Volume 2, No. 6, Nov-Dec 2011

ISSN No. 0976-5697

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

A Fuzzy Expert System for Cancer Diagnosis

Chaitali S.Suratkar*
ME Student of CE,
SIPNA's College of Engineering & Technology,
Amravati (MS), India
chaitalis_16@rediffmail.com

Prof. V. T. Gaikwad
Associate Professor,
Dept of CSE,
SIPNA's College of Engineering & Technology,
Amravati (MS) India

Abstract: In this paper, fuzzy expert systems explained that is capable of mimicking the behavior of a human expert. Fuzzy approach is useful to detect the region of various type of cancer from the original image by performing erosion operation. It is also helpful to determine need for the biopsy and it gives to user a clear idea of spread and severity level of cancer. A fuzzy expert system is design for diagnosing, analyzing and learning purpose of the cancer diseases. For this process suppose for prostate cancer it use prostate specific antigen (PSA), age and prostate volume (PV) as input parameters and prostate cancer risk (PCR) as output. This system allows determining if there is a need for the biopsy and it gives to user a range of the 1risk of the cancer diseases. An automated algorithm approach, based on quantitative measurements, is a valuable tool to a pathologist for verification of colon cancer image abnormalities for effective treatment. The system fuzzifies image feature descriptors and incorporates a clustering paradigm with neural network to classify images. The novelty of the algorithm is that it is independent of the feature extraction procedure adopted and overcomes the sharpness of class characteristics associated with other classifiers. It incorporates feature analysis and differs markedly from other approaches which either ignore them or perform them as separate tasks prior to classification.

I. INTRODUCTION

In many image processing applications, use the expert knowledge to overcome the difficulties (e.g. object recognition, scene analysis). Fuzzy logic has rapidly become one of the most successful of today's technologies for developing sophisticated control systems. The reason for which is very simple. Fuzzy logic addresses such applications perfectly as it resembles human decision making with an ability to generate precise solutions from certain or approximate information. Fuzzy set theory and fuzzy logic offer us powerful tools to represent and process human knowledge in form of fuzzy if-then rules. Fuzzy logic has rapidly become one of the most successful of today's technologies for developing sophisticated control systems.

The reason for which is very simple. Fuzzy logic addresses such applications perfectly as it resembles human decision making with an ability to generate precise solutions from certain or approximate information. It fills an important gap in engineering design methods left vacant by purely mathematical approaches (e.g. linear control design), and purely logic-based approaches (e.g. expert systems) in system design. A fuzzy logic based method for prognostic decision making cancers are proposed. It is not quite possible to diagnose of cancer fully based on only ultrasonography and image processing. I have proposed a rule-based fuzzy expert system (FES) that uses the laboratory and other data and simulates an expert-doctor's behavior. As known when the prostate cancer can be diagnosed earlier, the patient can be completely treated. If there is a biopsy for diagnosing, the cancer may spread to the other vital organs. For this reason the biopsy method is undesirable. For example, as laboratory data, prostate specific antigen (PSA) and prostate volume (PV) and age of the patient are used in the prostate cancer diagnosis. Using this data and help from an expert-doctor, the fuzzy rules to determine the necessity of biopsy and the risk factor.

II. LITERATURE REVIEW & RELATED WORK

Many methods to diagnose lung cancer are exist a fuzzy expert system design for diagnosing, analyzing and learning purpose of the prostate cancer diseases was described. For this process it was used prostate specific antigen (PSA), age and prostate volume (PV) as input parameters and prostate cancer risk (PCR) as output [1]. This system allows determining if there is a need for the biopsy and it gives to user a range of the risk of the cancer diseases. There was observed that this system is rapid, economical, without risk than traditional diagnostic systems, has also a high reliability and can be used as learning system. A fuzzy rule based inference system to determine and identify lung cancer.

The proposed system accepts the symptoms as input and provides the confirmed disease and stage as the output it also calculates the membership function for both input as well as the output variable. Domain expert knowledge is gathered to generate rules and stored in the rule base and the rules are fired when there exists appropriate symptoms [2]. The features of fuzzy logic toolbox is used to implement the proposed system and is used as the medical diagnosis model for providing treatments to the patients as well as it can be used to assist the doctor. The design a Fuzzy Expert System for heart disease diagnosis [3]. The designed system based on the V.A. Medical Center, Long Beach and Cleveland Clinic Foundation data base. The system has 13 input fields and one output field. Input fields are chest pain type, blood pressure, cholesterol, resting blood sugar, maximum heart rate, resting electrocardiography (ECG), exercise, old peak (ST depression induced by exercise relative to rest), thallium scan, sex and age. The output field refers to the presence of heart disease in the patient. It is integer valued from 0 (no presence) to 4 (distinguish presence (values 1, 2, 3, 4)). This system uses Mamdani inference method. The results obtained from designed system are compared with the data in upon database and observed results of designed system are correct in 94%. The system designed in Matlab software. The system can be viewed as an alternative for existing methods to distinguish of heart disease presence. Often unwanted results are occurred in situations such as long drug treatment durations, for the treatments at which the drug doses are important and for the cases where observation of results of drug interactivity on the blood are required. As a result of wrong decision having done by the physicians, low or high dose drug treatment may result in longer treatment time and complications may occur. In this study, chronic intestine illness symptoms such as sedimentation and prostate specific antigen are used for the design of fuzzy expert system to determine the drug dose. [4].

The research presents an investigation into the development of system identification using intelligent algorithms. A simulation platform of a flexible beam vibration using finite difference (FD) method is used to demonstrate the capabilities of the identification algorithms. These identification approaches using (a) traditional Recursive Least Square (RLS) filter, (b) Genetic Algorithms (GAs) (c) Adaptive Neuro_Fuzzy Inference System (ANFIS) model[5] (d) General Regression Neural Network (GRNN) and (e)Bees Algorithm (BA). The above algorithms are used to estimate a linear discrete second order model for the flexible beam vibration [6].

Fuzzy image processing has three main stages: image fuzzification, modification of membership values, and, if necessary, image defuzzification [7,8].

III. ANALYSIS OF PROBLEM

Many times minor region affected by cancer are not spotted so that there is possibility of cancer .Again patient have to suffer from many problems . Both time and money are wasted for biopsy which detects only major portion of affected area of cancer.

Fuzzy logic sometimes appears exotic or intimidating to those unfamiliar with it, but once you become acquainted with it, it seems almost surprising that no one attempted it sooner. In this sense fuzzy logic is both old and new because, although the modern and methodical science of fuzzy logic is still young, the concepts of fuzzy logic reach right down to our bones.

Thus in this, the fuzzy system to take original image as the input image and erode the image by fuzzy logic to determine the region of various cancer such as in this, the fuzzy expert system use fore detecting region of basically cancer respectively.

IV. PROPOSED WORK

Fuzzy image processing is a collection of different areas of fuzzy set theory, fuzzy logic and fuzzy measure theory. The following topics represent the most important theoretical components of fuzzy image processing:

a.Measures of Fuzziness and Image Information Using Fuzzy Logic: If we understand an image (or its segments) as fuzzy sets, then we have to answer the question how fuzzy is the image. The increase or decrease of image fuzziness can be used in processing tasks such as enhancement, segmentation and classification. Arnold Kaufmann introduced the (linear) index of fuzziness as follows:

$$\gamma_1 = \frac{2}{\mathrm{MN}} \sum_{m} \sum_{n} \min\left(\mu_{mn}, 1 - \mu_{mn}\right)$$

Where, we have an image of size M.N, and calculate the fuzziness regarding to the difference between the membership values and their complements. The quadratic index of fuzziness can be defined in a similar way:

$$\gamma_q = \frac{2}{\sqrt{\mathrm{MN}}} \left[\sum_{m} \sum_{n} \left\{ \min\left(\mu_{mn}, 1 - \mu_{mn}\right) \right\}^2 \right]^{\frac{1}{2}} .$$

The amount of fuzziness is zero if all memberships are 0 or 1 (ordinary set: e.g. binary image).

Let us go through basics of Fuzzy Logic. Fuzzy logic is all about the relative importance of precision: How important is it to be exactly right when a rough answer will do? All books on fuzzy logic begin with a few good quotes on this very topic, and this is no exception. Fuzzy logic has rapidly become one of the most successful of today's technologies for developing sophisticated control systems. The reason for which is very simple. Fuzzy logic addresses such applications perfectly as it resembles human decision making with an ability to generate precise solutions from certain or approximate information. It fills an important gap in engineering design methods left vacant by purely mathematical in system design.

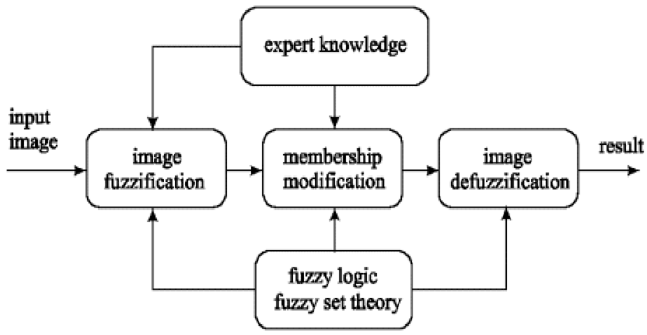

Figure1. The general structure of fuzzy image processing.

The fuzzification and de-fuzzification steps are due to the fact that we do not possess fuzzy hardware. Therefore, the coding of image data (fuzzification) and decoding of the results (de-fuzzification) are steps that make possible to process images with fuzzy techniques. The main power of fuzzy image processing is in the middle step (modification of membership values). After the image data are transformed from gray-level plane to the membership plane (fuzzification), appropriate fuzzy techniques modify the membership values. This can be a fuzzy clustering, a fuzzy rule-based approach.

b.Fuzzy Logic Inference System: Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made, or patterns discerned. The process of fuzzy inference involves all of the pieces that are described in the previous sections: membership functions, fuzzy logic operators, and if-then rules.

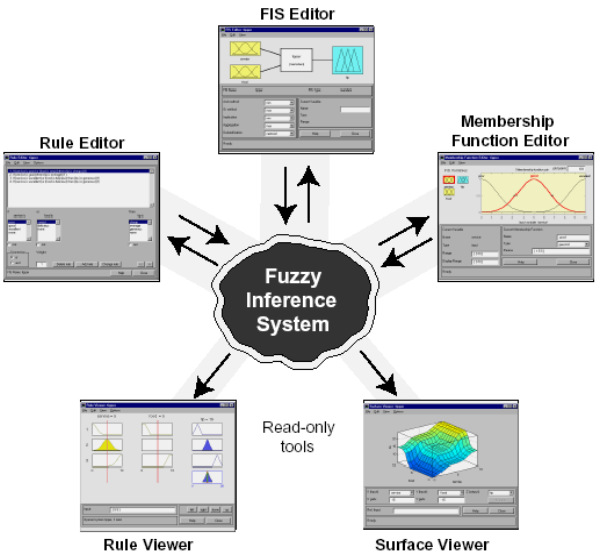

Figure 2. Fuzzy Logic Inference Systems

The FIS Editor handles the high level issues for the system: How much input and output variables? What are their names? The Fuzzy Logic Toolbox doesn't limit the number of inputs. However, the number of inputs may be limited by the available memory of your machine. If the number of inputs is too large, or the number of membership functions is too big, then it may also be difficult to analyze the FIS using the other GUI tools. The Membership Function Editor is used to define the shapes of all the membership functions associated with each variable. The Rule Editor is for editing the list of rules that defines the behavior of the system.

The Rule Viewer and the Surface Viewer are used for looking at, as opposed to editing, the FIS. They are strictly read-only tools.

c. Simulation Steps for Building Systems with the Fuzzy Logic Toolbox:

A. The FIS Editor:

The FIS Editor displays general information about a fuzzy inference system. The FIS Editor handles the high level issues for the system: How many inputs and output variables? What are their names? The Fuzzy Logic Toolbox doesn't limit the number of inputs. However, the number of inputs may be limited by the available memory of machine. If the number of inputs is too large, or the number of membership functions is too big, then it may also be difficult to analyze the FIS using other GUI tools. The FIS editor generally contains the information about the components which are involved in the comparison that is here the components which are involved are RED, GREEN and BLUE components. Here the particular Limit is set for the comparison between the values of the three components.. Here we are just associating the variable with the three components that is R for RED, G for GREEN and B for BLUE and along with the variable we are going to associate the range.

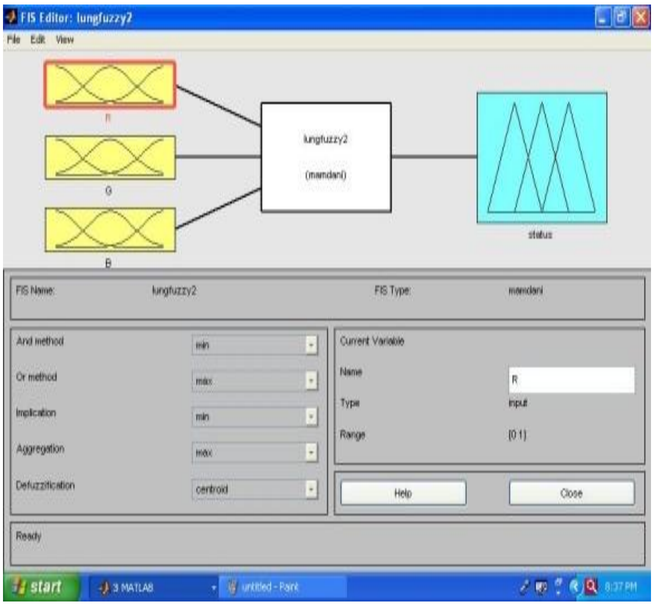

Figure 3. The FIS Editor

B. The Membership Function Editor:

The Membership Function Editor shares some features with the FIS Editor. In fact, all of the five basic GUI tools have similar menu options, status lines, and Help and Close buttons. The Membership Function Editor is the tool that lets you display and edit all of the membership functions associated with all of the input and output variables for the entire fuzzy inference system. Now instead of creating the combinations involving 0-255 values of each Red, Green and Blue components, divide these values in three parts. The values from 0-255 for the Red component which forms the Dark Red color will be stored under the name 'Dark Red', the values which forms the Medium Red color will be stored under the name 'Medium Red' and the values which forms the Light Red color will be stored under the name 'Light Red'. The same procedure will be repeated for the Green as well as Blue components. Once the values have been divided we can write the rules in the rule editor.

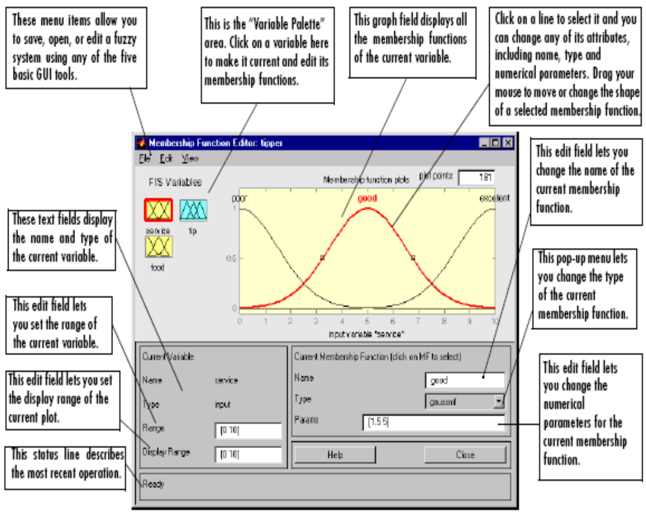

Figure 4 .Membership Function Editor

C. The Rule Editor:

Constructing rules using the graphical Rule Editor interface is fairly self-evident. Based on the descriptions of the input and output variables defined with the FIS Editor, the Rule Editor allows you to construct the rule statements automatically, by clicking on and selecting one item in each input variable box, one item in each output box, and one connection item. The following figure shows the window in which certain rules are written ,that is ‘ If (R is Dark Red) and (G is Medium Green) and (B is Medium Blue) Then (Status is cancer)’.This is one of the rule which we are going to apply on the image and if the particular pixel has the RGB value matching with this rule, then we can say that the particular pixel in the image is affected by cancer. Here the statement ‘R is Dark Red’ contains the set of values which are stored under the statement. If the value falls in the range then only its truth value will be considered as ‘True’. Similarly it will be checked for the Green and Blue components. If all the statements are true in the above rule we can say that that particular body part is having cancer. Thus the number of If…then rules can be written by creating all possible combinations of RGB components similar to the one given above. All these rules will be applied on all the pixels of the image and the appropriate decision will be made.

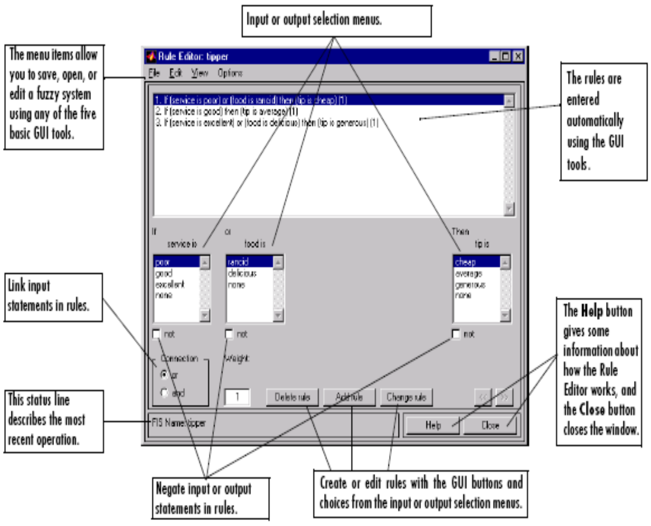

Figure 5. The Rule Editor

D. *The Rule Viewer:*

The Rule Viewer displays a roadmap of the whole fuzzy inference process. It’s based on the fuzzy inference diagram described in the previous section. You see a single figure window with 10 small plots nested in it. The three small plots across the top of the figure represent the antecedent and consequent of the first rule. Each rule is a row of plots, and each column is a variable.

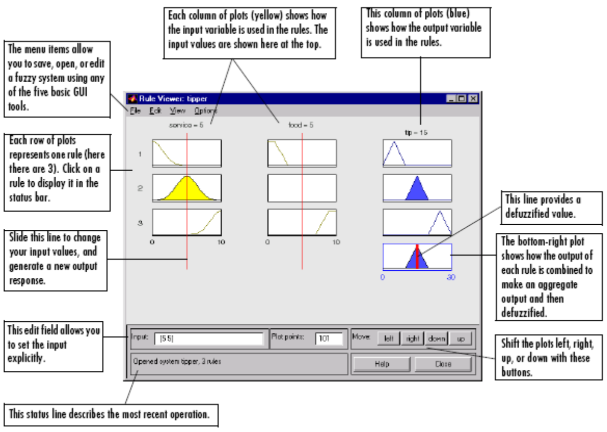

Figure 6. The Rule Viewer

E. *The Surface Viewer:*

Upon opening the Surface Viewer, It present with a two-dimensional curve that represents the mapping from service quality to tip amount. Since this is a one-input one-output case, we can see the entire mapping in one plot. Two-input one-output systems also work well, as they generate three-dimensional plots that MATLAB can adeptly manage. When we move beyond three dimensions overall, we start to encounter trouble displaying the results. Accordingly, the Surface Viewer is equipped with pop-up menus that let you select any two inputs and any one output for plotting. Just below the pop-up menus are two text input fields that let you determine how many *x-axis* and *y-axis* grid lines you want to include. This allows you to keep the calculation time reasonable for complex problems. To change the *x-axis* or *y-axis* grid after the surface is in view, simply change the appropriate text field, and click on either **X-grids** or **Y-grids**, according to which text field you changed, to redraw the plot.

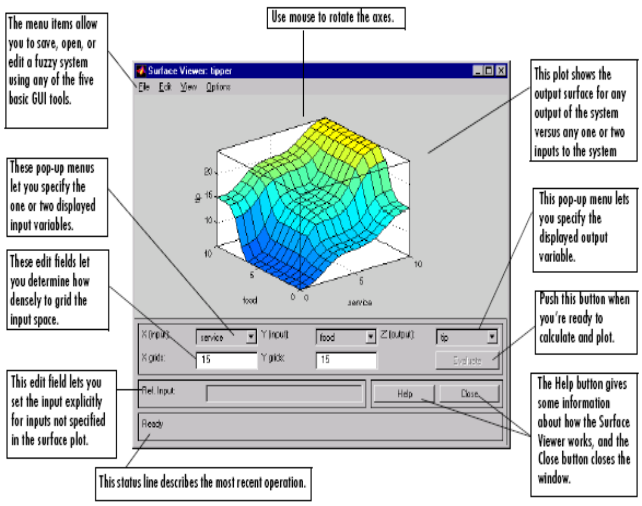

Figure 7. Surface Viewer

V. CONCLUSION & FUTURE WORK

In this paper used the fuzzy expert systems that are capable of mimicking the behavior of a human expert. Fuzzy approach is useful to detect the region of various type of cancer from the original image by performing erosion operation. It is also helpful to determine need for the biopsy and it gives to user a clear idea of spread and severity level of cancer.

VI. REFERENCES

[1]. Ismail SARITAS, Novruz ALLAHVERDI and Ibrahim Unal SERT, “A Fuzzy Expert System Design for Diagnosis of Prostate Cancer” International Conference on Computer Systems and Technologies - CompSysTech’2003.

[2]. K. Lavanya1, M.A. Saleem Durai2, N.Ch. Sriman Narayana Iyengar , “Fuzzy Rule Based Inference System for Detection and Diagnosis of Lung Cancer” International Journal of Latest Trends in Computing (E-ISSN: 2045-5364) (pg165-171)Volume 2, Issue 1, March 2011 .

[3]. Ali.Adeli, Mehdi.Neshat, “A Fuzzy Expert System for Heart Disease Diagnosis” Proceeding of the International

Multi Conference of Engineers and Computer scientist 2010 Vol I,IMECS,march 2010 Hong Kong.

[4]. Abbod M. F., von Keyserlingk D. G., Linkens D. A., and Mahfouf M., “Survey of Utilization of Fuzzy Technology in Medicine and Healthcare”, Fuzzy Sets and Systems, 120, pp. 331–349, 2007.

[5]. Jang, J.-S. R., “ANFIS: Adaptive-Network-based Fuzzy Inference Systems,” IEEE Transactions on Systems, Man, and Cybernetics, Vol. 23, No. 3, pp. 665-685, May 2008.

[6]. Allahverdi N., Expert Systems. An Artificial Intelligence Application, Istanbul: Atlas, 248 p., 2008.

[7]. Allahverdi N., and Yaldiz S., “Expert System Applications in Medicine and Example of Design of a Pre-Diagnosis Expert System”, Proc. Second Turkish-German Joint Computer Application Days, 15-16 Oct.1998, Konya, pp.175-192, 2005.

[8]. B. Kosko, *Neural Networks and Fuzzy Systems*. Englewood Cliffs, NJ: Prentice-Hall, 2000.