

Research Article

Design of Medicine Prescription Pattern using Fuzzy Logic in Case of Minor Ailments

Randhir J. Patil** and Pravin S. Bidkar

†Department of Electronics and Telecommunication, Sanjay Ghodawat Institute, Kolhapur, India

Accepted 12 June 2016, Available online 16 June 2016, Vol.6, No.3 (June 2016)

Abstract

Fuzzy logic is a science of knowledge representation suitable for notions that cannot be defined precisely, but which depends upon their context. In this paper, design of a generic medicine prescription pattern is proposed using fuzzy logic. Minor ailments such as Fever, Cough, Cold, Diarrhea, Burn, Acidity, Body pain, Headache, Skin disorders etc. is investigated. Various findings of investigation are used as respective components in building of fuzzy inference system. The rule base for inference is designed using knowledge of medicine expert.

Keywords: Fuzzy Logic, Fuzzy set theory, Medicine Prescription

1. Introduction

In field of medical science, use of computer based applications is consistently increasing. However there are certain issues such as medicine prescription that needs intensive help of computer applications. According to a survey, it is stated by [Pankaj Agarwal *et al*, 2012; Pragnadyuti Mandal *et al*, 2013] that prescription and medication errors is harsh reality in India. Medication error can occur anywhere in the health care system from prescriber to dispenser to administration and finally to patient use, the simple truth is that many errors are preventable. There are certain precaution that has to be taken. This includes hand writing-must be clear, spelling of medicine name-must be correct, formulation and strength of medicines-should be quoted clearly, abbreviation of medicine name should be avoided, leading zero should always be used, capital letter-should be used. (Pankaj Agarwal *et al*,2012 ; Sujata Sapkota *et al*, 2011)

In case of minor ailments patient avoids to consult with doctors. Such possibilities occur due to self confidence of medication or emergency situations where doctor's availability for consultancy is not possible. This situations leads to self medication or consultancy from non medico person or family member. Self medication and other conditions may leads to serious health care problems. The charts in figure 1 and figure 2 shows preference of doctors in case of minor ailments and patient's conditions respectively. Thus there is need for quality, safe and sophisticated healthcare application which has become

the primary objective of most countries in the world, especially of developing countries like India (Pragnadyuti Mandal *et al*, 2013).

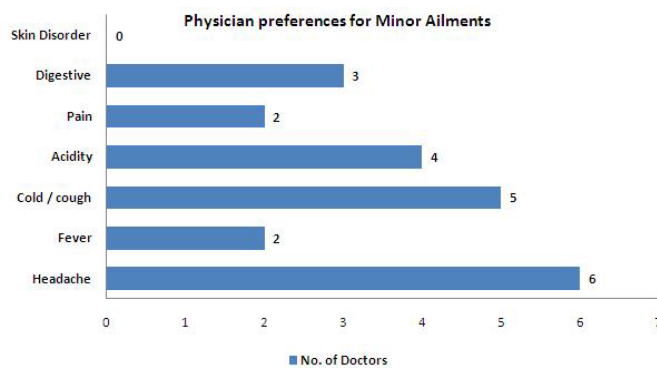


Fig.1 Physician preference chart for minor ailments

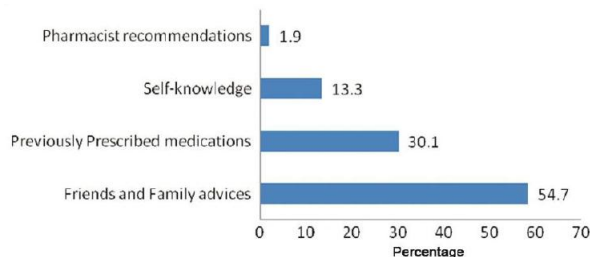


Fig.2 Patient reference chart for medication

2. Building Blocks of Fuzzy Logic

Basic building blocks for design of fuzzy system includes membership function, inference engine, fuzzy

*Corresponding author: **Randhir J. Patil**

rule base etc. membership function (MF) strictly depends on nature of system to be design. It is used to model the input and output parameters of system. Rule base is a support database for inference engine. It maps the input with output with some weight assign to them. (Nguyen Hoang Phuong et al, 2001; M. Mahfouf et al, 2001)

2.1 Membership Function

Membership Function (MF) is a curve that defines how each point in the input space is mapped to a membership value (or degree of membership) between 0 and 1. The input space is sometimes referred to as the universe of discourse.

- 1) Fuzzy sets describe vague concepts (e.g., body temperature is low, patient is young).
- 2) A fuzzy set admits the possibility of partial membership in it. (e.g., skin burn is sort of third degree, Diarrhea is sort of hard stool constipation).
- 3) The degree an object belongs to a fuzzy set is denoted by a membership value between 0 and 1. (e.g., body temperature of 1000 F is high grade fever with degree of membership 0.7).
- 4) A membership function associated with a given fuzzy set maps an input value to its appropriate membership value.

2.2 if-then Rules

Fuzzy rule base is designed with help of logical operators such as and, or, not. These if-then rule statements are used to formulate the conditional statements that comprise fuzzy logic. Interpreting if-then rules is a three-part process (Timoyht J. Ross et al, 2011; D Driankov et al, 2001)

- 1) Fuzzify inputs
- 2) Apply fuzzy operator
- 3) Apply implication

2.3 Fuzzy inference process

A fuzzy inference is a stepwise process from fuzzification through defuzzification. .(Timoyht J. Ross et al, 2011; D Driankov et al, 2001).

- 1) Fuzzify Inputs: The first step is to take the inputs and determine the degree to which they belong to each of the appropriate fuzzy sets via membership functions.
- 2) Apply Fuzzy Operator: After the inputs are fuzzified, you know the degree to which each part of the antecedent is satisfied for each rule. If the antecedent of a given rule has more than one part, the fuzzy operator is applied to obtain one number that represents the result of the antecedent for that rule.

- 3) Apply Implication Method: Before applying the implication method, you must determine the rule's weight. Every rule has a weight (a number between 0 and 1), which is applied to the number given by the antecedent. Generally, this weight is 1 (as it is for this example) and thus has no effect at all on the implication process.
- 4) Aggregate all output: Aggregation is the process by which the fuzzy sets that represent the outputs of each rule are combined into a single fuzzy set.
- 5) Defuzzify: The input for the defuzzification process is a fuzzy set (the aggregate output fuzzy set) and the output is a single number. As much as fuzziness helps the rule evaluation during the intermediate steps, the final desired output for each variable is generally a single number.(Timoyht J. Ross et al, 2011; D Driankov et al, 2001)

The overall building block can be understood by figure 3. This figure also describes how the prescription pattern is mapped to fuzzy logic process. Each step has its unique significance so as to replicate notion of medicine prescription intelligence in case of minor ailments. Every symptom considered in this paper has its unique fuzzy inference system which discriminate their investigation process.(Timoyht J. Ross et al, 2011)

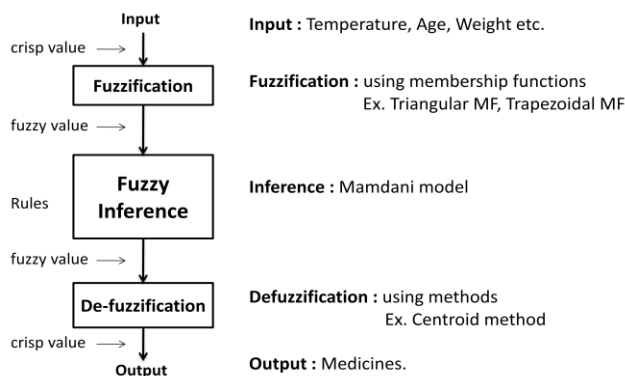


Fig.3 Fuzzy inference process

3. Proposed architecture

The main idea behind this project is to avoid wrong medication and to help medical interns by replicating the prescription pattern used by experts. Block diagram for proposed architecture is shown in figure 4.

The process of medicine prescription starts from selection of symptom by user. Selected symptom activates the corresponding FIS system. As user specifies the values (crisp) for input variable depend on selected symptom, the inference engine starts so as to give output value. Depend upon this output value (crisp) system lookup for medicine in database. Thus user will get desired medicine. If provision is given for print of prescription on GUI, user will get hard copy prescription.

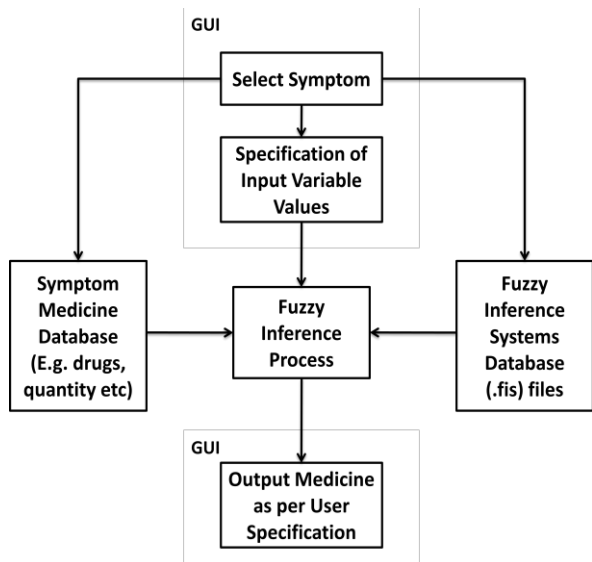


Fig.4 Block architecture

Next section describes how the FIS system for corresponding symptom executes.

4. Symptom inference engine

There are ten symptoms considered in this paper. Each symptom has its unique input and output variables. The entire input variables are mapped by membership functions such as triangular, trapezoidal, Gaussian functions etc. table 1 below shows various input variable for corresponding symptom.

User has to input crisp value as per input variables. Each symptom FIS system has age and weight as common input variables. Temperature value ranges between 970F to 1040F in case of fever. All other input values have to be given as per severity rating which ranges from 0 to 10. Description of FIS working is given in figure 5 and figure 6

Table 1. Specification of input variables

Sr. no.	FIS System	Input variables				Output
		Input1	Input2	Input3	Input 4	
1	Acidity	Age	Weight	Severity	----	Medicine
2	Burn	Severity	Age	----	----	Medicine
3	Cold	Watery nose	Age	Sneezing	----	Medicine
4	Cough	Dry	Age	Wet	----	Medicine
5	Diarrhea	Hard stool	Age	Weight	Loose motion	Medicine
6	Fever	Temperature	Age	Weight	----	Medicine
7	Headache	Severity	Age	----	----	Medicine
8	Pain	Joint pain	Age	Muscle pain	----	Medicine
9	Vomiting	Age	Weight	----	----	Medicine
10	Skin	Irritation	Age	Itching	----	Medicine

Consider selected symptom is fever. If FIS system has two rules viz

- if temperature is low and age is teen then medicine is tablet.
- if temperature is high and age is adult then medicine is syrup.

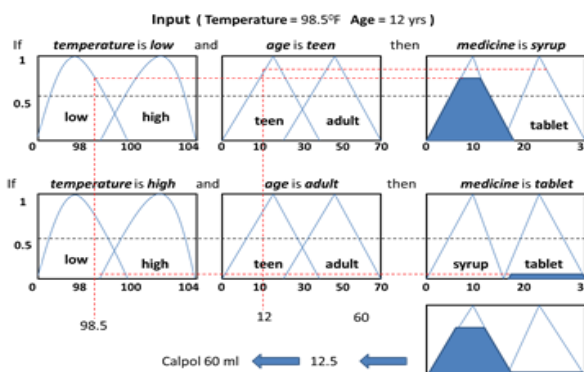


Fig.5 Evaluation of FIS condition 1

Here temperature is modeled by gaussian MF and age is modeled by triangular MF. Both rules are evaluated using *and* operator. Defuzzification is accomplished by aggregation followed by centroid calculation.

Consider another condition where symptom is fever but rules are changed as follows

- if temperature is low or age is teen then medicine is syrup.
- if temperature is high and age is adult then medicine is tablet.

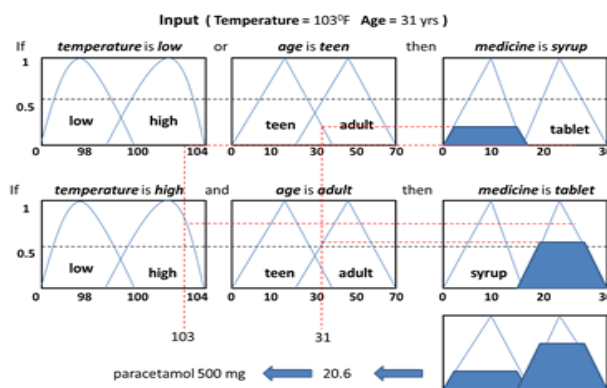


Fig.6. Evaluation of FIS condition 2

Here temperature is modeled by gaussian MF and age is modeled by triangular MF. First rules is evaluated using *or* operator while second rule is evaluated by *and* operator. Defuzzification is accomplished by aggregation followed by centroid calculation.

5. Results

System is implemented in MATLAB using fuzzy logic toolbox. Medicine prescribed by system for various conditions are mentioned in table 2.

Table 2 Specification of input variables

no.	Symptoms	Input	Input	Input	Medicines Prescribed by system	Medicines Prescribed by doctors
		1	2	3		
1	Headache	Severity = 6	Age = 60	----	Paracetamol	Paracetamol
2	Fever	Temperature = 99° F	Age = 20	Weight = 40	Antipiratic	Azitromicine/ antipiratic
3	Fever	Temperature = 100° F	Age = 27	Weight = 60	Combiflam 100 mg	Crocine 100mg
4	Cold	Watery nose = 8	Age = 27	Sneezing = 2	oneAH 350 mg	oneALmax 100 mg
5	Cold	Watery nose = 2	Age = 27	Sneezing = 9	oneALmax 100 mg	OneAlmax 100 mg
4	Skin	Irritation 8	Age 25	Itching = 1	Opox CV	Opox
5	Skin	Irritation 1	Age 30	Itching = 8	Zadro 250 mg	Zadro 250 mg

Acknowledgment

I am highly indebted to my guide Dr.S.A.Pardeshi for his valuable guidance. Special thanks to member of Sanjay Ghodawat Institute, Kolhapur, India for their kind co-operation and encouragement. I would like to express my heartfelt thanks to my beloved parents, for their blessings and constant support.

References

Pankaj Agrawal, Ajay Sachanb, Rajeev K Singlac, Pankaj Jain(2012) Statistical Analysis of Medication Errors in Delhi, India Indo Global Journal of Pharmaceutical Sciences, Vol. 1 Issue 1 pp 88-97
 Sujata Sapkota*, Nawin Pudasaini, Chandan Singh, Sagar Gc(2011) Drug Prescribing Pattern And Prescription Error In Elderly: A Retrospective Study Of Inpatient Record, Asian Journal of Pharmaceutical and Clinical Research Vol. 4, Issue 3.

Pragnadyuti Mandal, Swapan Jana, Balaram Ghosh, Souvik Ghosh, Indrani Dalal & Kamal Krishna Kundu(2013) An Assessment of Legibility and Accuracy of Prescriptions through Prescription Surveys, IOSR Journal of Nursing and Health Science (IOSR-JNHS) Volume 1, Issue 5 Aug 2013, PP 01-03
 Nguyen Hoang Phuong , Vladik Kreinovich (2001)Fuzzy logic and its applications in medicine International Journal of Medical Informatics 62, pp 165–173
 M. Mahfouf, M.F. Abbod, D.A. Linkens (2001) A survey of fuzzy logic monitoring and control utilisation in medicine Artificial Intelligence in Medicine, Vol.21 pp 27±42
 Timoyht J. Ross (2011) Fuzzy Logic With Engineering Application 3rd edition Wiley India Publication, 2011.
 D Driankov, H Hellendoorn, M Reinfrank (2001) An Introduction to Fuzzy Control Narosa publication.