

Analysis of Patients Data Using Fuzzy Expert System

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Received September 22, 2021; Accepted December 18, 2021

ISSN: 1735-188X

DOI: 10.14704/WEB/V19I1/WEB19265

Abstract

Many problems are facing many developed and developing countries in the medical field, and the most important of these problems is the analysis and diagnosis of patient data for government and private hospitals. This is due to the lack of experience of medical staff, especially new ones, which affects the provision of correct medical services to patients. It is no secret that these countries are making great efforts to overcome these problems. The study focuses on the use of a fuzzy expert system to analyze patient data based on (age, type of review) to reach the result of the analysis (intensive care, medium care, no care) and this system helps to give advice and good analysis of patient data, which can increase the speed of gaining experience for new and inexperienced medical staff in this field.

Keywords

Fuzzy Expert System, Patients Data, Fuzzy Logic.

Introduction

Fuzzy expert system is an artificial intelligence tool that aids in the resolution of decision-making problems including uncertainty and is useful in medicine for symptomatic diagnostic therapies. The focus is on the development of a Fuzzy expert system that aids in disease diagnosis. Zadeh invented the Fuzzy logic System at the University of California in 1965, it has since been widely employed as a successful methodology in a variety of fields. The Fuzzy logic System's four fundamental components.

- a) Fuzzification interface
- b) Rule bases
- c) Decision-making logic
- d) Defuzzification interface. (J. Sarkar, 2021).

Because it offers representation and inference than imprecise information, Fuzzy logic is employed in expert systems to manage uncertainties and ambiguities. In the realm of medicine, diagnosis criteria and treatment plans for diseases are mostly based on imprecise and ambiguous data such as patient data, medical history, laboratory test results, and physical check reading (I.K. Mujawa, 2019). Data is collected as of many other means like X-ray Ultrasonic, another medical finding, sometimes patients unclear, partial and more than reality answer. The use of Fuzzy Logic concepts in the improvement of expert System of the health field increases enormously. These Systems prove complete tools for people of the similar then associated fields (Cho, N.H., 2018).

To detect various medical disorders based on clinical symptoms, most expert systems are constructed utilizing diverse methodologies for example rule based expert system, Fuzzy Expert system, Artificial neural networks, adaptive Neuro Fuzzy Expert system (V. Bhandari, 2015).

Methodology used for a mamdani type Fuzzy inference System.

Step 1: Gather the facts from the doctors.

Step 2: Call the FIS function to generate a Fuzzy expert System.

- a) Carry out task.
- b) Input data gathered from physicians.
- c) Convert input crisp numbers like age, type review, to language variables like low, moderate, and high.
- d) Choice different membership functions used for many input values.
- e) Write rules that apply toward these membership functions.
- f) Defuzzify linguistic variables transforming them to crisp values.
- g) Until all inputs have been categorized correctly.

Step 3: Create a confusion matrix to evaluate the system's precision, sensitivity, and specificity (J Singla, 2014).

One of the strongest branches of Artificial Intelligence (AI), which has emerged as the most important branch of computer science, is Expert Systems (ES). The purpose is to

identify specific issues in an area by obtaining, assembling, analyzing, and reusing information and knowledge from human specialists in the field and putting it into the system (F. Anjara, 2019).

These methods can handle the challenges in this area without totally relying on specialists to diagnose their difficulties by constraining the symptom and criteria information collected. (S. S. A. Naser, 2016. T. Winanto, 2019).

In the absence of human competence, an expert system is a subset of applied artificial intelligence that is widely employed to provide an expert opinion (S. Karthika, 2018). FES will tackle a real-world complex challenge because there are no experts in a particular field. (Cavallaro, F, 2015).

FES is a fuzzy data and ambiguity assessment expert system. Human specialists preserve their knowledge in verbal words in the real world. As a result, using fuzzy rules to express information and fuzzy inference methods is completely natural. The structure of the FES is comparable to that of fuzzy logic controllers (N. Allahverd, 2011). Fig.1. shows the Fuzzy Expert System.

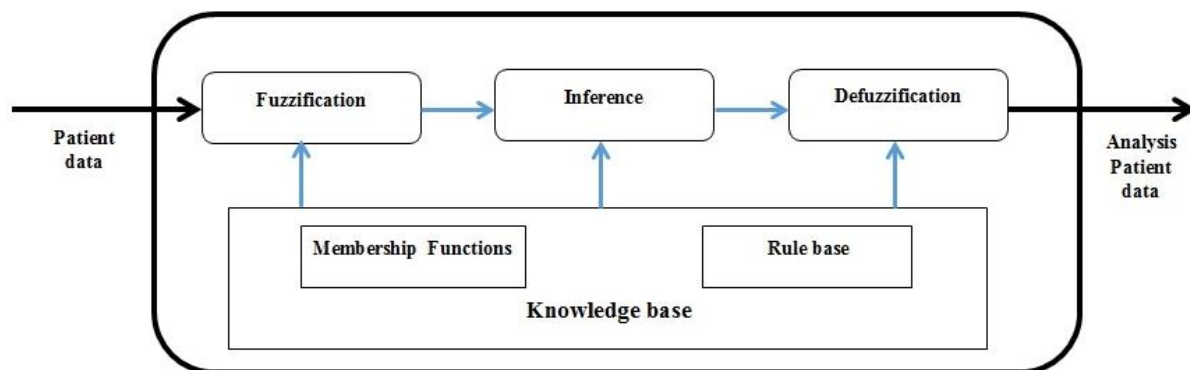


Fig. 1 Shows the fuzzy expert system schema

Methodology

1. Research Importance

The study focuses on developing a fuzzy expert system for analyzing patient data for government and private hospitals by utilizing the features of fuzzy logic, such as the use of natural language in data analysis that is simple for medical staff to understand.

2. Application Part

In this work, we assume age (Elderly, boy, kid) and the type of review. Therefore, these four parameters will stay used such as inputs for the intended system. Therefore, the patient's data is analyzed by these data, the type of cure process will be determined. Three categories of care will be used (intensive care, medium care, no care).

The validity value for each rule is determined by creating 9 fuzzy rules (Table 1).

Table 2.1 Shows 9 fuzzy rules

Rules	Inputs		Outputs
	Age	Type Review	
Rule 1	boy	surgical operation	Intensive care
Rule 2	boy	Check	No care
Rule 3	boy	Medical consultation	No care
Rule 4	Elderly	surgical operation	Intensive care
Rule 5	Elderly	Check	Mid care
Rule 6	Elderly	Medical consultation	Mid care
Rule 7	kid	surgical operation	Intensive care
Rule 8	kid	Check	Mid care
Rule 9	kid	Medical consultation	No care

- if age is boy And type is surgical operation Then Intensive Care
- if age is boy And type is Check Then No Care
- if age is boy And type is Medical consultation Then No Care
- if age is Elderly And type is surgical operation Then Intensive Care
- if age is Elderly And type is Check Then Mid Care
- if age is Elderly And type is Medical consultation Then Mid Care
- if age is kid And type is surgical operation Then Intensive Care
- if age is kid And type is Check Then Mid Care
- if age is kid And type is Medical consultation Then No Care

The mamdani technique is employed as the inference method.

The strength degrees (a) for both rules rendering to mamdani max-min rule are presented with formulas below.

$$a_1 = \min(\text{boy}(x), \text{surgical operation}(y), \text{Intensive care}(z))$$

$$a_2 = \min(\text{boy}(x), \text{Check}(y), \text{No care}(z))$$

$$a_3 = \min(\text{boy}(x), \text{low}(y), \text{No care}(z))$$

...

$a_5 = \min(\text{kid}(x), \text{Check}(y), \text{Mid care}(z))$

...

$a_9 = \min(\text{Elderly}(x), \text{Medical consultation}(y), \text{No care}(z))$

The maximum strength degrees of the started rules are calculated by the formulas below.

$a_{1,2,\dots,n} = \max(a_1, a_2, \dots, a_n)$

Now defuzzification, the exact look is obtained with the “centroid” process according to the strength degree. Matlab is software suite used for design system. A user friendly interface is counted in design to make entering patient data into the system easier.

Results and Discussion

After establishing the fuzzy expert system and analyzing patient data in public and private hospitals. Two experiments were carried.

First is to search and analyze data without using Fuzzy expert system.

Second is to use Fuzzy expert system to search, analyze data.

First experiment. We can see from (table.3.1) that the research was carried out and the results were analyzed without the use of the fuzzy expert system. The research and data analysis results are unclear, and the medical staff does not benefit from them, which has an impact on the provision of medical support and diagnosis to patients.

Table 3.1 Shows search without fuzzy logic

patientName	patientAge	Type Name	age	patient Address	ReservDate
Ali Adnan ali	20.00	Check	Kid	ALnoor	2/1/20 12:00:00 AM
Mahmoud Abbas	32.00	Surgical operation	Boy	Domez	2/1/20 12:00:00 AM
Haifa Hussein	17.00	Medical consultation	Kid	ALnada	2/1/20 12:00:00 AM
Safi Mohammed	60.00	Surgical operation	Elderly	ALwasiti	2/1/20 12:00:00 AM
Alana Kazan	45.00	Medical consultation	Elderly	Ronike	2/1/20 12:00:00 AM
Lilia haram	10.00	Surgical operation	Kid	Domez	2/1/20 12:00:00 AM
Said Ismail	23.00	Medical consultation	Boy	ALnada	2/1/20 12:00:00 AM
Mauna Facial	38.00	Check	Boy	ALwasiti	2/1/20 12:00:00 AM
Ahmed realize	19.00	Surgical operation	Kid	Domez	2/1/20 12:00:00 AM
Kamal Abdullah	50.00	Medical consultation	Elderly	ALnada	2/1/20 12:00:00 AM
Abram Adel	26.00	Check	Boy	ALwasiti	2/1/20 12:00:00 AM
Sabah Hat am	05.00	Surgical operation	Kid	Ronike	2/1/20 12:00:00 AM
Serag Kadar	57.00	Surgical operation	Elderly	ALnoor	2/1/20 12:00:00 AM
Assad Mustafa	27.00	Medical consultation	Boy	Domez	2/1/20 12:00:00 AM

Second experiment. We note from the table that the search and data analysis were conducted using the Fuzzy Expert system. The result of the research and data analysis is clear and easy to interpret by the medical staff because one of the features of this system is its use of natural language in interpreting the results, which leads to providing the required medical support and diagnosis.

Table 3.2 Shows search fuzzy logic

patient Name	patientAge	Type Name	age	patient Address	ReservDate	fuzzy
Ali Adnan ali	20.00	Check	Kid	ALnoor	2/1/20 12:00:00 AM	No care
Mahmoud Abbas	32.00	Surgical operation	Boy	Domez	2/1/20 12:00:00 AM	Intensive care
Haifa Hussein	17.00	Medical consultation	Kid	ALnada	2/1/20 12:00:00 AM	No care
Safi Mohammed	60.00	Surgical operation	Elderly	ALwasiti	2/1/20 12:00:00 AM	Intensive care
Alana Kazan	45.00	Medical consultation	Elderly	Ronike	2/1/20 12:00:00 AM	Mid care
Lilia haram	10.00	Surgical operation	Kid	Domez	2/1/20 12:00:00 AM	Intensive care
Said Ismail	23.00	Medical consultation	Boy	ALnada	2/1/20 12:00:00 AM	No care
Mauna Facial	38.00	Check	Boy	ALwasiti	2/1/20 12:00:00 AM	No care
Ahmed realize	19.00	Surgical operation	Kid	Domez	2/1/20 12:00:00 AM	Intensive care
Kamal Abdullah	50.00	Medical consultation	Elderly	ALnada	2/1/20 12:00:00 AM	Mid care
Abram Adel	26.00	Check	Boy	ALwasiti	2/1/20 12:00:00 AM	No care
Sabah Hat am	05.00	Surgical operation	Kid	Ronike	2/1/20 12:00:00 AM	Intensive care
Serag Kadar	57.00	Surgical operation	Elderly	ALnoor	2/1/20 12:00:00 AM	Intensive care
Assad Mustafa	27.00	Medical consultation	Boy	Domez	2/1/20 12:00:00 AM	No care

Conclusion

Despite all of the methods of medical analysis and diagnosis, correct analysis and diagnosis are still considered an art because it necessitates mastery as well as experience dealing with uncertainty. Despite the fact that medical science's bounds have considerably grown in our automated day, you cannot easily overcome this doubt. The aim of this work to create Fuzzy expert System for analyzing patient data in public and private hospitals. The Fuzzy expert System is a system allows you to make decisions based on your These tables show that there are some situations of data analysis for patients that require knowledge in order to provide accurate medical support and advice, and among these examples are the data of patients, both young and old, and those who have undergone procedures. and individuals who have had surgery This feature is found in the relaxed system, which uses natural language to analyze and interpret patient data and is simple and flexible to understand by inexperienced medical personnel as well as newcomers to the medical field, allowing them to provide accurate medical support and advice in the shortest amount of time and with the greatest efficiency. and individuals who have had surgery This feature is found in the relaxed system, which uses natural language to analyze and interpret patient data and is simple and flexible to understand by inexperienced medical personnel as well as newcomers to the medical field, allowing them to provide accurate medical support and advice in the shortest amount of time and with the greatest efficiency.

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