SICK PEOPLE SUSCEPTIBLE TO COVID-19– AN APPLICATION OF INTUITIONISTIC FUZZY SET

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Abstract : An application of Intuitionistic fuzzy set (IFS) is to spot the most susceptible Sick person who is at risk of getting infected to COVID-19 disease by calculating the approach of each sick person to different corona virus symptoms. The approach is calculated by the distance between each sick person and different corona virus symptoms found in them.

IndexTerms **- Intuitionistic fuzzy set, COVID-19, sick person, Normalized Euclidean Distance.**

I. INTRODUCTION

Corona virus disease (COVID -19) is an infectious disease caused by Corona virus. The Coronovirus patients experience a mild to moderate symptoms of cough, fever and other variety of symptoms. The virus mainly transmits through mucous split by human beings specially who are suffering from cough, cold or fever. A human being can be infected by coming in contact with the virus if they are in the contaminated radius. Normally the infection spreads through eyes, nose and mouth. Identifying the most infected person and providing the treatment and other precautionary measures to be implemented is very crucial at this juncture. Though we don't have machinery available to identify the presence or absence of virus in our surroundings.

The global pandemic of the corona virus disease, called COVID-19, continues to have a serious impact on many people, including cancer patients, their families, and care givers. Cancer patients are among those are at high risk of serious illness from an infection because their immune systems are often weakened by cancer and its treatments. Most people who were treated for cancer in the past (especially if it was years ago) are likely to have normal immune function, but each person is different. It's important that all cancer patients and survivors, whether currently in treatment or not, must refer to a doctor who understands their situation and medical history. Though no one is invulnerable, it is understood that older adults are at increased risk for severe illness or death from COVID-19. Sick people suffering from heart disease, lung disease, diabetes, etc are at increased risk even further in those who are older. While the information about the impact of the Corona outbreak on sick people is not specific, but the information of spotting the most affected sick person may support in timely treatment and taking precautionary measures for getting infected.

As some states continue to relax or lift stay-at-home orders and are allowing certain businesses to re-open, health officials continue to stress the importance of staying home and social distancing (keeping at least 6 feet away from others), as well as wearing a face covering if you go out in public. There is need of some support to identify sick people who are more vulnerable to infecting to Corona virus and provide timely treatment.

II. BASIC DEFINITIONS

Definition 1 (Zadeh, 1965): For a nonempty set X, a fuzzy set A is defined as $\left\{\left\langle x, \mu_A(x)\right\rangle : x \in X\right\}$, $\mu_A(x)$ is the membership function of the fuzzy set A.

Definition 2(Atanassov, 1999): An intuitionistic fuzzy set (IFS) A of X is defined as A = (μ_A, ν_A), where μ_A, ν_A are functions from the set X to the closed interval [0, 1] of real numbers such that for each x∈X, 0≤ μ_Ax + ν_Ax ≤ 1, where μ_A is called the membership function of A and ν_A is called the non-membership function of A. moreover, the hesitation function, $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$ is the hesitation margin of x in A. $\pi_A(x)$ is the degree of indeterminacy of $x \in X$ to the IFS A and $\pi_A(x): X \rightarrow [0,1]$ and $0 \le \pi_A(x) \le 1$ for every $x \in X$, $\pi_A(x)$ expresses the lack of knowledge of whether x belongs to IFS A or not.

Definition 3 (Szmidt and Kacprzyk, 2014): The normalized Euclidean distance $d_{n-H}(A, B)$ between two IFS A and B is defined as $d_{n-H}(A, B) = \left[\frac{1}{2n}\sum_{i=1}^{n}\left[\left(\mu_A(x_i) - \mu_B(x_i)\right)^2 + \left(\nu_A(x_i) - \nu_B(x_i)\right)^2 + \left(\pi_A(x_i) - \pi_B(x_i)\right)^2\right]\right]^{1/2}$ where X = {x_1, x_2, ..., x_n} for i = 1, 2,…, n.

III. APPLICATION OF INTUITIONISTIC FUZZY SETS

We use intuitionistic fuzzy set and define the membership degree (i.e. level of the symptoms from the day of infection of COVID-19 disease based on number of infected patients who are sick and suffering from some disease in the hospital), the non-membership degree (i.e level of the symptoms from the day of infection of COVID-19 disease based on number of non

infected patients who are sick and suffering from some disease in the hospital) and the hesitation degree (i.e. level of the symptoms from the day of infection of COVID-19 disease based on the number of recovered patients who are sick and suffering from some disease in the hospital). Similarly other intuitionistic Fuzzy sets are defined. Here we are assuming a sick person as a person who is suffering from or had been treated for some disease in past. Let Sick Persons suffering from some disease=D ={Diabetic Patient, Cancer Patient, Cardiovascular Disease Patient, Surgical Patient, Hypertension Patient}, and Symptoms of the COVID-19 virus infection for different days from the day of infection =S= {Fever, Dry cough, Skin Allergy, Cold}. We assume the above sick persons submit the symptoms regarding COVID-19 disease through themselves or through concerned reports from the hospital to determine their level of symptoms.

IV. RESULTS AND DISCUSSION

4.1 Results based on Euclidean Distance

In Table 1, the IFS is defined for different symptoms for different days from the day of infection for a sick person.

Table 1: Symptoms Vs Days

	Day1	Day 2	Day 3	Day 4
Fever	(0.8,0.1,0.1)	(0.6,0.1,0.3)	(0.5,0.4,0.1)	(0.7,0.2,0.1)
Dry Cough	(0.6,0.3,0.1)	(0.7,0.1,0.2)	(0.6,0.1,0.3)	(0.9,0.05,0.05)
Skin Allergy	(0.9,0.05,0.05)	(0.8,0.1,0.1)	(0.6,0.3,0.1)	(0.7,0.1,0.2)
Cold	(0.7,0.1,0.2)	(0.9,0.05,0.05)	(0.5,0.4,0.1)	(0.9,0.05,0.05)

In Table2, the IFS is noted for different sick people regarding the symptoms of Corona virus infection for different days from the day of infection.

Table 2: Sick person Vs Days

	Day 1	Day 2	Day 3	Day 4
Diabetic Patient	(0.6,0.3,0.1)	(0.7,0.2,0.1)	(0.6,0.2,0.2)	(0.6,0.3,0.1)
Surgical Patient	(0.8,0.1,0.1)	(0.7,0.2,0.1)	(0.8,0.1,0.1)	(0.8,0.1,0.1)
Cancer Patient	(0.6,0.3,0.1)	(0.8,0.1,0.1)	(0.7,0.2,0.1)	(0.7,0.2,0.1)
Asthama Patient	(0.8,0.1,0.1)	(0.7,0.2,0.1)	(0.8,0.1,0.1)	(0.8,0.1,0.1)
Cardiovascular Disease Patient	(0.7,0.2,0.1)	(0.6,0.2,0.2)	(0.9,0.05,0.05)	(0.7,0.2,0.1)
Hypertension Patient	(0.7,0.2,0.1)	(0.8,0.1,0.1)	(0.6,0.3,0.1)	(0.5,0.4,0.1)

Using definition 3 above to calculate the distance between each sick person and symptoms with respect to the days of infection, the following table is obtained:

From table 3, based on the distance between a sick person and symptoms, the most infected sick person can be cautioned or identified. Hence the Table 3 is presenting that the cancer patient is suffering from highest level of symptoms of Corona Disease as all the symptoms are at low distance (highlighted value) to the cancer patient.

4.2 Conclusion

The application of intuitionistic fuzzy set in providing sufficient information of most susceptible sick person expected to get infected by corona virus is of great importance at this juncture as this submits proper information to hospitals of their patients responses. In the proposed method, we used normalized Euclidean distance to calculate the gap or approach of each sick patient from the different levels of symptoms of COVID-10 disease. The different tables may be updated time to time and take decision

Table:3	Fever	Dry Cough	Skin Allergy	Cold	Sum
Diabetic Patient	0.1658	0.1561	0.1785	0.2062	0.7066
Surgical Patient	0.1803	0.1561	0.1299	0.1871	0.6534
Cancer Patient	0.1732	0.1346	0.1561	0.1658	0.6297
Asthama Patient	0.1803	0.1561	0.1299	0.1871	0.6534
Cardiovascular disease Patient	0.2016	0.1803	0.1936	0.2512	0.8267
Hypertension Patient	0.1581	0.225	0.1601	0.2062	0.7494

as per the table 3.

IV. ACKNOWLEDGMENT

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