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Hybrid Fuzzy Expert Systems: an Application to Medical Diagnosis

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Hybrid Fuzzy Expert Systems: An Application to Corona Diagnosis

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Abstract—Corona virus is like any other viruses or diseases according to medical experts Medial **Expert Systems are intelligent programs of Artificial Intelligence (AI). Information available to the medical expert system is uncertain like Corona diagnosis. This uncertain information is fuzzy rather than probable. Hybrid fuzzy Corona expert systems (HFCES) combination of different fuzzy expert systems and are co-ordinate and co-operated. In this paper, Hybrid fuzzy Corona expert Systems are studied. Fuzzy inference discussed for HFCES Fuzzy knowledge representation is disused for HFCES. Some examples are given for HFCES.**

Keywords— Corona knowledge representation, fuzzy inference, Fuzzy reasoning, fuzzy Corona Expert Systems, hybrid fuzzy Corona expert systems

I. INTRODUCTION

The Corona diagnosis is inexact, imprecise and uncertain reasoning rather than exact. Various theories are there to deal with inexact, imprecise and uncertain information in Corona diagnosis [1]. Fuzzy logic [14] will deal with the belief where as others are deal with probable (likelihood). The Corona diagnosis is of belief rather than likelihood.

. Hybrid fuzzy expert systems combination of different fuzzy expert systems of same type co-ordinate and co-operated. For instance, fuzzy Corona expert systems are with symptoms and fuzzy Corona expert systems are with Corona tests. Hybrid Fuzzy Corona Expert Systems are in cloud environment.

The Medial diagnosis is Hybrid, This system may be viewed as a collection of Corona Expert Systems and these HFMS are to be co-operated and co-ordinate in cloud environment. The Corona diagnosis will h deals with independent component in the diagnosis system, each of which reasons based on the Corona Knowledge available and combined for total systems.

II. FUZZY LOGIC AND FUZZY REASONING

Fuzziness occurs when the body of information is not clearly known. In Corona knowledge [1] symptoms and diagnosis are fuzzy rather than likelihood. For example "John has headache (0.9)", "John has chest pain (0.6)" where 0.9 0.6 are fuzzy values. Given some universe of discourse X, a fuzzy subset A of X is defined by its membership function μA taking values on unit interval [0,1] , i.e.,

$\mu A : X \rightarrow [0,1]$

Suppose X is finite set. The fuzzy subset A of X may be represented as

$A = \mu A(x1)/x1 + \mu A(x2)/x2 + \mu A(x3)/x3 + \mu a(x4)/x4 + \mu A(x5)/x5$

Where x1,x2,x3,x4,x5 are individuals and "+" is union.

The fuzzy conditional proposition is of the form "if <precedent> then <consequent-part>"

Zadeh [12] fuzzy conditional inference is given by

if x is A ten x is B

$A \rightarrow B = A \times B = \min \{1, 1-\mu_A(x) , \mu_B(x)\}$ Implication

If x is A_1 and x is A_2 and,…, and x is A_n then x is B

$= \min \{1, 1-(A_1 , A_2 , \ldots, A_n)+ B)$

Mamdani[5]fuzzy conditional inference is given by

if x is A ten x is B

$A \rightarrow B = A \times B = \min \{\mu_A(x) , \mu_B(x)\}$ Implication

If x is A_1 and x is A_2 and,…, and x is A_n then x is B

$= \min \{A_1 , A_2 , \ldots, A_n , B)$

In Corona diagnosis, the consequent part is derived from precedent part[6].

If x is A_1 and x is A_2 and,…, and x is A_n then x is B

$= \min \{A_1 , A_2 , \ldots, A_n)$

The Fuzzy propositions may contain quantifiers like "Very", "More or Less" etc. These Fuzzy quantifiers may be eliminated as

$\mu_{Very}(x) = \mu_A(x)^2$ Concentration

$\mu_{More\ or\ Less}(x) = \mu_A(x)^{1/2}$ Diffusion

Fuzzy reasoning is drawing conclusions from Fuzzy propositions using fuzzy inference rules[5]. Some of the Fuzzy inference rules are given bellow

R1: x is A

x and y are B

---

y is $A \wedge B$

III. FUZZY CORONA EXPERT SYSTEMS(FCES)

An Expert System is called Fuzzy Expert System if it reasons about fuzzy information. The components of fuzzy expert system are shown in fig.1. It is necessary to understand the components of fuzzy Expert system. The Fuzzy Expert System contains Fuzzy knowledge base (Fuzzy rule based), Interference engine, Working memory, Explanation subsystem, Natural language interference and knowledge question. We mainly concentrate on fuzzy knowledge bases because the others are vastly developed[11, 12, and 25].

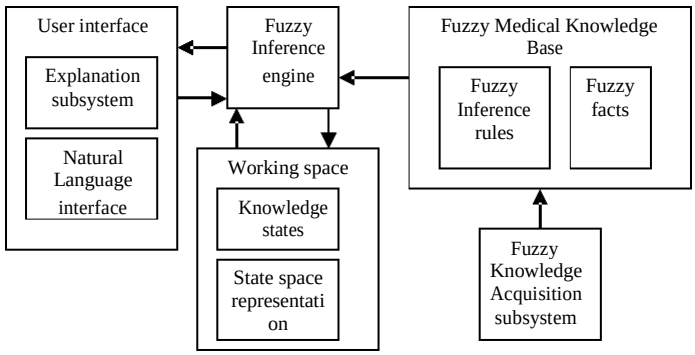

Fig.1. Fuzzy expert System

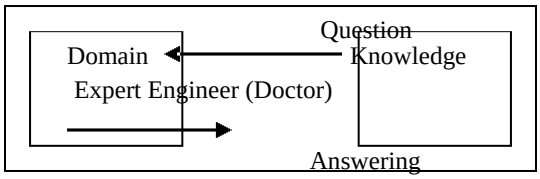

Fig.2. Question Answering Sub-System

Domain expert

The knowledge and experience have been used to specific area of interest to store it in the fuzzy expert system.

Knowledge Engineering

The knowledge engineering is the problem solving strategy consists of problem solution such as control architecture(search strategies), Fuzzy knowledge representation and problem solution strategy, which determine, what knowledge to apply.

Inference engine

It is responsible for interpreting the contents of the Fuzzy knowledge base in order to reach a goal or conclusion. The inference engine can be divided into three parts.

Context Block

This part contains the current state of the problem and solution.

Inference (Reasoning) Mechanism

These parts search the appropriate set of knowledge and data with the help of context block in order to reach a goal or conclusion.

Explanation Facility

The facility helps the user to understand the line of reasoning.

Knowledge acquisition facility

New knowledge is generated with the assistance of this facility.

Work Space

It is storage structure of problem description and the levels of problem states (knowledge sources). The Fuzzy rule based knowledge to be stored can be schematically represented in a net form.

G. User Interface

The module of the Fuzzy expert system permits the user to benefit from the system.

EMYCIN] is medical expert system shell in which Corona diagnosis shall be defined defined by MB[h,e] - MD[h,e], . MB[h,e] and MD[h,e] are the probabilities of Belief and Disbelief. used in EMYCIN

Fuzziness is considered instead of probabilities.

The fuzzy certainty factor (FCF) for proposition “x is A”is defined as

$FCF[x,A] = \mu_A^{FCF}(x) = MB[x,A] - MD[x,A]$.

$\mu_A^{FCF}(x) \rightarrow [0, 1]$ is single membership function.

$$\mu_A^{FCF}(x) = \mu_A^{Belief}(x) - \mu_A^{Disbelief}(x)$$

for instance,

$$\mu_{cough}^{FCF}(x) = \mu_{cough\,A}^{Belief}(x) - \mu_{cough}^{Disbelief}(x)$$

The conjunction and disjunction, negation and implication are given below.

FCF[x, A v B] = max { FCF[x, A] , FCF[x, B]

FCF[x, A^B] = min{ FCF[x, A], FCF[x, B]

FCF [x , A’]= 1-FCF[x, A]

FCF[x , A→B] = { FCF[x , A] }

FCF[x , A1, A2, An→B] = min { FCF[x , A1] , FCF[x , A2] + FCF[x , B] , FCF[x , An] }

The fuzzy Corona expert systems are is problem solving systems using Fuzzy Corona reasoning with Fuzzy Corona facts and rules. These Fuzzy facts and rules are modulated to represent the Corona Knowledge available to the system. The Fuzzy Corona Expert System is independent component which performs Fuzzy reasoning in HFCES.

Consider the following fuzzy facts and fuzzy rules of Corona Diagnosis.

if Fever
and Allergy
and Infection
and immunity
and Breathing
Then the patient has Corona Diagnosis.

The symptoms may be added or deleted by medical expert in the above rule.

The fuzzy Corona rule is given by using MB and MD

if Fever (0.8, 0.2)
and Allergy (0.9, 0.1)
and Infection (0.8,0.1)
and immunity (0.9, 0.1)
and Breathing (0.7,0.1)
Then the patient has Corona Diagnosis.

The fuzzy Corona rule are given by using FCF
if Fever (0.6)
and Allergy (0.8)
and Infection (0.7)
and immunity (0.8)

and Breathing (0.6)
Then the patient has Corona Diagnosis

In Corona diagnosis, the consequent part is derived from precedent part[6].

If x is A_1 and x is A_2 and,…, and x is A_n then x is B
= min {A_1 ,A_2 ,…, A_n)

if Fever (0.6)
and Allergy (0.8)
and Infection (0.7)
and immunity (0.8)
and Breathing (0.6)
Then the patient has Corona Diagnosis= min{0.6,0.8,0.7, 0.8.,0.6)=0.6

IV. HYBRID FUZZY CORONA EXPERT SYSTEMS

HFCES is collection of expert system and is combined the solutions of the different type of expert systems in the cloud environment in which the Fuzzy Corona Expert Systems are to be co-ordinate and co-operated HFCES performs reasoning with the Fuzzy Corona Expert Systems. In the First, the Fuzzy Corona Expert System and Fuzzy modulations are defined for the Fuzzy information. In the Second, if the local Fuzzy Corona Expert System has no sufficient information, it connects to other Fuzzy Corona Expert System for required information. Third, the HFCES is to co-operate and co-ordinate to get the final solution .

FCES is the individual problem solving expert system. It will give individual solution. The HFCES system is shown in Fig.3.

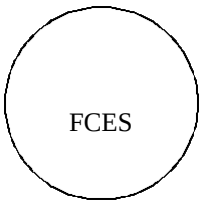

Fig.3 FCES

Hybrid Fuzzy Corona Expert Systems are different types of Corona Expert Systems. Independent expert systems are combined for total solution. The HFCES system is shown in Fig.4.

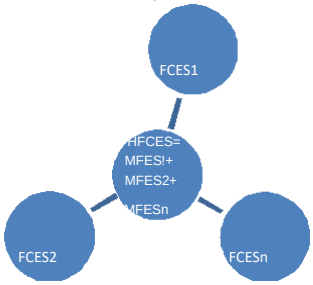

Fig..4. HFCES.

FCES1

Consider facts and rule of fuzzy expert system. If Fever and Allergy and Infection and immunity and breathing then the system will be given by Corona diagnosis with fuzziness of 0.9.

if Fever (0.6)
and Allergy (0.8)
and Infection (0.7)
and immunity (0.8)
and Breathing (0.6)
Then the patient has Corona Diagnosis=
min{0.6,0.8,0.7, 0.8.,0.6)=0.6

FCES2
The fuzzy Corona rule is given by using MB and MD

if Fever Lab_Test (0.7, 0.2)
and Allergy Lab_Test Lab_Test (0.8 0.1)
and Infection Lab_Test (0.7,0.1)
and immunity Lab_Test (0.8, 0.1)
and Breathing Lab_Test (0.9, 0.1)
Then the patient has Corona Diagnosis.

The fuzzy Corona rule are given by using FCF
if Fever (0.5)
and Allergy (0.7)
and Infection (0.6)
and immunity (0.7)
and Breathing (0.8)
Then the patient has Corona Diagnosis

In Corona diagnosis, the consequent part is derived from precedent part[6].

If x is A_1 and x is A_2 and,…, and x is A_n then x is B
= min {A_1 ,A_2 ,…, A_n)

if Fever (0.5)
and Allergy (0.7)
and Infection (0.6)
and immunity (0.7)
and Breathing (0.8)
Then the patient has Corona Diagnosis=
min{0.5,0.7,0.6, 0.7.,0.8)=0.5.

The Hybrid Fuzzy Corona Expert System is given by

HFCES =min{FCES1, FCES2}=(0.6,0.5)=0.5.

According to medical expert or physician, the treatments is suggested

1:Antipyretic (Paracentamol) to bring down temperature.

2:Antibiotic (Cefelo sporins) to tackle infections.

3:Imprve immunity (use Vitamins).

4: Anti-allergy (Cortisone)

5: Steroids (Predinislove) if necessary

V. FUZZY CORONA EXPERT SYSTEM

An Example of fuzzy corona expert system is given by

```
<HTML>
<HEAD>
<SCRIPT languge = "JavaSript">
document.write("<H1> The AI fuzzy corona diagnosis Expert system<H1>");
document.write("<H1> The corona mainly influence on breathing problem<H1>");
document.write("<H3> The fuzziness is given by Doctor mind value in [0,1.0], for example 0.75 <H3>");
document.write("<H3> Fuzzy inference is the fuzziness of diagnosis will be minimum of fuzziness of symptoms <H3>");
document.write("<H3> The featured extraction symptom (most influenced) fuzziness is the maximum fuzziness of the symptoms <H3>");
document.write("<H3> The following fuzzy rule are given for diagnosis. <H3>");
document.write("<H3> Rule-1:If the patient has breathing problem and fever and body pains and cold then corona<H3>");


var s1= prompt("Does the patient has breathing problem?","y/n");
 var f1 = prompt("enter fuzziness of breathing ", "fuzziness");
document.write("<H3> patient has fuzziness of breathing "+ f1 +"<H3>" );
var s2= prompt("Does the patient has temperature ?","y/n");
var f2 = prompt("enter fuzziness of the temperature ", "fuzziness");
document.write("<H3> patient has fuzziness of the temperature"+ f1 +"<H3>" );
var s3= prompt("Does the patient has body pains ?","y/n");
 var f3 = prompt("enter fuzziness of the body pains ", "fuzziness");
document.write("<H3> patient has fuzziness of body pains "+ f1 +"<H3>" );
var s4= prompt("Does the patient has cold ?","y/n");
var f4 = prompt("enter fuzziness of cold ", "fuzziness");
document.write("<H3> patient has fuzziness of cold "+ f1 +"<H3>" );
var f7 = prompt("enter Threshold fuzziness of diagnosis ", "fuzziness");
document.write("<H3> Threshold fuzziness of diagnosis "+ f1 +"<H3>" );
</SCRIPT>
</HEAD>
<BODY>
<SCRIPT languge ="JavaSript">

if ((s1== "y" && s2== "y" ) && (s3="y")&& (s4="y") ){
document.write("<H3> The following fuzzy rule satisfies <H3>");
document.write("<H3> Rule-1:If the patient has brething problem and fever and body pains and cold then corona<H3>"); var f12= Math.min(f1,f2,f3, f4);
var f13= Math.max(f1,f2,f3, f4);
document.write("<H3> patient has corona with fuzziness "+ f12 +"<H3>" );
 document.write("<H3> The featured extraction symptom (most influenced) fuzziness is the maximum fuzziness of the symptoms "+ f13 +" <H3>");
}


if (f12>=f7) {
document.write("<H3> The following treatment suggested by Doctor and Consult the Doctor for treatment. <H3>"); document.write("<H3> 1:Antipyretic (Paracentamol) to bring down temperature.<H3>");

document.write("<H3> 2:Antibiotic (Cefelo sporins) to tacle infections.<H3>");
document.write("<H3> 3:Imprve immunity (use Vitamins).<H3>");
document.write("<H3> 4: Anti allergy (Cetrizine).<H3>");
document.write("<H3> 5: Steroids (Predinislove) if necessary.<H3>");
 }
else
{
document.write("The diagnostic rule not satisfies");
}


</SCRIPT>
</BODY>
</HTML>
```

The compilation of corona rxpert sytem is given by

THE AI FUZZY CORONA DIAGNOSIS EXPERT SYSTEM

THE CORONA MAINLY INFLUENCE ON BREATHING PROBLEM

The fuzziness is given by Doctor mind value in [0,1.0], for example 0.75

Fuzzy inference is the fuzziness of diagnosis will be minimum of fuzziness of symptoms

The featured extraction symptom (most influenced) fuzziness is the maximum fuzziness of the symptoms The following fuzzy rule are given for diagnosis.

Rule-1:If the patient has breathing problem and fever and body pains and cold then corona

patient has fuzziness of breathing 0.8
patient has fuzziness of the temperature0.8
patient has fuzziness of body pains 0.8
patient has fuzziness of cold 0.8 Threshold
fuzziness of diagnosis 0.8 The following
fuzzy rule satisfies

Rule-1:If the patient has brething problem and fever and body pains and cold then corona patient has corona with fuzziness 0.7

The featured extraction symptom (most influenced) fuzziness is the maximum fuzziness of the symptoms 8.5 The following treatment suggested by Doctor and Consult the Doctor for treatment.

1:Antipyretic (Paracentamol) to bring down temperature.
2:Antibiotic (Cefelo sporins) to tacle infections.
3:Imprve immunity (use Vitamins).
4: Anti allergy (Cetrizine).

5: Steroids (Predinislove) if necessary.

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