Neurofuzzy Inference System for Diagnosis of Leukemia

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Abstract

In this paper, we are using Neurofuzzy system for either prediagnosis or preidentification of leukemia. Mainly the technique of Backpropagation algorithm is used in order to complete the process of training and testing our data, that (data) has already been obtained by generating the Sugeno based model of all considered rules, based on different symptoms of Leukemia taken as input in this procedure .In carcinogenesis, Neurofuzzy is favourably applicable to sort out various types of problems occurs in both pre-clinical as well as post-clinical types of diagnosis. In this application, a fuzzy logic dependent system is presented for the support of the justification of disease for prediagnosis of Leukemia.

Keywords: Backpropagation algorithm, leukemia**,** Neurofuzzy inference system.

I. INTRODUCTION

Neurofuzzy applications are used in a wide range of various medical diagnosis .The diagnosis of cancer disease specially "blood cancer" represents a serious clinical problem .The medical knowledge in the field of Neurofuzzy is characterized by uncertainty and vagueness. Various research groups [1,7,10] are working all over the world for the development of neural networks in medical diagnosis. The main applications in this field basically includes, character recognition, medical diagnosis, stock market prediction and financial analysis. Such applications can be solved using either artificial neural networks (ANN) or simply fuzzy system, but complex structures may not be solvable by a single technique only but by combining the ANN[4] and fuzzy system together, the benefits of both techniques can be completely utilized. In fuzzy logic[9,10] an element can reside in more than one set with different degrees of similarity e.g. 50*F of temperature may correspond to 64% low, 36% medium and zero degree high. There are many advantages of using Neurofuzzy in medical diagnosis i.e., it becomes easy to interpret, act as robust for noisy data and as unified classifier for numerical and categorical features. A comparative test is designed between Analytic Hierarchy Process (AHP) and fuzzy logic. The results proved the superiority of concept of fuzzy over AHP.[3,5]

Neural fuzzy is a combination of neural network and fuzzy logic[9] which uses human knowledge to tackle with the problems, that normally require human intelligence, using Neurofuzzy, the diagnosis of Leukemia will provide a self learning experience that will capable of handling various uncertainties in the diagnosis process.

In order to facilitate an easy and systematic understanding of proposed work, section 2 discusses Neurofuzzy system for Leukemia, section 3 discusses symptoms of leukemia, section 4 discusses Some of the partial rules for adaptive fuzzy system for Leukemia, section 5 discusses Simulated results that have been obtained using ANFIS and finally section 6 presents the conclusions and scope for future research.

II. NEUROFUZZY SYSTEM FOR LEUKEMIA

Leukemia is a cancer of the blood or bone marrow and is characterized by abnormal blood-forming cells especially white blood cells (WBC's). In 2007, about 344,240 cases of Leukemia were registered all over the world and about 21,790 deaths are expected in the U.S only because of Leukemia. Generally, two pathological types of Leukemia are there: chronic and acute and usually, two types of cells are there, due to whose abnormal growth Leukemia will takes place are: lymphocytic and myelogenous. Other forms of Leukemia basically includes: chronic lymphocytic Leukemia, multiple myeloma and non-Hodgkin's lymphoma.

Blood cells usually, white blood cells (WBC'S) are highly affected by Leukemia, which mainly occurs in the bone marrow of our nervous system. Leukemia results in too many abnormal or uncommon white blood cells (WBC's) being produced in the nervous system. White blood cells (WBC'S) are the part of our immune system which helps human body to fight off with infection ; and their production takes place in "bone marrow" at a constant rate of growth .Leukemia usually, occurs when a certain type of WBC's called lymphocytes get multiply too quickly and also perform their function for a long time ,than they should, this symbolized that there is a very large quantity of poorly functioning lymphocytes(WBC's) has taken place in the blood, that will make our body enable to protect itself from any sort of infection. Leukemia can be easily cured, if caught in the earliest stages, while advanced Leukemia will definitely leads to a proliferation of abnormal WBC'S.The most common symptom of Leukemia is "anaemia"; and hence leads to very low number of red blood cells, which will adversely effects our haemoglobin and also results in low number of platelets; which are needfully required for blood clotting, in case of any damage or injury. the abnormal WBC's, which usually generate due to Leukemia ,also get accumulate in the various organs of human body like liver, brain, testes and many other organs.

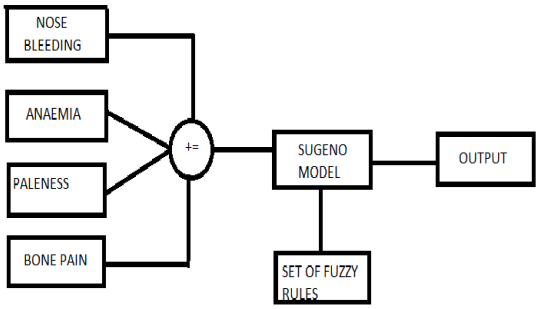

Figure1: Block diagram of Neurofuzzy.

Treatment: generally the techniques like, intense induction chemotherapy to bring about remission, followed by consolidation therapy are used for the treatment of Leukemia. Survival opportunities and various suitable treatment plans are accordingly and significantly different for different subtypes of various blood cancers and Leukemia. In order to design an accurate and appropriate the rape tic approach and hence to increase the chances of survival for a particular patient of Leukemia and to decrease different uncertainties in medical diagnosis[2,5] up to certain extent. Therefore, now it is necessarily required to determine the specific diagnostic technique and risk classification group and factor in advance as per the expert system[1,5] will generate the results .

III SYMPTOMS

There are the following factors which can easily lead to increases the risk of acquiring Leukemia, these factors include:-

3.1 Nose Bleeding: - It usually refers to the ejection of blood out of the nose; it may be at lower rate in earlier stages and may increase, as any sort of advancement in the stages of Leukemia take place.

3.2 Anaemia:-The growth of red blood cells (RBC's) usually takes place in bone marrow and millions are released into blood streams each day (according to the requirement), a constant new supply of RBC's is required to replace the existing red blood cells that breaks down in the bone marrow. In order to make RBC's and haemoglobin constantly, you must have a healthy bone marrow, which requires a diet rich in nutrients. Anaemia refers to that you have a deficiency of red blood cells as compared with the bone marrow of a healthy person.

3.3 Bone pain**: -** It refers to tenderness, which is a common problem particularly among those people, who are either middle aged or older. Bonepain is most likely due to any sort of decrement in bone density or if an injury to your bone takes place. Bone pain can be either the result of infection, either an interruption in the blood supply, or cancer (i.e. of any type depends upon circumstances). If you have an unexplained bone pain then, under these conditions you require the immediate medical attention.

3.4 Paleness**: -** Paleness usually refers to the irregular lightness of skin colour in respect to a normal skin. Anaemia is one of the most common causes of paleness, which has been already described in the upper section(C). Other causes of paleness includes lack of laying open to sunlight, cold exposure and frostbite, dangerously low blood pressure and low blood sugar.

IV. SOME OF THE PARTIAL RULES FOR ADAPTIVE FUZZY SYSTEM FOR LEUKEMIA ARE DEFINED BELOW

Now in this section we are going to define some rules ,that are directly focusing upon the various symptoms , which has been used as input variables in this research paper for the diagnosis of Leukemia, these are as follows :-

- If (nose bleeding is high) and (anaemia is low) and (bone pain is low) and (paleness is medium) then (patient is with Leukemia).
- If (nose bleeding is low) and (anaemia is high) and (bone pain is low) and (paleness is low) then (patient is with might be Leukemia).
- If (nose bleeding is low) and (anaemia is low) and (bone pain is high) and (paleness is low) then (patient is with not Leukemia).
- If (nose bleeding is low) and (anaemia is low) and (bone pain is low) and (paleness is low) then (patient is with not Leukemia).
- If (nose bleeding is low) then (patient is with not Leukemia).
- If (nose bleeding is medium) and (anaemia is medium) and (bone pain is high) and (paleness is medium) then (patient is with Leukemia).
- If (nose bleeding is medium) and (anaemia is medium) and (bone pain is low) and (paleness is low) then (patient is with might be Leukemia).
- If (nose bleeding is high) and (anaemia is high) and (bone pain is high) and (paleness is high) then (patient is with Leukemia).
- If (nose bleeding is low) and (anaemia is low) and (paleness is low) then (patient is with not Leukemia).
- If (nose bleeding is high) and (anaemia is high) and (bone pain is medium) and (paleness is high) then (patient is with Leukemia).

The flowchart, which is shown in fig 2, demonstrates the methodology of diagnosis of Leukemia using fuzzy logic[9,10]. First of all, we need to classify the different symptoms of Leukemia as input variables in the Sugeno model and the various stages of Leukemia as output variables and the desired ranges according to the different stages of Leukemia are provided to input as well as output variables and then various functions of membership are need to be defined , thereafter various rules of Neurofuzzy will be constructed ,

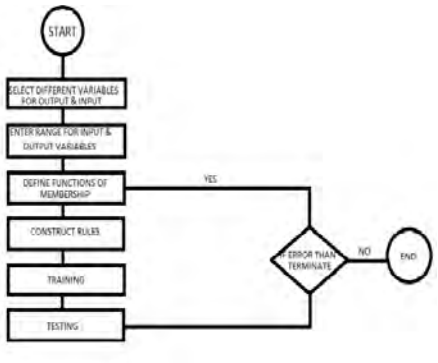

Figure 2: Methodology of diagnosis of Leukemia.

which will rapidly help in obtaining the training and testing data, which can easily be converted to the format of dat file , and finally the training and testing data will be loaded and manipulated according to Backpropagation algorithm[11] and hence the desired results will be obtained . Now we will proceed towards the process of, testing of error in the obtained Sugeno model with help of predefined fuzzy rules. if the error tolerance will be of greater magnitude as compared to the error, it means rules needs to be modified and hence the whole process will be repeated again or otherwise in the opposite case, the whole process will come to an end and finally, we got the desired result in the form of a 3D graphical representation between any two predefined input variables and the output variable, which is also known as the surface view of the Sugeno model.

V SIMULATED RESULTS THAT HAVE BEEN OBTAINED USING ANFIS ARE AS FOLLOWS

5.1 Neurofuzzy using Sugeno type of file:-

A Sugeno model is constructed using nose bleeding, paleness, anaemia and bone pain as input parameters and Leukemia as output parameters then, after fuzzifying the predefined input parameters, we need to apply various fuzzy operations in order to get Sugeno model, which is as shown in figure3:-

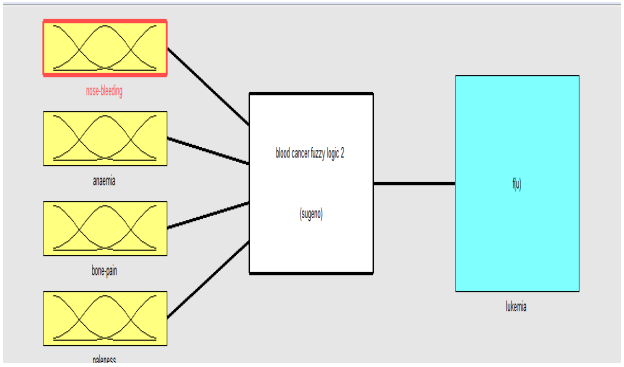

Figure 3: Sugeno model for defined input variables.

5.2 Fuzzy rule based system:-

After obtaining the Sugeno model and after applying various neuro and fuzzy rules , we need to construct a highly modified rule based system for Sugeno model , which has already been obtained in previous section. a fuzzy rule based system is shown in figure 4.

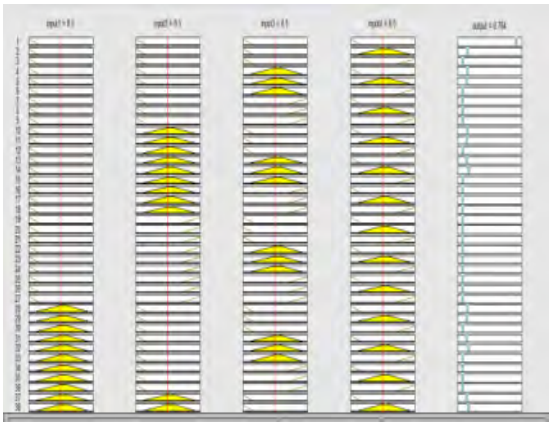

Figure 4: Fuzzy rule based system:-

5.3 Training and testing files:-

After obtaining the rule viewer file, our Neurofuzzy system will provide a certain set of values , which will be then randomly arranged in the form of training data and testing data , in the form of two different data files , that need to be loaded at the time of loading of training and testing data , as demonstrate in the Neurofuzzy system, where * demonstrate the training data , while .(dot) demonstrate the testing data , as shown in figure 5.

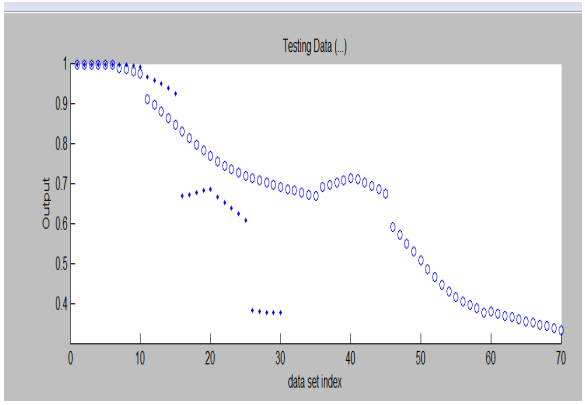

Figure 5: Training and testing files:-

5.4 Occurrence of error during training:-

After defining the primary values of network weights, the network need to proceed towards the program of training, using the algorithm of back propagation and after the completion of whole process, it achieves a maximum error of 0.0148**.** This is extremely demonstrated in the fig as shown below in figure 6.

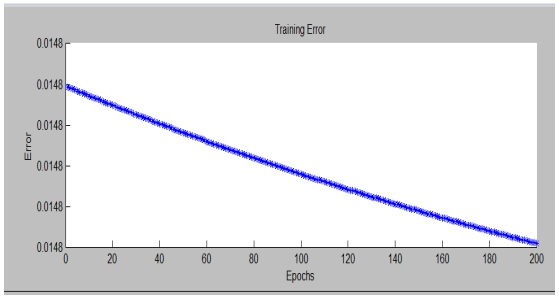

Figure 6: Reduction in error.

5.5 Outer face view of Sugeno model:-

In this section, we are going to draw a 3D, graphical demonstration between predefined, two input variables and the output variable using the modified Sugeno method. This plot will provide the outer surface view of the already existing or stored fis file. we can easily rotate, that generated 3D view at 360 degrees in order to observe it from different angles. That is described below in the figure 7:

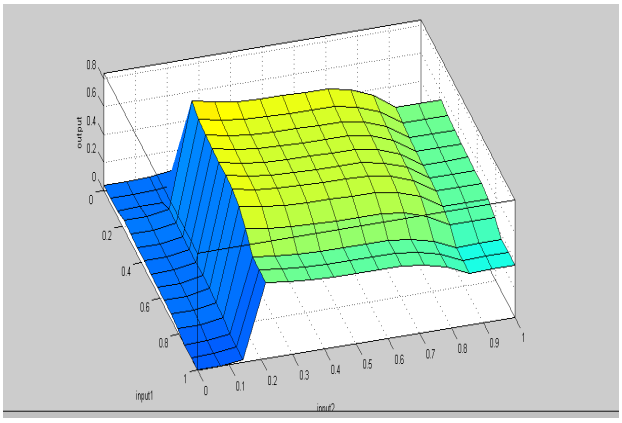

Figure 7: 3D surface view of Sugeno model.

5.6 Neurofuzzy model for Leukemia :-After our Sugeno file or Sugeno model get processed from the process of testing and training , a Neurofuzzy model will appeared on the screen, as per allocated according to Fuzzy cognitive maps[7,8,10]. Neurofuzzy model will consists of a complex and complicated combination between the different predefined 4 input variables and the output variable , as shown in the figure 8 below :

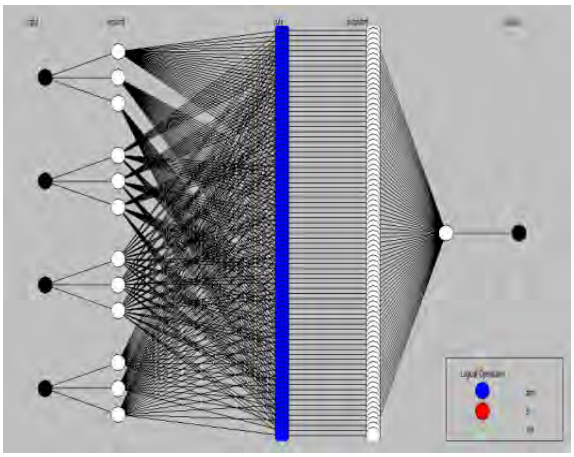

Figure 8: Neurofuzzy model of Leukemia.

VI Conclusion

This research paper will definitely going to help in the prediagnosis or preidentification of Leukemia in the form of a virtual doctor, especially in the rural areas, where there is non-avaibility of medical facilities for the diagnosis of Leukemia. It consists of a automatic decision making[6] ability, which can easily decide the stage of Leukemia in accordance with the set of predefined rules. First of all we need to provide some inputs in the form of known symptoms and it will hurrily provide you the stage of Leukemia in the form of the generated output.

VII References

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