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CODEN: IAASCA **ORIGINAL ARTICLE**

An overview on Fuzzy Logic based Clinical assessment Model

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ABSTRACT
Clinical judgment for the diagnosis and management of mans' diseases is an art. It can neither be acquired from textbooks alone, nor can it be taught, but has to be developed slowly through years of observation and experience. This is because unlike other professions, which thrive on calculations based on yes/no or present/absent, very little is clearly black and white in clinical medicine. Most clinical scenarios present in shades of gray. Instead of "present or absent", patients' symptoms are described using terms like "never, rarely, sometimes, often, most of the times, always, etc". Moreover, each specific symptom may also be graded as "mild, moderate or severe". This is compounded by the fact that most symptoms are experienced and described differently by patients and many symptoms may overlap in the same patient. In this paper different fuzzy rule-based systems have been suggested to predict clinical diseases on the basis of general symptoms.
Key Words: *Fuzzy Rule, Fuzzy Rule Based System, Fuzzy Inference System,Defuzzifier.*

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INTRODUCTION

Each individual patient may also have a multitude of characteristics other than the disease, rendering it unique in itself. Medical problems, therefore, cannot be generalized and analysed using Aristotelian or binary logic, and an analytical program is desperately required which could integrate this complex network of problems and devise individualized solutions. Fuzzy logic is the nearest response to the call. It has the potential of combining human heuristics into computer-assisted decision making. Imagine combining the experience of five university professors with all the current literature and developing a software that can calculate probabilities based on this, tailored specifically for each individual patient. Fuzzy logic can do all that [1,2].

The concept was first introduced by Lotfi Zadeh in 1965. He defined fuzzy logic as "a class of objects with a continuum of grades of membership". It accounts for all the complexities and variations in patients and results in a statistical analysis which is appropriate for an "individual", unlike evidence-based medicine, which is applicable to a group of patients. It enables the scientific community to look into all shades of gray and determine the grade and severity of the disease. Fuzzy logic is a well-established concept in mathematics and engineering but its usefulness in medicine was not realized till the last decade. A recent review highlighted that the medical publications on fuzzy logic increased from 2 per year in 1991 to 175 per year in 2002. Till last year, a Medline search using the keyword "fuzzy logic" generated around 1600 publications, but a recent Medline search generated a total of 2448 articles, out of which more than 300 were published during last year. This reflects that the use and applicability of fuzzy logic is accelerating at a significant pace in medical and scientific community [3, 4].

Literature reveals that fuzzy logic has been used effectively in medicine. Different types of methodologies have been applied to diagnose the diseases based on symptoms, historical and clinical data of an individual. Increase in the number of recent applications of medicine with fuzzy-logic is an indication of growing popularity of fuzzy systems. Fuzzy intelligent systems developed during 2007–2018 have been studied to explore various techniques applied for disease prediction. In the traditional approach, a physician is required to diagnose disease based on historical and clinical data but the intelligent system will help physicians as well as individuals to detect disease at any location of the world [5].

WHAT IS FUZZY LOGIC

Fuzzy logic is a multi-valued logic which was introduced by Zadeh in order to deal with vague and indecisive ideas. It has been described as an extension to the conventional Aristotelian and Boolean logic as it deals with "degrees of truth" rather than absolute values of "0 and 1" or "true/false". Fuzzy logic is not like a computer software which understands only binary functions or concrete values like 1.5, 2.8, etc; instead, it is similar to human thinking and interpretation and gives meaning to expressions like "often", "smaller" and "higher". Fuzzy logic takes into account that real world is complex and there areuncertainty. Fuzzy logic (FL) is a mathematical discipline that we use every day and helps us to reach the structure in which we interpret our own behaviours. Its basis is formed by "true" and "false" values and Fuzzy Set Theory (FST) in which the values between 'partially true", "partially false"- are determined. FST is a theory that aims to express the uncertainties of life such as "warm" and "cool" which are in between "hot" and "cold" mathematically. And behind these values there is an unclear numerical value. Generally, fuzzy expert systems (FES) are systems based on knowledge or rule. That is, in the basis of a FES lie the "if-then" rules. After deciding to design a fuzzy system the first step to follow is to collect the rules of "if-then". These rules are generally collected with the help of a domain expert.

Characteristics of Fuzzy Logic [6-8]

There are a few basic principles of fuzzy logic which were laid down by Zadeh in 1992.

- Exact reasoning is viewed as a limiting case of approximate reasoning.
- Everything is a matter of degree.
- Knowledge is interpreted as a collection of elastic, fuzzy constraints on a collection of variables.
- Inference is viewed as a process of propagation of elastic constraints.
- Any logical system can be "fuzzified".

Fuzzy Sets :

A classical set of binary logic has "crisp" boundaries whereas fuzzy sets have fuzzy or imprecise boundaries. A fuzzy set consists of linguistic variables where values are words and not numerical. For example, intracranial pressure (ICP) can be defined as low, normal or high. Thus, ICP is a linguistic variable where the values have fuzzy margins and can overlap each other. The transition from one value to another is gradual and each value is given a membership function which represents the degree to which it belongs to that value. A fuzzy set can be represented by the following equation-

Fuzzy Sets: low, medium and high

$A = \{\{(x, \mu_A((x)))) \mid x \in X\}\}$

where A is a fuzzy set in X and $\mu_A(x)$ is the membership function, which can have any value between 0 and 1 inclusive.

Membership functions overlap each other as evident. Thus, a value for ICP can be both low and normal to a certain degree. Membership functions are not equivalent to probabilities. A membership value of low ICP does not signify that there is a certain probability of having low ICP or not; instead, it is the degree to which it is a low ICP.

Fuzzy Rules

Fuzzy rule is based on "if…then" rule and connects the different input and output fuzzy variables. It can be expressed as:

if is x *A* then y is *B*

where *A* is the antecedent and *B* is the consequent. Fuzzy rules are similar to common sense rules as they resemble human thinking and are based on human experience. For example, in order to control ICP in a patient with traumatic brain injury, sedation is often required but needs to be carefully monitored. A simple rule can be, "If the ICP is high, increase propofol infusion", or "If the ICP is low, stop propofol infusion". These rules are based on collective experience of specialists in the field as well as available literature. Thus, as more fuzzy rules and sets are obtained from various sources, uncertainties are potentially reduced.

FuzzyReasoning

Fuzzy reasoning is also called approximate reasoning and is the process of drawing conclusions from fuzzy sets and fuzzy rules.

Fuzzy Inference System

Fuzzy inference system (FIS) is a framework which is based on fuzzy sets, fuzzy rules and fuzzy reasoning. It has four main components including fuzzifier, rule base, inference engine and defuzzifier. The fuzzifier creates fuzzy sets from "crisp" values like a fuzzy set for ICP will be divided into "low, normal and high" and a fuzzy set for propofol infusion will be divided into "stop, decrease and increase". Next, the fuzzy rules are formed based on these two input fuzzy sets: "If the ICP is low, stop propofol

infusion", "If the ICP is normal decrease propofol infusion" and "If the ICP is high, increase propofol infusion". The inference engine applies all the fuzzy rules on the fuzzy sets to determine the resultant fuzzy output. If a "crisp" output value is required, the process of defuzzification converts the fuzzy output into a "crisp" output value by determining the center of mass of the combined, overlapping membership functions [9-11].

Diagnosis as the initial step of medical practice, is one of the most important parts of complicated clinical decision making which is usually accompanied with the degree of ambiguity and uncertainty. Since uncertainty is the inseparable nature of medicine, fuzzy logic methods have been used as one of the best methods to decrease this ambiguity and will be a sensitive and specific tool for various clinical problems. Although, a number of studies have been conducted on fuzzy logic, it is still largely underutilized in neurosciences[12]. On one hand, where the concept has the potential of changing medical diagnosis and management completely, it remains to be seen how effectively it can be incorporated in routine clinical practice. If focused research is conducted, it is possible that in future neurophysiology labs will be reporting EMGs and EEGs with the help of fuzzy logic, ICUs will have fuzzy controllers for controlling blood pressure, ICP and ventilator settings, MRI scans will be analysed by fuzzy logic software's and neurosurgeries will be planned by FIS. However, change is always difficult to introduce but hope should be alive.

CONCLUSION

Recently, several kinds of literature have been published related to fuzzy logic methods in a wide range of medical aspects in terms of diagnosis. However, in this context there are a few review articles that have been published which belong to almost ten years ago. Hence, we conducted a systematic review to determine the contribution of utilizing fuzzy logic methods in disease diagnosis in different medical practices. Consequently, the result of this study approved the effectiveness of applying different fuzzy methods in diseases diagnosis process, presenting new insights for researchers about what kind of diseases which have been more focused. This will help to determine the diagnostic aspects of medical disciplines that are being neglected.

Overall, this systematic review provides an appropriate platform for further research by identifying the research needs in the domain of disease diagnosis.

REFERENCES

1. LA Zadeh (1973). Outline of a new approach to the analysis of complex systems and decision processes" IEEE Transactions on systems, Man, and Cybernetics.
2. Allahverdi N. (2009). Some Applications of Fuzzy Logic in Medical Area, Proceedings on the 3rd International Conference on Application of Information and Communication Technologies (AICT2009), Published by IEEE, 14-16.
3. Ramesh A.N., Kambhampati C. J.R.T. Monson J.R.T. & Drew P.J. (2004). Artificial intelligence in medicine, Annals of The Royal College of Surgeons of England, Vol. 86, Number 5, pp. 334-338.
4. Tsoukalas L. H., &Uhrig R. E. (1997). Fuzzy and neural approaches in engineering, John Wiley & Sons Inc..
5. Torres A. & Nieto J. J. (2006). Fuzzy Logic in Medicine and Bioinformatics, Journal of Biomedicine and Biotechnology, Vol. pp. 1–7.
6. Abbod M. F. von Keyserlingk D. G Linkens&Mahfouf M. (2001). Survey of utilisation of fuzzy technology in Medicine and Healthcare, Fuzzy Sets and Systems. 120(2), pp. 331– 349.
7. Mordeson J. N., Malik D. S. & Cheng S-C. (2000). Fuzzy Mathematics in Medicine, Heidelberg, Germany, Physica.
8. Barro S. & Marin R. Fuzzy Logic in Medicine. Heidelberg, Germany: Physica, 2002.
9. Seising R. Fuzzy Sets and Medicine – Historical and Epistemological Remarks, IEEE, 2007.
10. Wakami N., Araki S. & Nomura H. (1993). Recent applications of fuzzy logic to home appliances. In Proceedings of the IECON'93. International conference on industrial electronics, Vol. 1, pp90-98
11. E.Sivasankar, Dr.R.S.Rajesh,(2010). "Knowledge Discovery in Medical Datasets Using a Fuzzy Logic rule based Classifier"; 978-1-4244-7406-6/10/$26.00.
12. Carlos Ordonez, (2006)."Comparing association rules and decision trees for disease prediction"; ACM.