

Fuzzy Based Analysis of Medical Diagnosis

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Abstract- *The purpose of the present paper is to classify among different age group of the patients and their symptoms under single diseases and to determine appropriate therapeutic action. This also helps to diagnosis of diseases which having the same symptoms. This paper deals with knowledge based expert systems which have been developed for the diagnosis of diseases based on the symptoms obtained from the interaction and observation from the patient. The diagnoses is vague or uncertain for the treatment so there is a requirement of fuzzy .An example of Glaucoma and other group of diseases is taken where the retaliated diagnosis is approach to fuzzy logic.*

I. INTRODUCTION

The Medical information acquired in the two ways

- Through numerical or Linguistic evaluation by Medical Experts.
- By statically evolutionary of the database or schema containing the medical data of the patient with confirm diagnosis. The information on the relationship gathered numerically or linguistically.

Generally the primary stage of investigation of diseases is uncertain, mainly Medical Experts follow the way of diagnosis through the interaction from the patients and also know the history of the patient, and after the process of the primary investigation he got a schema of various symptoms from the patients. The Expert kept all the information in mind and these information is vague at the right movement because various diseases having some common symptoms so for the diagnosis there is a requirement of **fuzzy logic** i.e. relationship from the standard data base through fuzzy membership function , and identify the actual diseases through fuzzy membership which is represented by the binary value (1) and if the symptoms is not retaliated with the standard schema that shows false membership (0) .After the diagnosis of the diseases they prescribe the related treatment for the diseases. After the medicine if the patient is perfectly alright so the treatment is true i.e. true relationship, and if the patient doesn't get any relief i.e. false relationship .Then once again the patient approach to the Expert. The accuracy of this expert system depends on the accuracy of the data presented to it.

The physician subjects the patient to a physical examination from which he obtains more or less objective data. However, measurement errors, organizational problems (misleading samples, sending them to the wrong laboratory, etc), or improper behavior on the part of patients prior to examinations lead to imprecise and sometimes even totally incorrect data and physicians make mistakes, overlook important indications, or fail to carry out a complete examination. Furthermore, they may misinterpret other indications because the boundary between healthy and pathological status is not always clearly defined. There are always borderline values that can not be said to be either normal or pathological and the physician can not interpret it. But with this expert system, we can define the healthy, borderline, clear cut and severe pathological conditions. There has been a growing interest in healthcare among many people. Some topics related to healthcare are: drinking water quality, driving fatigue, health risks in work environment and healthcare organizations.

II. FUZZY CONTROL TECHNIQUES

Various therapeutic situations are related to control problems. Although the early medical systems appeared at the same time as the article by Zadeh (1965), there has been little communication between the research fields, but recently this has changed due to the developments in computer systems, and rapid development of the literature searching methods motivated by the internet. Many systems are being developed which utilize fuzzy logic and fuzzy set theory.

Rule-Based Open-Loop Systems:

Deterministic open-loop fuzzy control approaches have been proposed in many applications. Generally, in open-loop configuration, it is assumed that the pharmacokinetics relationships can be modeled exactly by a linear system with known parameters. Open-loop fuzzy control is based on a different approach. Rather than assuming the patient model is known, the physiological behavior is modeled using control rules and actions. Most of the controllers are advisory systems. In healthcare, the "heaviness" is defined by mean of fuzzy sets for advising workers how heavy their weight. Also fuzzy control was used to develop a computer-based system for control of oxygen delivery to ventilated infants. An open-loop

system for treatment of diabetic out-patients was developed for calculating the insulin dose. Advisory expert systems can also be considered as an open-loop controller for advising on drug administration in general anesthesia

III. FUZZY LOGIC

Definition and design of Fuzzy Relational Maps (FRMs). In FCMs with the help of correlations between causal associations among concurrently active units. But in FRMs we divide the very causal associations into two disjoint units.

Definition 1: Let X be some set of objects, with elements noted as x . $X = \{x\}$.

Definition 2: A fuzzy set A in X is characterized by a membership function $\mu_A(x)$ which maps each point in X onto the real interval $[0, 1]$. As $\mu_A(x) = 1$, the "grade of membership" or true membership function of x in A increases.

Definition3: A is EMPTY or Null iff for all x , $\mu_A(x) = 0$.ie. False membership.

Definition 4: $A = B$ iff for all $\{x: \mu_A(x) = \mu_B(x) \text{ [or } \mu_A(x) = \mu_B(x)]\}$

Definition6: A is contained in B if $\mu_A(x) \subseteq \mu_B(x)$

Definition7: $C = A \text{ UNION } B$, where $\mu_C(x) = \text{MAX}(\mu_A(x), \mu_B(x))$

Definition8: $C = A \text{ INTERSECTION } B$ where: $\mu_C(x) = \text{MIN}\{\mu_A(x), \mu_B(x)\}$

Definition9: Data are binary Computer representation of stored logical entities.

Definition 10: Index files and data dictionaries, store administrative information known as meta data.

Definition 11: A fuzzy relational R on a relational schema if A_i be the set of attributes and $R(A_1, A_2, \dots, A_n)$ is the fuzzy sub set of the Cartesian product of Universe defined by $\text{dom}(A_1) \times \text{dom}(A_2) \times \dots \times \text{dom}(A_n)$. According to the complexity of the $\text{dom}(A_i)$ the classical fuzzy relational can be classified to type 1, fuzzy relational. In first type each attribute domain $\text{dom}(A_i)$ can only crisp set or a fuzzy sub set so we can capture the impression of attributed value in a type 1 fuzzy relational allow each domain to be a crisp set, a fuzzy sub set of fuzzy sets, and the second type is relation express the imprecision in the association among the attribute value.

IV. FUZZY TECHNIQUES FOR BIOMEDICAL DATA ANALYSIS

The knowledge acquisition system is capable of acquiring information on medical entities and relationship between the relationships is stored in terms of numerical values in the range 0 and 1.

Example : Leprosy in its preliminary stage is uncertain in its character. There is a loss of appetite and sign of dyspepsia, neuralgia, nausea, rheumatic and articular pains, fever irregular or intermittent and un-accountable lassitude and anxiety. After some time the new symptoms are developed by periodical eruptions. The symptoms blotches first reddish, then brown with a white border and then appear and disappear in various parts of the body. Some times on the joint but generally on the articulation of the fingers and toes of the small tumor rise failed with a yellowish substance fast turning to darker hue. These tumors leaves the permanent spots pale or brown, or nodules. According to its effect on the skin and mucous membrane (cutaneous leprosy) or the nerves (anesthetic) or both mixed or complete the diseases develop in the form of leprous formation and diverges in to the different varieties. Each of these varieties merges frequently on others and some times became very difficult to draw the line between the causes. The effect of tubercular leprosy they may occur on the part of the body but usually effect the face (forehead, eyelids, nose, lips, chin, cheeks and ears. In anesthetic leprosy the anesthesia of the little finger is one of the characteristic symptoms which may occur. The ulcer, at first usually located on to the finger, attack on the fingers, on other hand in some cases feet is also effected at the same time. The medical history of the patient, which is highly subjective and may include simulated to understated symptoms that finally leads to the correct diagnosis,.

Fuzzification of the Symptoms :

A binary relationship is established for the symptoms of the subject and takes the values between 0 and 1. These values indicate the degree of which the exhibits a symptoms. In fuzzy set theory these binary is expressed in terms of membership function. Diseases or diagnosis also takes values between 0 and 1. Fuzzy values is ranging from 0 and 1 represent the membership function of any diseases while the values 1 and 0 represent the confirmation of the diseases. Some fuzzified symptoms of some diseases is given in the table for the Leprosy fuzzy number is assigned to the symptoms Glaucoma is a silent disease which results in blindness which has symptoms similar to other common eye and ear problem. If deducted during earlier stages can be cured and the damage

to the human system can be reduced. It is basically due to the variation of pressure of aqueous

S. no	Symptoms	Range	Fuzzification Value
	Tempature	T<98.6 F	00
		98.6 F<T<100 F	01
		100 F<-T<102 F	10
		102 F<T	11
2	Rheumatic Pain	No pain	00
		Mild	01
		Severe	10
		Acute	11
3	Articular pain	No pain	00
		Mild	01
		Severe	10
		Acute	11
4	Neuralgia Pain	No pain	00
		Mild	01
		Severe	10
		Acute	11
5	Loss of appetite	No pain	00
		Mild	01
		Severe	10
		Acute	11
6	Loss of Dysepsia	No pain	00
		Low	01
		Medium	10
		High	11
7	Loss of Nausia	No pain	00
		Low	01
		Medium	10
		High	11
8	Unaccountable Anexity	No pain	00
		Low	01
		Medium	10
		High	11
9	Unaccountable Lasitude	No pain	00
		Low	01
		Medium	10
		High	11
10	Raddish spot on the body	No pain	00
		Low	01
		Medium	10
		High	11
11	Brown Spot on the body	No pain	00
		Low	01

		Medium	10
		High	11
12	Spot With White border	No pain	00
		Low	01
		Medium	10
		High	11
13	Depression of the lips/lips became flabby/drops	No pain	00
		Low	01
		Medium	10
		High	11
14	Muscule control Lost	No pain	00
		Low	01
		Medium	10
		High	11
15	Eyelids Droop		
16	Apperence of soft nodules on the cheeks	Yes/ No	1/0
17	Diffculties in shutting the eyes	Yes/ No	1/0
18	Sensory Loss	Yes/ No	1/0
19	Hands are unable to grasp/claw hand deformity	Yes/ No	1/0
20	Offensive smell	Yes/ No	1/0
21	Hair Falls	Yes/ No	1/0
22	Nails Falls	Yes/ No	1/0
23	Teeth Falls	Yes/ No	1/0
24	Skins changes/Shrinks	Yes/ No	1/0
25	Toumers on articular lations of the fingers/toes/joints &filled with a yellowish substance	Yes/ No	1/0
26	Turning to the darker hue &leave peramanent spots,paleor	Yes/ No	1/0

	brown or nodules		
27	Blotches	Yes/ No	1/0
28	Anesthesia of the little finger	Yes/ No	1/0
29	Blindness/ Visual imparement	Yes/ No	1/0
30	Punctate Keratitis	Yes/ No	1/0
31	Presence of bacilli in Ires pearls/Ires atrophy occoures	Yes/ No	1/0
32	Presence of Mycobacterium lepral in deep layer of skin	Yes/ No	1/0
33	Typical Leonine appearance	Yes/ No	1/0
34	Loss of Tarsal plates	Yes/ No	1/0
35	Thickened eyeloids/face /ears	Yes/ No	1/0
36	Corrugation of the face skin	Yes/ No	1/0
37	Madarosis of lashes/brows /Iris pearls	Yes/ No	1/0
38	Cornal Hyperthesia	Yes/ No	1/0
39	Apperance of soft nodes on the ears/nose/throt/cheeks	Yes/ No	1/0

And some other symptoms also defined with the help of membership value for the same dieses .

Fuzzy Clustering:

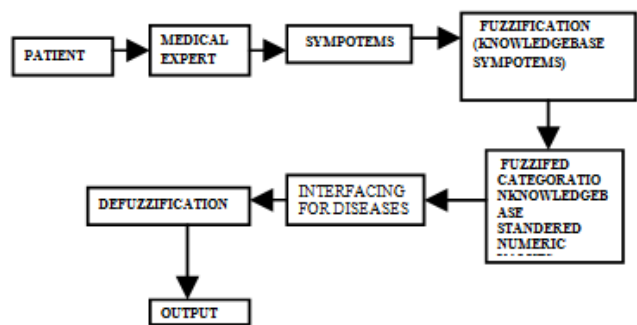
Clustering algorithms are mainly concerned with partitioning the data into a number of subsets. Within each subset, the elements are similar to each other. On the other

hand, elements from different sets are as different as possible. There are different fuzzy clustering techniques based on unsupervised learning such as relation criterion functions, object criterion functions, c-means clustering, etc. Most of the clustering techniques are being applied to diagnosis. C-means clustering was applied for brain injury using magnetic resonance images),and tumor measurement in response to treatment Fuzzy classification differs from clustering by the labeling method, the former giving a label to each data set, while in the latter method a label is given to each data set. Supervised learning is usually used for classification. Most of the fuzzy classification applications occur in the psychology field There are also forensic application and classification of path physiology laboratory data

Fuzzy Modeling and Identification:

Fuzzy logic models can be developed from expert knowledge or from process (patient) input-output data. In the first case, fuzzy models can be extracted from the expert knowledge of the process. The expert knowledge can be expressed in terms of linguistics, which is sometimes faulty and requires the model to be tuned. Therefore, identifying the processes a more attractive way using the help of expert knowledge. This process requires defining the model input variables and the determination of the fuzzy model type. There are two ways to develop a fuzzy model, the first beings based on defining the initial parameters of the model (membership functions) and selecting the rules construction method Neuro fuzzy algorithms are often used for the tuning of parameters). The second method is used if there is no knowledge about the process, when the rules and membership functions can be extracted directly from the data by clustering the input / output space

V. FUZZY METHODOLOGIES



Relational Mapping:

Relational mapping is defined between patient and Medical Expert by taking an example domain symptoms set $D_i = \{d_1, d_2, d_3, d_4, d_5\}$ and range disease

Set $R = \{r_1, r_2, r_3\}$ where r_1, r_2, r_3 be the disease like hart attack ,general disease, glaucoma

Fuzzy matrices and their applications

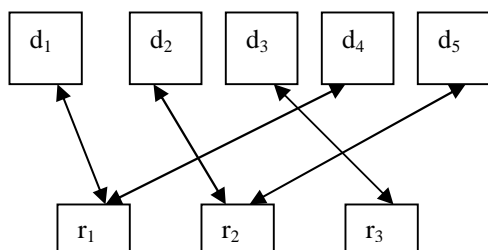
Matrix theory has become a very simple but an effective tool in the analysis of collected raw data. Fuzzy matrix or CETD matrix model is the one, which helps to analyze the raw data. The analysis is carried out in five stages. In the first stage the collected raw data, which is time dependent is made into an Initial Raw Data (IRD) matrix.

Definition :A FRM is a directed graph or a map from D to R with concepts like policies or events etc, as nodes and causalities as edges. It represents causal relations between spaces D and R .Let D_i and R_j denote that the two nodes of an FRM. The directed edge from D_i to R_j denotes the causality of D_i on R_j called relations. Every edge in the FRM is weighted with a number in the set $\{0, \pm 1\}$. Let e_{ij} be the weight of the edge $D_i R_j$, e_{ij} The weight of the edge $D_i R_j$ is positive if increase in D_i implies increase in R_j or decrease in D_i implies decrease in R_j ie causality of D_i on R_j is 1. If $e_{ij} = 0$, then D_i does not have any effect on R_j . We do not discuss the cases when increase in D_i implies decrease in R_j or decrease in D_i implies increase in R_j .

Definition :When the nodes of the FRM are fuzzy sets then they are called fuzzy nodes. FRMs with edge weights $\{0, \pm 1\}$ are called simple FRMs.

Definition :An FRM with cycles is said to be an FRM with feedback.

Definition :When there is a feedback in the FRM, i.e. when the causal relations flow through a cycle in a revolutionary manner, the FRM is called a dynamical system.



And the fuzzy relational matrix is between D and R defined as

$$E = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

where (1 0 0) vector which shows that the symptoms is matched for diagnosis of dieses

Error Back Propagation:

Through the above mentioned tables the out put that is the fuzzified values taken by the various combination of the symptoms

Dieses Diagnosis Related Thepratic Action:

It is a complex partly uninvestigated process in which the knowledgebase expert system is obviously able to work with uncertain and imprecise set of possibilities so for that IF-THAN rule is followed

VI. CONCLUSIONS

The fuzzy based expert system has been successfully developed and tested for the diagnosis of other dieses. This approach is reliable and provides wide spread of information to help the physician in reaching a more logical conclusion for a more accurate diagnosis. The system has been successfully tested for disease diagnostics for number of combinations of healthy and diseased categories. With the help of this system, it is possible to know the degree of severity as well as the type of disease. The expert system has been successfully developed and tested for the diagnosis of other dieses. This approach is reliable and provides wide spread of information to help the physician in reaching a more logical conclusion for a more accurate diagnosis. The system has been successfully tested for disease diagnostics for number of combinations of healthy and diseased categories. With the help of this system, it is possible to know the degree of severity as well as the type of disease.

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