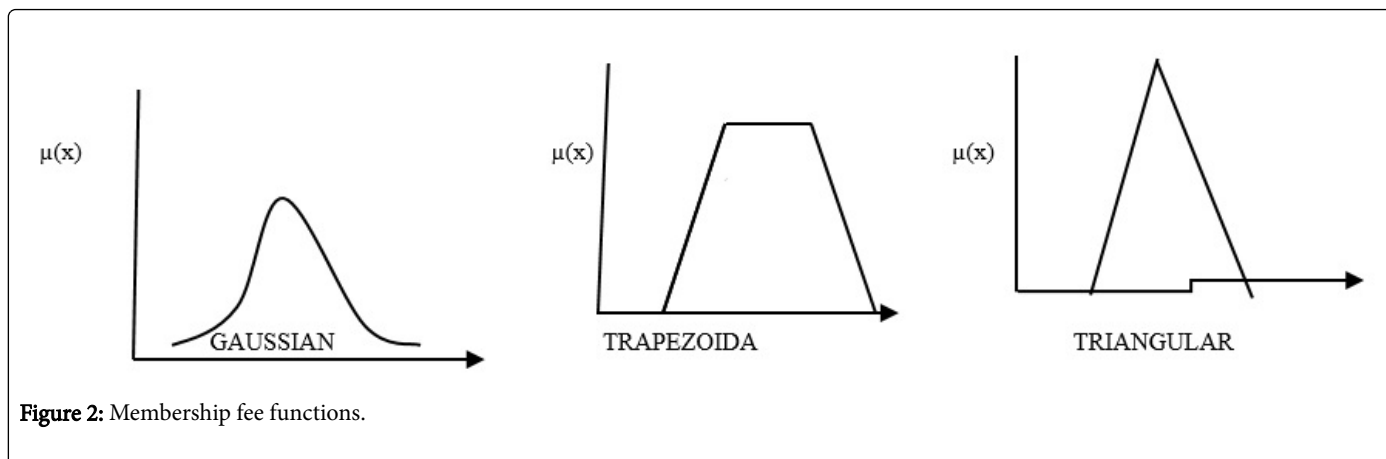This can be illustrated drawing functions through the form (2) in Figure 2.

Figure 2: Membership fee functions.

Determine the degree of organic

To determine the degree of belonging molecule (organic degrees) for any data element can be used the following methods [6].

- Style reliance on human experience: Because Fuzzy sets are often used to formulate human knowledge and membership functions represent a penalty of human knowledge. This side gives a flexible formula for organic function and the need to work combinations minutes.

- Style use of the collected data from the various sensors to determine the organic function. In this way are usually organic function to determine the composition first. Then a fine-tuning of the parameters for the function of organic based on those statements [7].

Stages of construction fussy model

After addressing the conditions that must be met before the construction process is now clarifying building model Fuzzy.

- Fuzzification
- RuleEva nation
- Defuzzification.

Artificial neural network

The artificial neural networks are working on the representation of the human mind through a network of digital data (which represents the nerve cell) connected balanced ties (which represent the links between cells), which are processed by the mathematical model specified. The data are alone is not doing any impact. As if these facts are ruined with the weights they lead to select the desired function of neural network [8,9].

Hybridization fuzzy logic using artificial neural networks

Observed through the study of neural networks and systems Fuzzification a common recipes to resolve the various issues and to

being the most regimes similarity thinking man, if the merger between the two systems on the grounds that the two methods complement each other, are getting more effective results and the lowest rate of wrongdoing as it to hide that each system is loaded Behan and disadvantages If applied Fuzzy logic unit it does not give acceptable results, or even satisfactory because it is necessary to know the rules that are classified on the basis of which the data and the fact that these linguistic rules must be linguistic data as well. As of artificial neural network technology is represented role by selecting the appropriate format input data without the need to know this is the nature data. With this result from this integration system adjusts the function parameters are organic fits the input data through the use of an algorithm Gradient Descent. So as to obtain the most favorable results through this Fuzzy bases with organic functions called this system resulting from this merger (AdaptiveNeuro Fuzzy Inference System), which writes Acronym (ANFIS). architectural and technical contain the simulation process by which the introduction of new data [10].

Adaptive neuro fuzzy inference system

This algorithm includes the following layers [11].

First layer: Called layer Fuzzification First layer Fuzzy as inputs where through membership functions are as follows:

$$o_i^1 = \mu A_i(x) \quad - Eq(4)$$

$\mu A_i(x)$ is representing organic function. O_t^1 is output for first layer.

Second layer: Called layer rules as each neuron in this layer corresponds Fuzzy base and a single type of Takagi-Sugino and each base cell receives entries from Fuzzietion cells and calculates the Firing strength to raise the base represented by the technology (ANFIS) priorities of al-Qaeda link is estimated through the inner product and calculate the cell output (i) the second layer is done through the following equation:

$$o_i^2 = w_i = \pi \mu A_i(x) \quad - Eq(5)$$

Third layer: All the neurons in this layer receives entries from all the nerve cells in the base layer, as it is where a normalization process on the neurons in the third layer is done through the following equation.

$$o_i^3 = \overline{w}_i = \frac{w_i}{\sum w_i} \quad - Eq(6)$$

Fourth layer: Takes place in this layer Defuzzification, as each neuron in this layer related to cell normalization own and also receive the initial Inputs such (x_1 and x_2) that every cell in this layer calculates the value of the output of the base-dependent.

$$o_i^4 = y_i = \overline{w}_i f_i = \overline{w}_i(p_i x_1 + q_i x_2 + r_i) \quad - Eq(7)$$

As the (p_i,q_i,r_i) disciples parameters of the base (i).

Fifth layer: Consisting of a single nerve cell represents the sum of the outputs of neurons in the previous layer (inverse fuzzy layer) and through which the final output of the system account Adaptive Neuro Fuzzy Inference System), (ANFIS).

$$o_i^5 = \sum_i^n y_i = \sum_i^n \overline{w}_i f_i = \sum_i^n \overline{w}_i(p_i x_1 + q_i x_2 + r_i) \quad - Eq(8)$$

Application Fuzzy logic models normal and hybrid data on thalassemia: Each model has been applied to the Fuzzy logic normal and hybrid neural networks, artificial pathological data on Thalassemia and by identifying three basic and effective variables have been mentioned in the description of data, As has been the estimated values of the data thalassemia patients set and relying on algorithms each of the model Fuzzy logic normal and model Fuzzy logic hybrid neural networks, artificial, and Figures 3 and 4 illustrate flowcharts for each of the dependent Fuzzy normal system medical system and order Fuzzy hybrid.

Been identified inference model Fuzzy normal type Mamdani while the functions of organic type trigonometric in both input and output space, and the number of functions organic Each variable is the two functions ranges of falls between (0) and (80), according to the entry for thalassemia patients data.

It is produced through the practical application of using the usual Fuzzy thalassemia data model set of outputs were represented compared with the real outputs through Figure 4 as follows.

Notes from Figure 5 and a disparity in the results which have been obtained through Fuzzy model normal compared with real output data for patients with thalassemia, due this disparity is a result of the difficulty in determining the form of appropriate organic functions in model building Fuzzy for this needed to find a way an ideal semi-be from which to determine the form of the appropriate membership functions and by which inferred on the output of the system more efficiently, and this method is based on the use of artificial neural networks to determine the appropriate membership function parameters that give the appropriate form in the mechanism of the conclusion, by relying on the concept of adjustable weights parametric as follows:
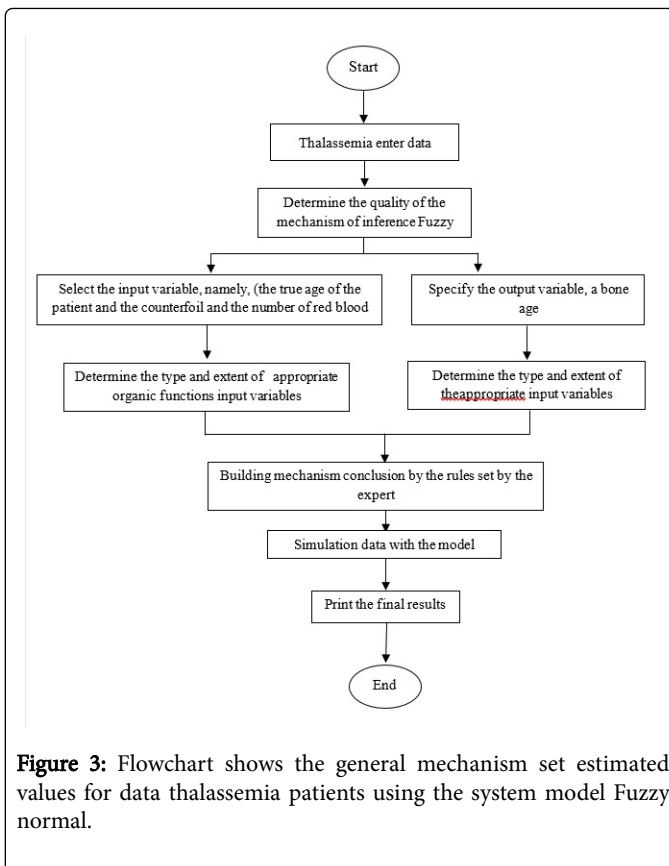

Figure 3: Flowchart shows the general mechanism set estimated values for data thalassemia patients using the system model Fuzzy normal.
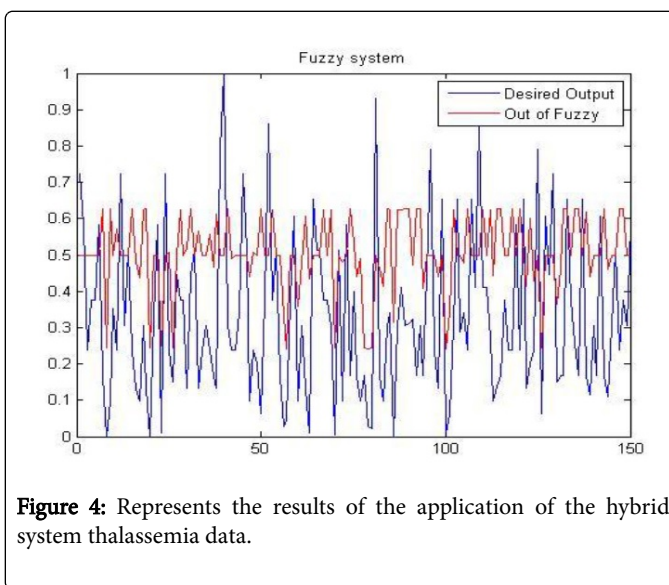

**Figure 4:** Represents the results of the application of the hybrid system thalassemia data.

$$p_i(new) = p_i(old) + y\frac{\partial E}{\partial \Delta P_i} \quad - Eq(9)$$

$$E = \frac{1}{2}(Target - Out)^2 \quad - Eq(10)$$

P_i is represented in the membership function, y is Learning ratio, Out is real output, Target is directing required, E is amount of errors.

Figure 5: Flowchart shows the general mechanism set estimated values for data thalassemia patients using nervous Fuzzy system hybrid model.

Figure 6: Represents the results of the application of the hybrid system thalassemia data.
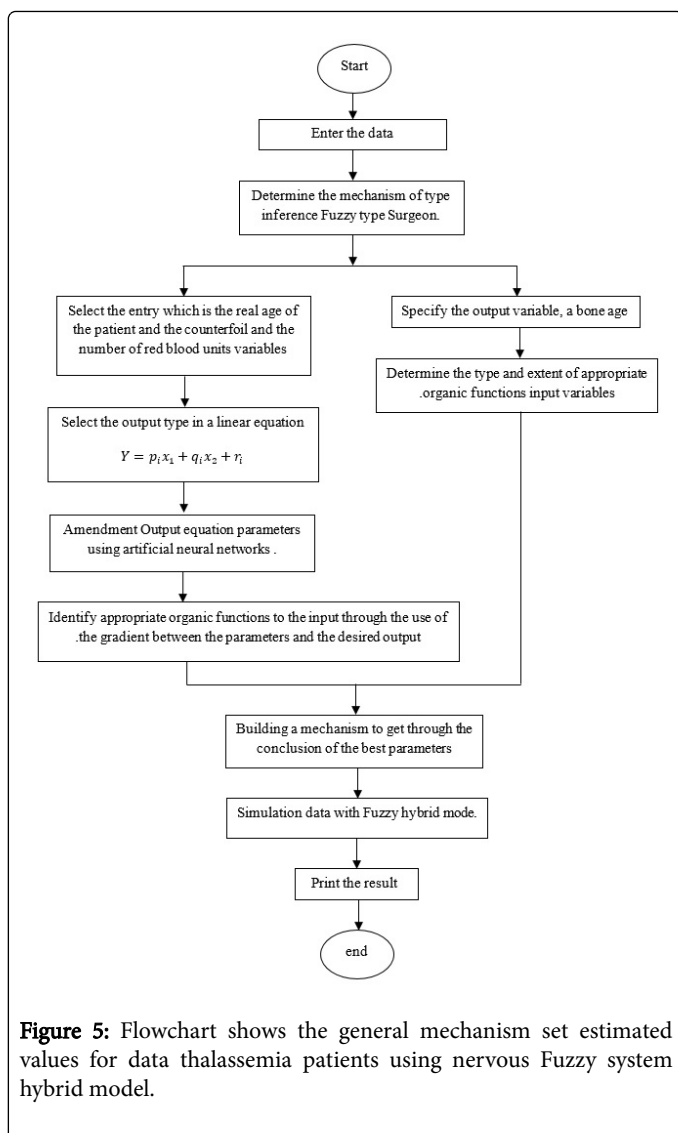
The hybrid system is a system common between Fuzzy logic artificial neural networks, where they are modifying the appropriate form of organic function through the concept of rear retreat process occurring in artificial neural networks, which have the biggest role in acquiring a major role in obtaining the required solutions through a series of repetitive actions to modify the parameters of the form of appropriate organic function .protect through the practical application of using the hybrid model thalassemia data set of outputs were represented compared with the real outputs through Figure 6. Notes of Figure 6 that the hybrid model has proven highly efficient in congruence with real data, compared with the usual Fuzzy logic model.
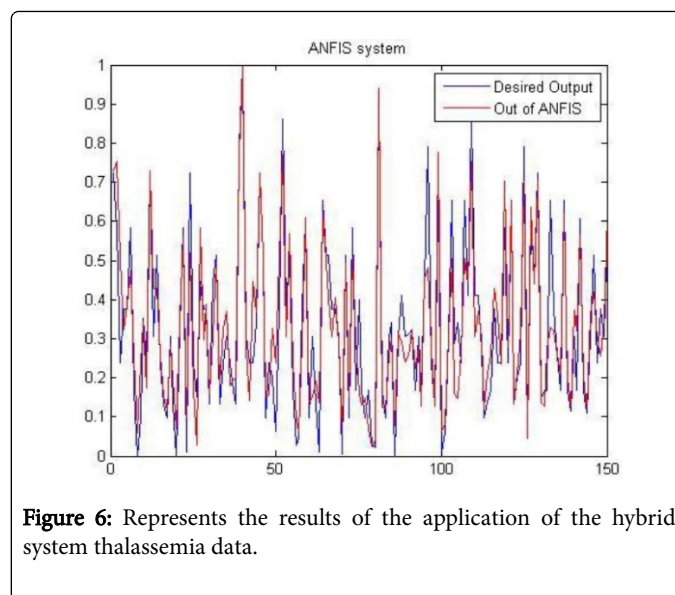
Compare the results

Been compared to each of the Fuzzy usual form with the hybrid model using artificial neural networks through applied to thalassemia data, and the results proved that the hybrid model has errs less than the proportion of errs model Fuzzy normal and Table ratio 1 shows the comparison between the Fuzzy logic model hybrid model.

Model user	MSE
Fuzzy logic system	0.0791
Neuro Fuzzy system	0.097

Table 1: Compare the results between the way through and hybrid Fuzzy logic.

Notes from the Table 1: The MSE in the hybrid model is much less than the MSE in the form of ordinary fuzzy cal (ie, that the error in hybrid model is less than the error in Fuzzy cal model normal by 9.8875% which shows the hybrid system efficiency compared with the system Fuzzy normal.

Conclusions and recommendations

Proved Fuzzy hybrid model using artificial neural networks in the Table 1, a high possibility of the appointment of the estimated values of the data Thalassemia patients through scale (MSE) compared with the normal model Fuzzy.The possibility of a hybrid model in determining the number of functions appropriate to the nature of the organic matter in the data given by adjusting the parameters to get the best format for these functions.difficult to determine the number and type of organic functions used in the normal model which is determined mostly by trial and not through a record representation.

Garret and recommends the following:

- Recommends action hybridization between Fuzzy normal model and other technologies such as intelligent genetic algorithm.

- It recommends the use of expert medical system based on a hybrid model Fuzzy assistant as a doctor in private thalassemia patients and medical centers in the city of Nassiriya.

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