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DEGREE OF ILLNESS IN CORONA VIRUS DISEASE USING FUZZY MODEL

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Abstract

There are different degrees of illness in corona virus disease. Some degree of corona virus disease needs ventilation, for some cases it will last up to 7 to 10 days, for some cases up to 15 days with good medication and for some case treatment is necessary under the guidance of Doctor. As ICU bed crisis is the main problem for the corona patients it is necessary for to find out the degree of illness in corona virus disease. By analysing the degree of illness only the patients who are having critical condition can be preferred to allot the bed This paper finds out the different degree of illness by using Fuzzy model with inputs as dry cough and shortness of breath in percentage.

I. Introduction

The corona virus was first identified in Wuhan, China. The corona virus disease is named as COVID-19. The 'CO' stands for corona, VI stands for Virus, D stands for Disease and 19 tells us that it was originate in the year 2019. This virus is transmitted in to respiratory system of the human by coughing or sneezing. So through coughing and sneezing the affected person transforms that virus into the healthy persons. To avoid the risk of infection we have to follow the following precautions

1. Have to wash our hands regularly
2. Have to cover our mouth and nose
3. By maintaining social distance

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4. Seeking medical advice when required

The symptoms include fever, cough and shortness of breath also called as dyspnea. Depends upon the severity of those symptoms the degree of illness evaluates.

II. Literature Survey

A. Fuzzy Model or Classifier

The Fuzzy model classifies and also predicts the data based upon the inputs. The Traditional model is used for producing the outputs like 'yes' or' no' or '0' or '1'.The Fuzzy model produces the intermediate results also.

B. Triangular membership function. Let a, b, c are the three vertices to represent the x-coordinate of $f(x)$ in fuzzy set A.

a- lower boundary where membership degree is zero

c- upper boundary where membership degree is zero

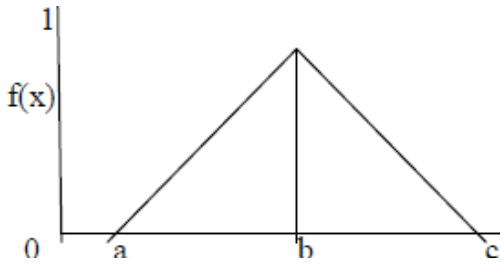
b-the centre where membership degree is one

$f(x) = 0$ if $x \leq a$;

$f(x) = (x - a)/(b - a)$ if $a \leq x = b$;

$f(x) = (c - x)/(c - b)$ if $b \leq x \leq c$;

$f(x) = 0$ if $x >= c$



C. Different degrees of illness.

The output of our fuzzy model is different degrees of illness in corona virus. Those different cases are asymptomatic, mild, moderate, severe and critical.

Asymptomatic: Being asymptomatic means no symptoms of corona virus

Mild: This degree of illness leads to runny nose, red eyes and vomiting

Moderate: This degree of illness leads to coughing and breathless becomes worse

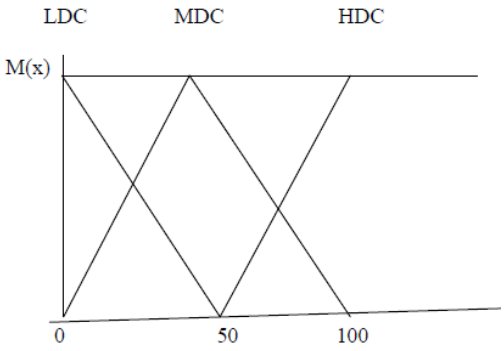
Severe: This degree of illness leads to pneumonia which produces infection in the lungs

Critical: This degree of illness needs ventilator to inflate lungs

III Proposed Method

There are many symptoms for corona virus disease .Among them I have taken two symptoms as inputs for fuzzy model. Those are dry cough and shortness of breath. By taking those inputs the fuzzy model tells whether a person is suffering from less corona affect, mild corona affect or serious corona affect .For the dry cough input variable the descriptors are low dry cough, medium dry cough and high dry cough. For the shortness of breath input variable descriptors are low, high, rapid. For the out variable degree of illness the descriptors are asymptomatic, mild, moderate, severe and critical. There are many fuzzy membership functions to design the fuzzy model, among them to find out the degree of illness this fuzzy model uses Triangular membership functions. Now we define membership functions for each and every input variable and output variable.

The membership function for dry cough input variable is



LDC- Low Dry Cough

MDC- Medium Dry Cough

HDC-High Dry Cough

The membership functions for above graph are

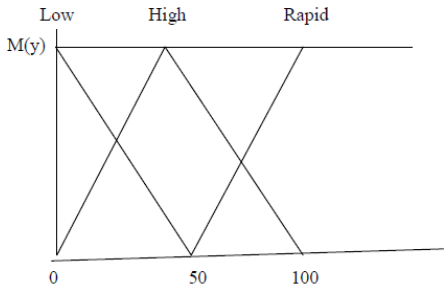
a. $MLDC\ (X) = (50 - X)/50$ if $0 \le x \le 50$

b. $MLDC\ (X) = (X - 0)/50$ if $0 \le x \le 50$ and

$MLDC\ (X) = (100 - X)/(100 - 50)$ if $50 \le x \le 100$

c. $MLDC\ (X) = (X - 50)/(100 - 50)$ if $50 \le x \le 100$.

The membership function for shortness of breath input variable is



The membership functions for above graph are

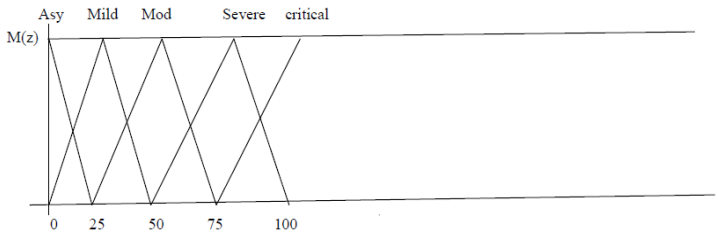
a. $M_{Low}(y) = (50 - y)/50$ if $0 \le y \le 50$

b. $M_{High}(y) = (y - 0)/50$ if $0 \le y \le 50$ and

$M_{High}(y) = (100 - y)/(100 - 50)$ if $50 \le y \le 100$

c. $M_{Rapid}(y) = (y - 50)/(100 - 50)$ if $50 \le y \le 100$.

The membership function for degree of illness output variable



The membership function for above graph is

a. $M_{Asy}(z) = (25 - X)/25$ if $0 \le z \le 25$

b. $M_{Mild}(z) = (X - 0)/25$ if $0 \le z \le 25$ and

$M_{Mild}(z) = (50 - X)/(50 - 25)$ if $25 \le x \le 50$

c. $M_{Mod}(z) = (X - 25)/(50 - 25)$ if $25 \le x \le 50$

$M_{Mod}(z) = (75 - x)/(75 - 50)$ if $50 \le x \le 75$

d. $M_{Seve}(z) = (X - 50)/(75 - 50)$ if $50 \le z \le 75$ and

$M_{Seve}(z) = (100 - 75)/(100 - 75)$ if $75 \le x \le 100$

e. $M_{Crit}(z) = (X - 75)/(100 - 75)$ if $75 \le x \le 100$.

A. Forming a Rule Base. After defining the membership function now we have to form a Rule base .The horizontal values represent different descriptors of dry cough. The vertical value represents the increase of shortness of breath After forming the rule base now this fuzzy model evaluates the rule by taking some assumption values. For example if a person is having medium dry cough i.e. of 45% and rapidity in shortness of breath i.e. of 70%. Now we have to find out degree of illness in corona disease. For the above example we have to map the membership functions

1. $MLDC(X) = (50 - X)/50$ if $0 \le x \le= 50$

$MMDC(X) = (X - 0)/50$ if $0 \le x \le 50$ and

2. $M_{Rapid}(y) = (y - 50)/(100 - 50)$ if $50 \le y \le 100$

In the above rules substitute x value as 45% and y value as 70%

(1.a) $5/50 = 1/10 = 0.1$

(b) $45/50 = 9/10 = 0.9$

2. $20/50 = 2/5 = 0.4$

The above membership function evaluates rules

(a) The medium dry cough and rapidity in shortness of breath

(b) The low dry cough and rapidity in shortness of breath

Degre of illness	LOW	HIGH	RAPID
LDC	Asy	Mild	severe
MDC	Mild	Severe	critical
HDC	moderate	Severe	critical

IV Results and Discussion

Here we have to find out the strength of each rule

Strength of above rule 'a' is min of $\{0.9,\ 0.4\} = 0.4$

Strength of above rule 'b' is min of $\{0.1,\ 0.4\} = 0.1$

Next we have to use defuzzification technique i.e. finding out the max value max{0.4,0.1}=0.4.This technique is used to find out the exact value.

$$M_{Crit}(z) = (z - 75)/(100 - 75) \text{ if } 75 \le z \le 100$$

$$(2/5)^{*} 25 = z - 75 \ge 10 = z - 75 \le z = 85$$

If z value is 85 the output is critical.

V. Conclusion

This work classifies different degrees of illness in corona. In future our proposed method can be used to find out the different performance measures

References

[1] D. Dubois and H. Prade, (Eds.): Fundamentals of Fuzzy Sets The Handbook of Fuzzy Sets Series Kluwer Academic Publishers, Boston-London-Dordrecht (2000).

[2] H. Ishibuchi and T. Murata and M. Gen, Performance evaluation of fuzzy rule-based classification systems obtained by multi-objective genetic algorithms, Computers and Industrial Engineering 35(3-4) (1998), 575-578.

[3] H. Ishibuchi, T. Nakashima and T. Morisawa, Voting in fuzzy rule-based systems for pattern classification problems, Fuzzy Sets and Systems, Soft Computing for Pattern Recognition 103(2) (1999), 223-238.

[4] L. I. Kuncheva, Fuzzy classifier design. Springer-Verlag, Heidelberg, (2000).

[5] Z. Lei and L. Ren-hou, Designing of classifiers based on immune principles and fuzzy rules, Information Sciences 178(7) (2008), 1836-1847.

[6] T. H. Li, N. R. Guo, and C. L. Kuo, Design of adaptive fuzzy model for classification problem, Engineering Applications of Artificial Intelligence 18(3) (2005), 297-306.

[7] J. A. Roubos, M. Setnes and J. Abonyi Learning fuzzy classification rules from labeled data, Information Sciences 150(1-2) (2003), 77-93.