DIAGNOSIS OF THE JAUNDICE USING FUZZY EXPERT SYSTEM

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Abstract

The objective of our study is to design fuzzy expert system to diagnose the jaundice. To diagnose the jaundice both Mamdani and Sugeno fuzzy expert system is used. The symptoms of the jaundice are fed as inputs of fuzzy inference system and the outputs, i.e. grade of disease, is obtained. The grade is obtained using the fuzzy tool in MATLAB R2007a software. Ten patients of different ages and genders are taken into our study.

Keywords

Diagnosis, Jaundice, fuzzy expert system

1. Introduction

Diagnosis (in greek- dia means to apart split and gnosi means to learn, knowledge) is the identification of the nature of anything, either by process of elimination or other analytical methods. Diagnosis is used in many different disciplines with slightly different implementations on the application of logic and experience to determine the cause and effect relationships. In the current scenario, the computer is used in the field of medical science such as to diagnose and to treat the diseases. The intelligent systems such as fuzzy logic, artificial neural network and genetic algorithms have been developed and all these are computer based. To diagnose the disease, fuzzy expert system is used. In such designed systems, when the results are taken and evaluated, the reliability of the fuzzy rule-based system, which is designed to determine the grade of the disease, is comparatively easy.

The study is based on the disease namely jaundice. Actually jaundice is not a disease but the manifestation of a diseased state of human body. Many symptoms of jaundice are known but only four prominent symptoms which are numerically measurable are taken into account.

1.1. Fuzzy expert system

The concept of Fuzzy Logic (FL) was conceived by Lotfi Zadeh, a professor at the University of California at Berkley, and presented not as a control methodology, but as a way of processing data by allowing partial set membership rather than crisp set membership or non-membership. Fuzzy logic provides a mathematical tool for representing and manipulating information in a way that resembles human communication and reasoning processes. Its basis is formed by “true” and

"false" values and fuzzy set theory in which between- "partially true", "partially false"-are determined. Fuzzy set theory defines set membership as a possibility distribution.

A fuzzy expert system (FES) is an expert system that uses fuzzy logic instead of Boolean logic. In other words, a fuzzy expert system (FES) is a collection of membership functions and rules that are used to reason about data. Unlike conventional expert systems, which are mainly symbolic reasoning engines, fuzzy expert systems are oriented toward numerical processing. After deciding on designing a fuzzy system the first step to follow is to collect the rules of "if-then". These rules are generally collected with the help of a domain expert (Allahverdi 2002, 2007).

In FES model (fig. 1), the input and output values of the system are crisp values. In the fuzzification subprocess, the membership functions defined on the input variables are applied to their actual values, to determine the degree of truth for each rule premises. In the inference subprocess, the truth value for the premises of each rule is computed, and applied to the conclusion part of each rule. This results in one fuzzy subset to be assigned to each output variable for each rule. Sometimes, it is useful to just examine the fuzzy subsets that are the results of the composition process, but more often; this fuzzy value needs to be converted to a single number crisp value. This is what the defuzzification subprocess does.

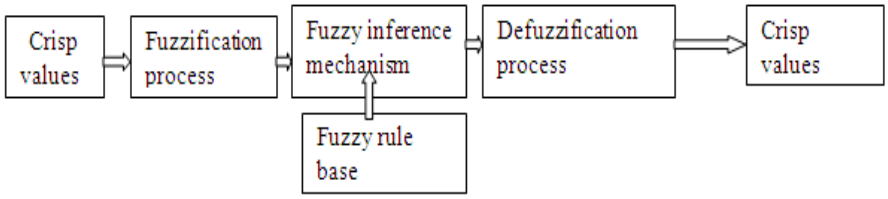
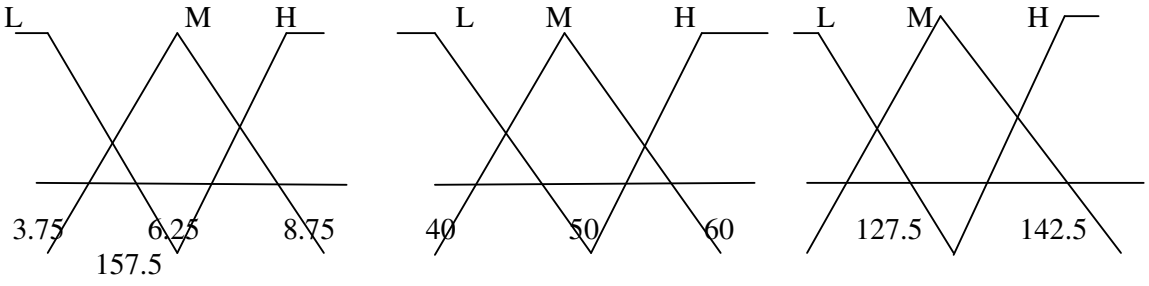


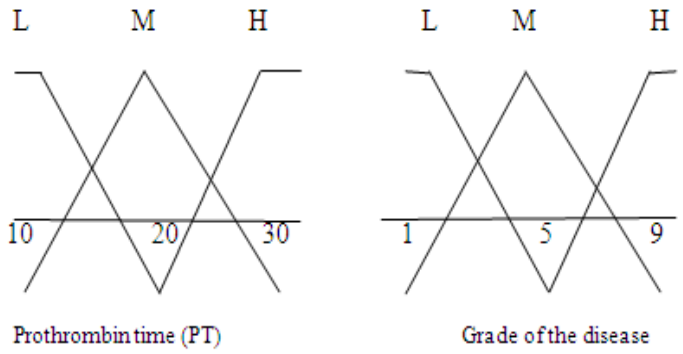
Fig.1 Fuzzy expert system

2. Material and Method

Our study is based on Hepta –cellular Jaundice. The symptoms are bilirubin level (B), enzyme levels AST & ALT (AA), alkaline phosphate (AP) and prothrombin time (PT). The ranges of the symptoms and the output (grade of disease) and their membership function shown in fig 2. As there are three levels for each of four inputs, 3*3*3*3=81 rules are considered.



Bilirubin level (B in mg) AST& ALT (AA) Alkaline phosphate (AP)



Fuzzy theory is used to apply a linguistic controlling strategy dependent on human knowledge in FES and especially in Automatic Control System. While designing fuzzy control systems, the fuzzy rules are determined and the input output of the systems are fuzzified and thus eventually the output is clarified (Allahverdi 2002, 2007; Wang 1997).

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The general structure of fuzzy expert system is shown in Fig.3.

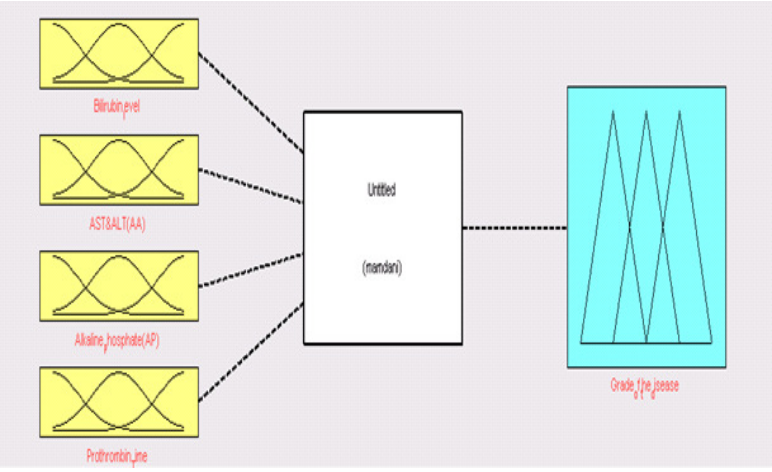

Fig. 3 General structure of fuzzy expert system

As the output mechanism both Mamdani and Sugeno approach is used. In the defuzzification process, the exact expression is obtained with "centroid" method according to a validity degree.

The output value (Grade of disease) with respect to the input values (B, AA, AP, and PT) obtained from the designed FES is shown as in fig. 4. As material, the data collected from the 10 patient is taken. The grade of disease in crisp values according to the patient symptoms is given in Table 1.

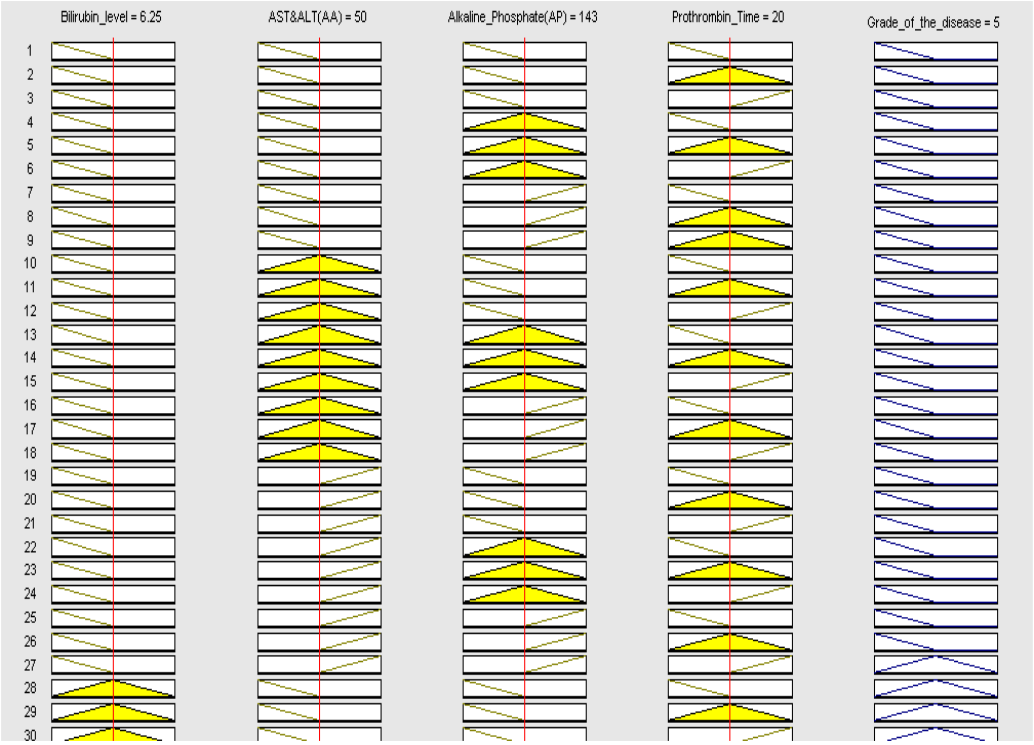

Fig.4(Output obtained according to the inputs)

Table 1. Results of some of the training and test cases-Jaundice

B	AA	AP	PT	Grade(Mamdani)	Grade(Sugeno)
5.40	48.00	139.00	22.00	4.77 (M)	0.33 (M)
5.50	49.00	145.00	23.00	4.82 (M)	0.35 (M)
7.00	52.00	149.00	25.00	5.22 (M)	0.641 (M)
6.40	54.00	154.00	22.00	5.1 (M)	0.556 (M)
7.50	56.85	155.00	25.85	5.57 (M)	0.832 (H)
4.30	43.00	146.30	12.00	3.70 (M)	0.11 (L)
5.43	51.34	132.56	21.86	4.78 (M)	0.33 (M)
7.34	47.00	135.40	16.93	5.39 (M)	0.68 (M)
6.93	56.78	154.64	24.89	5.47 (M)	0.731 (M)
8.46	58.35	150.65	27.73	6.54 (M)	0.962 (H)

3. Discussion and conclusion

In this study, FES is designed to help the expert doctors to diagnose the jaundice and other diseases easily. Results showed that the proposed FES can be used to determine the severity of the jaundice. The result obtained from both the Mamdani and Sugeno model is slightly variable. As far as seen, Mamdani model is used to diagnose the disease. The system prevents the patient's from taking the wrong dose.

The number of input factors taken up for jaundice can be increased for a more comprehensive study of the symptoms. The data collected from the 10 doctors can be replaced by a data bank

collected from a large number of doctors. This will help to give a more realistic solution to the problem. As the result, it is seen that FES can be used to apply in complex and uncertain fields such as the treatment of illness.

4. References

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