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Recognition and Cure Time Prediction of Swine Flu, Dengue and Chicken Pox using Fuzzy Logic

Ravinkal Kaur[1], Virat Rehani[2]

[1]*M.tech Student, Dept. of CSE, CT Institute of Technology & Research, Jalandhar, India*
[2]*Assistant Professor, Dept. of CSE, CT Institute of Management & Information Technology, Jalandhar, India*

Abstract - *Healthcare is the maintenance of health via the diagnosis, treatment, prevention of disease and illness. With diseases like swine flu and dengue fever, chicken pox, on the rise, which have symptoms, are so closely associated that it sometimes become practically Herculean task to differentiate between the above-scribed diseases based on symptoms. Thus, it becomes inevitable to design such a system that would closely monitor the symptoms and infer the disease based on FIS (fuzzy inference system). We do this by assigning different coefficients to each symptom of a disease and to predict and quantify the severity impact of the recognized disease. For predicting the cure time of a disease, based on the symptoms. Perdition of cure time is clinically based on hypothetic studies and to estimate the cure time of a disease based on the symptoms. We also infer the current medical condition of a user relative to people who have suffered from the same disease.*

Key Words: Medical, Fuzzy Logic, Fuzzy inference model, Mamdani Model, GUI, De-fuzzification.

1. INTRODUCTION

Fuzzy logic was advanced in 1965 by Dr. Lotfi Zadeh a professor at the University of California, Berkley. One kind of uncertainty is fuzziness that is no sharp transition from complete membership to non-membership. In human reasoning much of the logic is not based on two values, it is not even multi-valued but fuzzy truth. In conventional logic everything is considered true or false, black or white but nothing in between.

The Fuzzy logic idea is similar to the human being's feeling and inference process which is a point-to-point control or range-to-range control. The output of a fuzzy controller is borrowed from fuzzifications of both inputs and outputs using the identify membership functions. A crisp input will be transformed to the different members of the identity membership functions established on its value. From this point of view, the output of a fuzzy logic controller is established on its memberships, which can be tested as a range of inputs.

The idea of fuzzy logic was advanced by Dr. Lotfi Zadeh of the University of California at Berkeley in 1965. This development was not well recognized until Dr. E. H. Mastrategymdani who is a professor at London University, related the fuzzy logic in an applied application to control an automatic steam engine in, which is approximately ten years after the fuzzy theory was created. To control cement kilns in 1976, Blue Circle Cement and SIRA in Denmark established an industrial application. That system began to operation in 1982. Fuzzier implementations have been since the 1980s, along with those utilizations in industrial manufacturing, automobile production, banks, hospitals and academic education. The main aim is to construct a control system that will provide good transient and steady state reply of the system. Fuzzy logic develops into a standard technology and is also applied in data and sensor signal analysis. Fuzzy logic has verified to be a powerful tool for decision-making systems, such as expert systems and pattern classification systems. Dr. Zadeh was working on the difficulty of computer understanding of natural language.

Formation of the fuzzy knowledge base in MATLAB can be done using a tool Fuzzy Logic Toolbox [2]. The Toolbox is a suite of software applications that make up the environment Matlab. It allows you to create fuzzy inference system and fuzzy classification in the environmental MATLAB, i.e., functionally driven to the formation of versatile classification for data systems. The base element in the Collection is the FIS-structure, i.e. the Fuzzy Inference System. FIS-structure contains the necessary functional blocks for implementation of fuzzy inference [3].

The Medical Diagnosis System takes input in the form of symptoms and gives output in the form of a particular disease. The fuzzy rules used in the system are based on expert knowledge.

2. BACKGROUND AND RELATED WORKS

Schuh C. et al. proposed for increasing the efficiency and reliability of health care delivery that holds great promise in fuzzy logic which is still a largely untapped area in medicine. For encapsulating the subjective decision-making process Fuzzy logic provides an algorithm which is suitable for computer implementation [5].

Imran M. et al. proposed that the designed system can be extended to any number of inputs. On the inputs like protein, red blood cell, lymphocytes, neutrophils and eosinophils on which the normal, hemorrhage and the brain tumor are depended. As the inputs are the blood cells and the designed system use five blood cells as inputs, similarly more than five inputs may be defined to get more efficient human diagnose results. The design work is being carried out to design the art fuzzy logic medical diagnosis control system in future using FPGAs [6].

Kumar M. et al. developed following membership functions, input variables, output variables and rule base that are used in a fuzzy expert system to diagnose the heart disease. There are six input variables and output variables. With expert-doctor, the designed system has been tested. A person with any heart disease risk or not is also checked out in this system. For the diagnosis of heart diseases analysis, this is one of the simple and more efficient methods [8].

Mfon M. et al. developed a proposed fuzzy framework for cholera diagnosis and monitoring. The designed system can be increased to any number of inputs. The following membership functions like No cholera, mild cholera, moderate cholera and severe cholera all depend on the inputs diarrhea, vomiting and dehydration. We can define this system for any number of inputs. To achieve more efficient human diagnose and monitoring result, the system can be defined with more than three inputs [10].

Baruah N. et al. described the designed expert system has been tested with some set of values of patient's vital signs. This system describes a design of a fuzzy expert system for determination of the risk level of the patient, which can be used in any situation when it is necessary to predict the health status of the patient [14].

Shankar M. et al. mentioned the predicting diseases and their respective cure time based on the symptoms. The main focus was on the classification of symptoms based on their severity and importance and using this knowledge to calculate a numerical value to identify diseases. Although the method was tested in a limited environment with high accuracy, it can be extended to larger settings. Apart from this, we also estimated the cure time of a disease based on the experiences of other patients. We also provide a severity rating for the current condition, relative to the other users with similar symptoms [18].

3. PROPOSED METHODOLOGY

- The theoretical framework of a decision making (if-then) system for defining the proper design of object-oriented software.
- The basic concept of fuzzy logic.

Theoretical framework: Online primary medical aid symptoms evaluation implies pointing out of those symptoms that are relevant for the analysis of disease and then infer from the database/rule-base the possible disease. Hence, the framework is comprised of three metals:

- The dataset for the symptoms.
- Design principles.
- Relevant inference.

Fuzzy logic: The term Fuzzy logic is a method to calculate a solution based on "degree of truth". The concept was advanced by Dr. Lotfi Zadeh of the University of California at Berkeley in the 1960s. Dr. Zadeh was going through the concept of computer understanding natural language, which is not obviously translated into the discrete terms of 0 and 1 [3]. Fuzzy logic consists of 0 and 1 as horizons of truth (or "the state of matters"), it also contains the various states of truth in between, for example, the result of identification between two things could be not "tall" or "short" instead it is.

Assigning weight: Weighting factors are estimated values indicating the relative impact of each item in a group as compared to the other items in the group. Work priorities are established with the purpose of assigning weighting factors. The simplest way is to consider a standard fixed weight to your data set according to the specified criteria. Each individual response can then be compared to this standardized weight.

ASSIGNING: A

- Low=3
- Med=2
- High=1

$$O[W] = \frac{Values[symptom1 + symptom2 + \cdots + symptom\ 6]}{6}$$

Adding up all the values of "6" inputs of symptoms. We divide the sum by "6" to get the average value. The structure of a fuzzy rule can be divided into two parts: an if-part (also referred to as the antecedent part) and a then-part (also referred to as the consequent part)

IF<antecedent>THEN<consequent>

The antecedent describes a condition whereas consequent describes a conclusion. Fuzziness helps to evaluate the rules, but the final output of the fuzzy system has to be a crisp number. De-fuzzification is used to convert the fuzzy set value into a crisp set output. The principle of this system has two major components which are symptoms as input and the output as a disease.

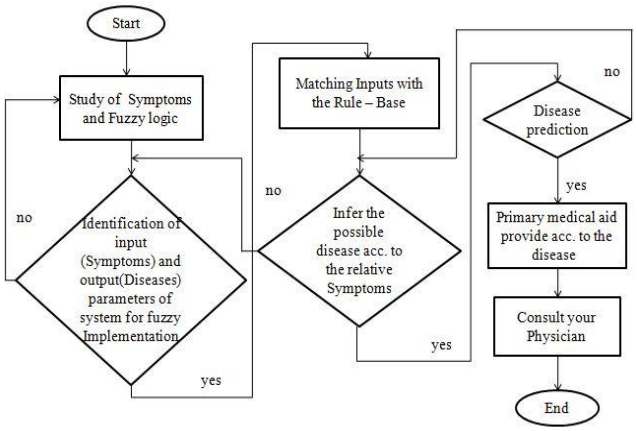

Fig -1: Graphical layout of the working of the system

4. MEDICAL DIAGNOSIS SYSTEM

4.1 Fuzzy Interface System

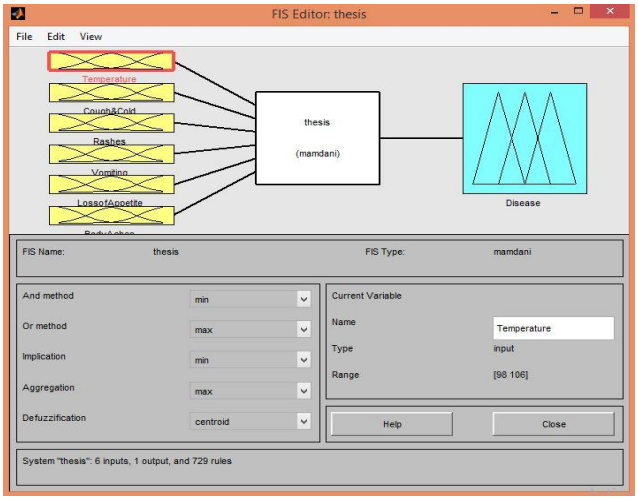

Fig -2: Fuzzy Inference System

To design a Fuzzy Diagnosis System, Fuzzy Inference System (FIS) Toolbox in MATLAB is a very powerful Graphical User Interface (GUI). The FIS Editor displays instruction about a fuzzy inference system. There's a simple diagram at the top that shows the names of each inputs on the left and those of each outputs on the right. However, the number of inputs may be limited by the available memory of your machine.

4.2 Membership Function Editor

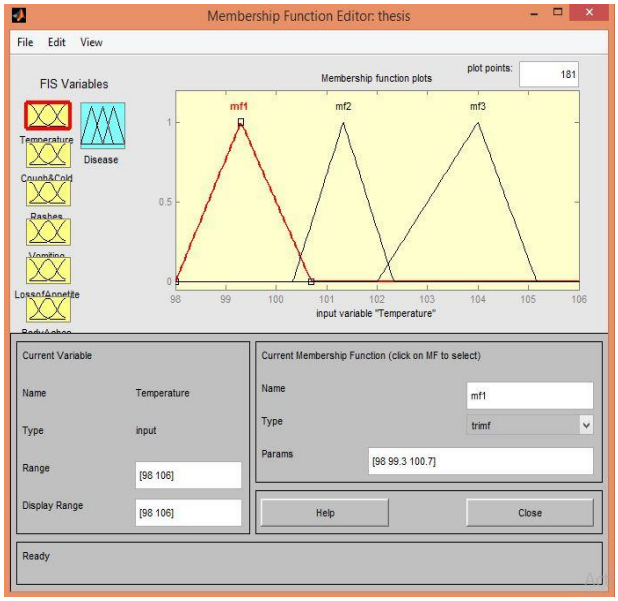

Fig -3: Membership Function Editor

Figure 3 is to define the shapes of all the membership functions associated with each variable. The sample membership functions shown in the boxes are just icons and do not depict the actual shapes of the membership functions.

The Membership Function Editor is the tool that lets you display and edits all of the membership functions for the integrated fuzzy inference system, including both input and output variables.

4.3 Rule Editor

Rule Editor is for editing the list of rules that defines the behavior of the system. The Rule Editor consists of a large editable text field for displaying and editing rules. Rule Editor is also has some familiar landmarks similar to those in the FIS (fuzzy inference system) Editor and Membership Function Editor, including the menu bar and the status line.

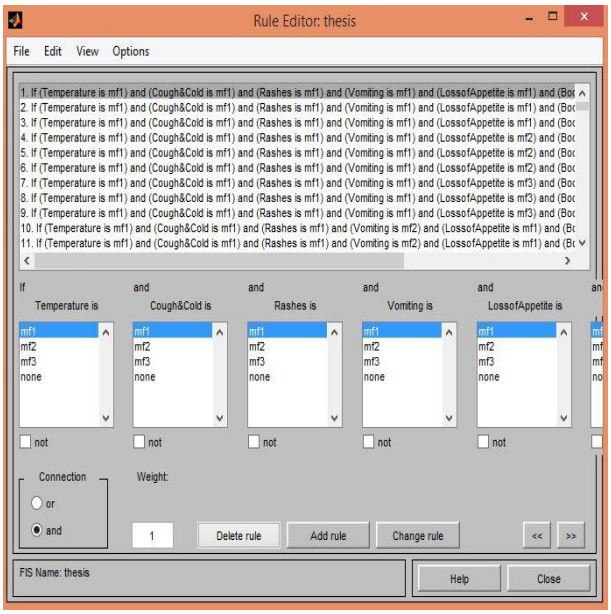

Fig - 4: Ruler editor

4.4 Rule Viewer

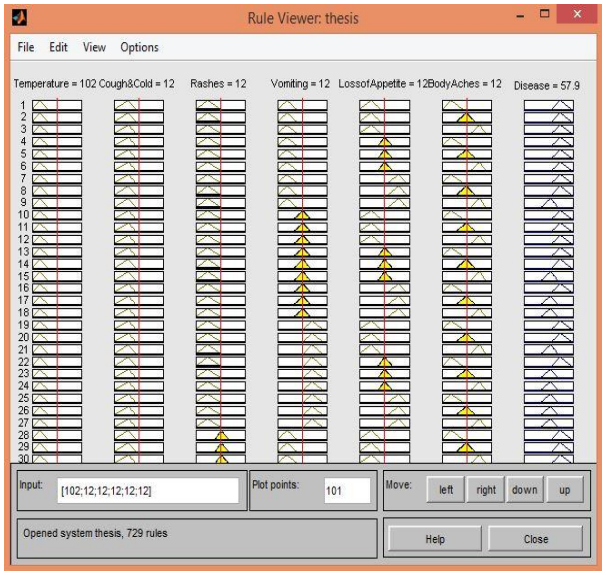

Fig -5: Rule Viewer

Rule Viewer to view the fuzzy inference diagram. Use this viewer as a diagnostic to see for example, the individual membership function shapes significance the results. The Rule Viewer displays the instructions of the whole fuzzy inference process. In addition, there are the now intimate items like the status line and the menu bar. In the lower right, there is a text field where you can enter a specific input value.

4.5 Surface Viewer

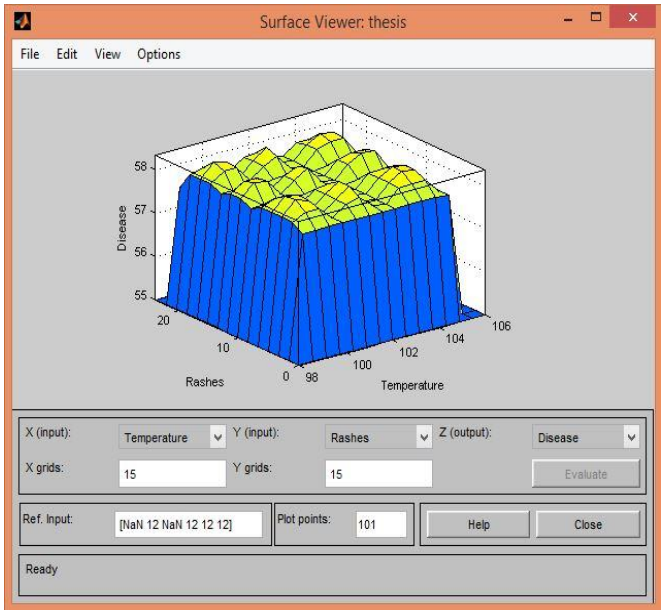

Fig - 6: Surface Viewer

Surface Viewer to view the dependency of one of the outputs on any one or two of the inputs-that is, it generates and plots an output surface map for the FIS (fuzzy inference system). It generates a 3-d surface from two input variables and one output variable of a FIS.

5. CONCLUSION

Fuzzy logic is used for medical diagnosis of a wide range of diseases. This work proposed a methodology to capture the experience of expert physicians. It can be used to provide diagnosis decisions in fuzzy inference system techniques. Complete agreement with the diagnosis of human expert specialists has been obtained in many experiments with different input symptoms by various researchers. Fuzzy logic provides an alternative way to represent linguistic and subjective attributes or variables. It is ready to be applied to control systems and other applications in order to improve the efficiency and simplicity of the design process.

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BIOGRAPHIES

Ravinkal Kaur, is pursuing M.TECH final year in department Computer Science Engineering at CT Institute of Technology and Research, Jalandhar. She has done her B.TECH in trade Information Technology from CT Group of Institute. Her topic of research is fuzzy logic, fuzzy K-NN approach for regcognition the disease.