Novel Respiratory Diseases Diagnosis by Using Fuzzy Logic

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Abbas K. Ali, Xu De Zhi, Shaker K. Ali

***Abstract*-In this paper we design an expert system to diseases diagnosis by using Fuzzy set depending on doctor's opinions. Approach: Using fuzzy set to diseases diagnosis depending on opinion of 20 doctors, Results: it has been to diagnose three types of respiratory diseases (primary kinds of respiratory diseases) (pneumonia (PEN), tuberculosis (TB) and normal influenza (INF)), there are four symptoms X- ray, Respiratory rate (RR), Cough (CO) and Fever (F) which indicate as input of the fuzzy logic and the output will be a range of the risks and type of respiratory diseases.**

Key words- expert system; respiratory diseases; fuzzy set .

I. Introduction

Respiratory diseases are common diseases in human life, the goal of our work is diagnosing a diseases with rapidly, economically and without risks than traditional diagnostic systems. This system allows determining if there is a need for the biopsy and it gives the user a range and types of this diseases. Diagnosis of a disease is a problem in medicine because some patients may have similar symptoms but the doctor may diagnose different diseases, so this work will help doctor when he or she has fuzziness in that thinking process [1,10].Fuzzy logic controller (FLC) was initiated in 1965 by Lotfi Zadeh as a new way of representing vagueness in everyday life [6].The architecture of the proposed fuzzy system consists of three main blocks: the fuzzification step, the fuzzy rule base, the fuzzy inference engine [13].Diagnosis is based on indirect evidence too, the presence of symptoms, and the knowledge of the medical mechanisms that relate presumed causes to observed effects. The problems of
diagnosis do not only arise from the incompleteness of this knowledge, but also and most immediately from the theoretical and practical limitations associated with the reversal of the chain of implications that lead from an initial cause to its observable effects [8,9].The natural evolution of various diseases, the obscure nature of medical data and the intrinsic ambiguity of medical problems require a consistent framework that can handle uncertainty by allowing variable and multiple class memberships and facilitating approximate reasoning. This inevitably makes the fuzzy logic (FL) a valuable tool for depicting medical concepts by treating them as fuzzy sets [11,12].The system was developed by aid of the Mat lab 6.5. The rest of paper Experiments is organized as follow: Section 2 give the background information including respiratory diseases and fuzzy set, Section 3 will explain experiments use to diagnose and the result obtain after that. In section 4 we conclude the paper by summary of result and mentioning about future work.

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II. Back ground

1) *Respiratory diseases*

Respiratory diseases are an inflammation of the lung that is most often caused by infection with bacteria, viruses, or

other organisms. Healthy people can usually fight off respiratory diseases. However, people who are sick,including those who are recovering from the flu (influenza) or an upper respiratory illness, have weakened immune systems that make it easier for bacteria to grow in their lungs, There are three primary types of respiratory diseases are (pneumonia , tuberculosis and normal influenza) we will try to diagnosis in our work [3,7].

2) *Fuzzy set*

Medicine is one field, in which the applicability of fuzzy set theory, within this field it is the uncertainty found in the process of diagnosis of disease that has most frequently been the focus of applications of fuzzy set theory [4].In other word real word knowledge is characterized by in completeness, in accuracy and in consistency.Makes it is possible to define in exact medical entities as fuzzy set ,it is provides an excellent approach for approximating medical text, furthermore fuzzy logic provides reasoning methods for approximate inference this paper surveys the utilization of fuzzy logic on the basis of three medical application

C. algorithm :-

The algorithm is:

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Call our fuzzy logic function (see fuzzy logic section).
        If output1 then
Print ("Pneumonia")
    Else if output2 then
        Print ("Tuberculosis")
         Else if output 3 then
                        Print ("Normal Influenza")
        Else
                                Print ("unknown disease")
End if
      End if
   End if
```

III. Metod

There are 40 cases that were collected from Xiang Ya second Hospital in (Changsha, Hunan, China). Our

experiments have been very beneficial for medical treatment and perm solving many problems in an easier manner.

1) *Input*

Our work is an expert system for diagnosing the respiratory diseases by using fuzzy set for which inputs will be used symptoms of this disease (X- ray , Respiratory rate (RR), Cough (CO), Fever (F)) **a**nd the output will be pneumonia (PEN), tuberculosis (TB) and normal influenza (INF) As show in figure 1 :-

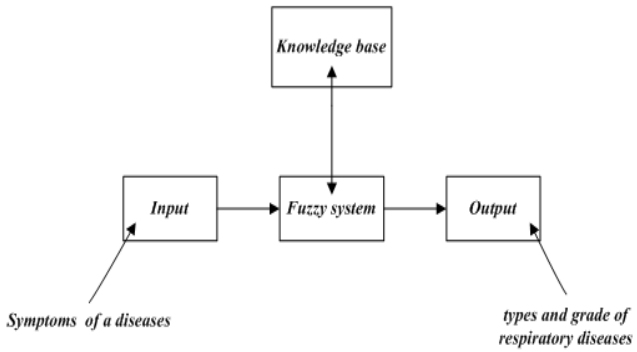

Figure 1 show the schematic diagram of the fuzzy system

The inputs of the diseases (symptoms) must be as numerical values, by built data base of the symptoms depending on the doctor's guess grade of all four symptoms and also the result measurement of temperature of the fever. All these symptoms will be as numerical as shown in table1. The inputs ranges will be change as shown in the bellow:

1) **X- ray** is has three levels (low, medium, high) and the values will be (1-9). As shown in figure 2.
2) **Respiratory rate (RR)** it also depends on doctor's opinion; we also give it three levels (low, medium, high) and value (30 -40). As shown in figure 3
3) **Cough, (C)** the level of cough we proposition it is has three levels is (low, medium, high), and values will be (1-9). As shown in figure 4.
4) **Fever (F)** doesn't need to be guess, we can check it by using a Thermometer, so we proposition three levels too, and the value is (98,102). As shown in figure5.

2) *Output*

The out puts as we said the grade of the diseases as show in figure 6. The number of probabilities are 3×3×3×3= 81which mean we need 81 rules as shown in table 2 [1], in fuzzy logic every rule has result (type of respiratory diseases and level this disease), the inputs (symptoms) of the fuzzy set will be 4 inputs ,the fuzzy will decide the type and grade of risk of the respiratory diseases, it will make decisions depend on the rules that we made, so it will give the percentage of the respiratory diseases; pneumonia (PEN), tuberculosis (TB) and normal influenza (INF) as shown in table 3.If for example, X-ray is low and respiratory rate is high and cough level is high and fever is high then the result is normal influenza, and level of influenza is high, other diseases have low value, so we can deduce the output by these rules as show in the algorithm

Table 1. the range of symptoms

Symptoms	Range
Cough,(C)	1-9
Respiratory rate (RR)	30-40
Fever (F)	98-102
Chest X- ray (CH)	1-9

Table2 Collection rules of fuzzy logic

No of rules	inputs				outputs		
	X-ray	RR	CO	F	PNE	TB.	INF
Rule1	L	L	L	L	L	L	L
Rule2	L	L	L	L	L	L	L
..	..	..	..	..	..	..	..
Rule81	H	H	H	H	H	L	L

The input will pass three stage (fuzzifiction, rule evaluation, and defuzzifiction) .Inputs are given as real crisp values and the output is a fuzzy value. The accuracy of rules should be clarified at this defuzzifuction stage. Firstly, the minimum amount of each rule is recognized and then the maximum amount between them is chosen.

For instance:

X-ray =5.00, RR=3.00, CO=5.77, BT=98.00 the result will be INF (4.99) (medium) .

$\alpha 1$= min (M ,L ,M ,L)
= min (1 ,1 ,0.90 ,1)
= 0.90

$\alpha 2$ = min (M,L,H,L)
= min (1,1,0.10,1)
= 0.10

Using the Mamdani inference (max, min) [2], the system's membership function is:

max ($\alpha 1$, $\alpha 2$)= 0.90

as show in rules this case is medium of influenza the final result is 4.99.

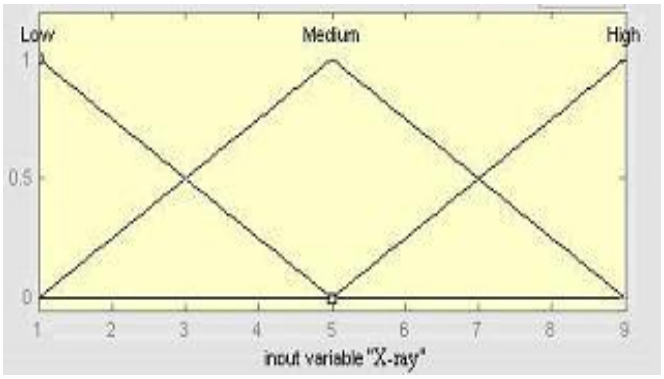

Figure 2 show the membership function X-ray

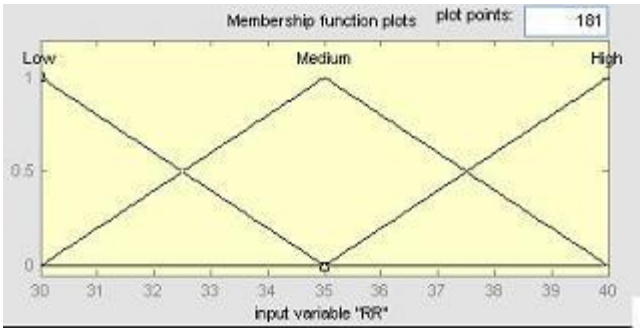

Figure 3 show the membership function respiratory rat

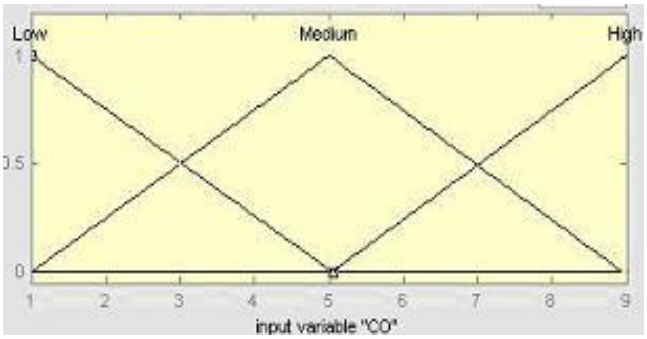

Figure 4 show the membership function cough

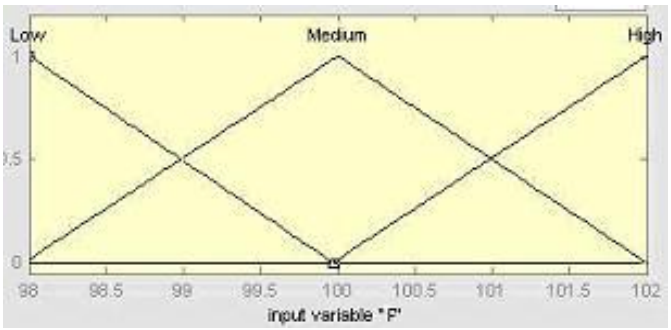

Figure 5 show the membership function fever

Table 3 Results of some of the training and test cases-respiratory diseases

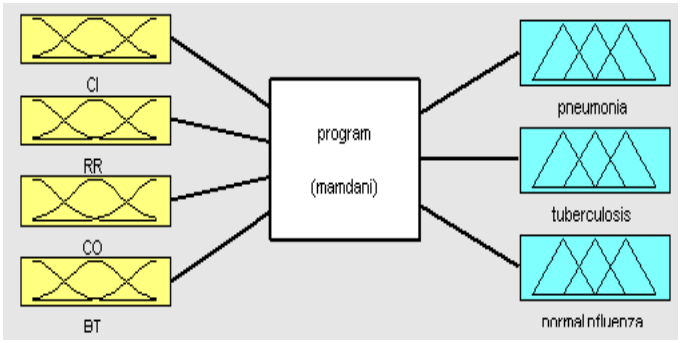

Figure 6 show the outline model of respiratory diseases fuzzy expert system

Table 3 Results of some of the training and test cases-respiratory diseases

X-ray	RR	CO	BT	Result
1.00	30.00	1.00	98.00	INF(2.33)L
5.00	30.00	5.77	98.00	INF(4.99)M
1.00	37.00	4.50	100.50	INF(6.94)H
4.50	35.50	1.50	100.00	PIN(2.80)L
4.00	38.55	1.50	99.00	PIN(4.79)M
9.00	31.50	1.50	101.50	PIN(6.16)H
5.55	30.00	1.00	101.00	TB(3.38)L
5.01	35.50	5.50	98.50	TB(5.00)M
8.5	35.50	8.50	98.50	TB(6.71)H

Defuzzification's centre of gravity formula is used for calculating the certain output amount:-

$$D^{\cdot} = \frac{\int D \cdot \mu_{middle}(D) dD}{\int \mu_{middle}(D) dD} \qquad (2)$$

As it is shown in figure 7, the amount 0.81 indicates intensity. The repertory diseases diagnosis for this field is the normal situation while the system reports a small disease risk.

Figure 7 shows the repertory diseases diagnosis

IV. Conclusion

In this paper we will help doctor to diagnosis of diseases and away from fuzziness in the thinking process a doctor, the classification accuracies obtained by expertise of 20 doctors and other studies, these expertise of the disease has been modelled by fuzzy logic.This will help to give a more realistic solution to the problem. The effectiveness of the developed algorithm will be tested,In future work, can apply this method to diagnosis other diseases.

V. Acknowlegements

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VI. References

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