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Feature Extraction of kidney Tumor implemented with Fuzzy Inference System

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***Abstract:** The most common problem in the daily lives of men and woman is the occurrence of kidney disease, which is named as renal cell carcinoma, due to living nature of the people. Most of the existing study in the diagnosis of CT image of the carcinoma identifies the presence or absence of tumor in the kidney. The main objective of the paper is to propose a computer aided diagnosis prototype for early detection of cancer which helps to change the diet condition and prevention of tumor formation in future. The proposed work is based image acquisition, Preprocessing, Boundary segmentation, feature extraction and classification, whereas in initial stage, renal CT image is diagnosed for the presence of renal carcinoma and its level of growth measured in sizes. The extracted features are in input for designing the fuzzy membership functions for achieving the improved accuracy compared to SVM works. The expected output findings are based on texture feature values, threshold variations, size of the extended tumor from the renal CT image samples with the support of clinical research center. The Boundary detection of renal segmentation and morphological operation helps to diagnose the presence or absence of renal cyst and carcinoma, which leads to an early detection tumor formation in the kidney and improve the accuracy rate of classification.*
***Keywords:** Renal cancer, Segmentation, Feature selection, Fuzzy, cyst,FeatureExtraction and Classification.*

I. INTRODUCTION

The Kidney cancers are one of the most common disorders of the urinary tract. Kidney cancer problem occurs as a common problem to every men and woman in India, due to nature of living. A kidney cancer termed as renal carcinoma is a solid or fluid form in a kidney when substances that are normally found in the urine become highly concentrated. Renal Cancer [1] may occur in the kidney or travel down the urinary tract. The size of the tumor varied from smaller, medium and larger size, as per the diagnosis, if in early stages not diagnosed, growth is to higher. When the size of the cancer is smaller, it may pass on its own, causing little or no pain in the body. This common blood test measures the amount of various types of blood cells in a sample of your blood. Blood cancers may be sensed using this test if too many or too few of a type of normal or abnormal blood cells are found. A bone marrow biopsy may help confirm a diagnosis of a blood cancer. The growth of cancer leads to the lump of tumor and can block the flow of urine, causing severe pain or bleeding. The urinary tract includes two kidneys, two ureters, a bladder, and a urethra. The left and right kidneys are bean-shaped organs, each about the size of a fist. In daily routine, the two kidneys process about 200 quarts of blood to produce about 1 to 2 quarts of urine, composed of wastes and extra water. The urine flows from the kidneys to the bladder through tubes called ureters. The urine filled in the bladder is released after the urination is dropped out. When the bladder empties, urine flows out of the body through a tube called the urethra at the bottom of the bladder. The occurrence of renal cancer can be in the kidney, ureters or urinary bladders. Cancer are due to abnormal action of smoking and tobacco etc., Most of the previous study in diagnosis of Renal Cancer spots out the presence or absence of the cancer growth in the kidney. In this project we propose an algorithm to detect the renal carcinoma and to find the size of the tumor. It is more helpful to change the diet conditions. In this paper, we presented a method for CT kidney image diagnosis for cancer and to find the size of the cancer using Active contour segmentation [13],[16]. The treatment based CT image acquisition procedure on detecting the tumor accuracy is not promising in the previous work, so current proposed work on computer aided diagnosis system will improve the accuracy of tumor detection.

A. Stages Of Renal Cancer Of Both Sexes

Figure 1 illustrates the stages of Renal Carcinoma (Image Acquired from
Medical Imaging Modalitis www.cancer.net, 2005)

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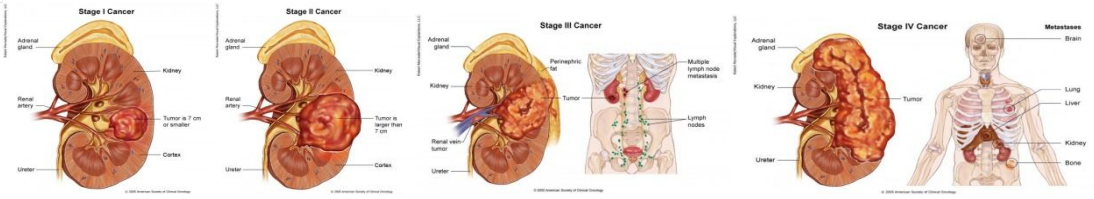


Figure 1 illustrates the stages of Renal Carcinoma (Image Acquired fromMedical Imaging Modalities www.cancer.net, 2005)

B. Kidney cancer symptoms

1) Blood in your urine.
2) A lump in your side or abdomen.
3) A loss of appetite.
4) A pain in your side that doesn't go away.
5) Weight loss that occurs for no known reason.
6) Fever that lasts for weeks and isn't caused by a cold or other infection.
7) Extreme fatigue.
8) Anemia.

The paper is organized as follows:
Section 1 Introduction of Kidney Cancer
Section 2 Explain the study of research challenges.
Section 3 Describes the research objective for the research carried out Section 4 Detailed explanation of the background of research study. Section 5 Existing works of morphological operation and
Commercial CAD [9] system explained in.
Section 6 Proposed Active contour segmentation method
Section 7 Expected outcomes of the proposed method
Section 8 Conclusion

C. A person's risk of developing kidney cancer:

1) Smoking.
2) Gender.
3) Race.
4) Age.
5) Nutrition and weight.
6) Overuse of certain medications. .
7) Exposure to cadmium.
8) Chronic kidney disease.
9) Long-term dialysis. .
10) Family history of kidney cancer

D. Prevention

A. Qitting smoking
B. Lowering blood pressure
C. Maintaining a healthy body weight
D. Eating a diet high in fruits and vegetables and low in fat

II. RESEARCH CHALLENGES

The research paper has focused on the kidney image segmentation and diagnosis for cancer detection and absence in the ultrasound images. Ultrasound is a screening test, its efficiency depends on the Expert doctor handling. There are two constraints have a direct

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effect on image quality. Moreover, it is not uncommon to break some optical fibers, resulting in black dots on the image. Second, kidney cancer have demonstrated different in shapes, colors and textures finally; the system
must be fast enough to work over the laser shooting rate on diagnosis of cancer. The mentioned research challenges with constraints of image quality have been overcome the proposed study to detect the renal cancer. It is very difficult to interpret the ultrasound image. More experienced and expert in training is required to interpret the ultrasound images. Even human experts differ in the interpretation of ultrasound images. The computed Tomography gives the slice of images [10]of particular positioning of the near and far away images of the kidney. The available segmentation algorithms are general techniques to detect the kidney from CT images from cancer detection. The manual segmentation requires high attention of ultrasound sonographer and also suffers from poor accuracy and time consuming. The proposed algorithm is based on the snbxke model framework. The detection of kidney cancer is done with the help of boundary segmentation of CT images.

E. Research Questions

Based on the research challenges, several research questions are framed to conduct the study:

1) How to improve the contrast of image based on intensity
2) How to determine the ROI (region of interest) to extract the different sizes of renal cancer location for segmentation.
3) Extracting the local and global features, how many are determined to use for classification.
4) Within the integration of Fuzzy Rule based, challenges are imposed to feature selection and accuracy of datasets?
5) For improving the classifiers, how resulting classifiers are faithful with respect to the data i.e., how the dependences and independences of the data are represented correctly.

III. RESEARCH OBJECTIVES

Among all type of imaging modalities, Computed Tomography (CT) images play a crucial role, because they can be produced at video rate and therefore allow a dynamic analysis of crucial structures. Apart from that, the acquisition of these images is non-invasive, cheap, and does not produce noise compared to other medical imaging techniques. The research challenge of segmentation of anatomical structures in our proposed CT imagery is a difficult task due to ionizing radiation causes to cancer and artifacts which are inherent in these images. Radiation in a CT image is treated as cancer and our proposed algorithm reduces the cancer in the image by prior treatment. Radiation gives CT images their characteristic coarse appearance. It is integrally exist in coherent imaging, including CT imaging. Compare to existing works of reducing the ionizing radiation, we have proposed image enhancement approaches in this study. Due to the relatively to increase the quality of clinical CT images, a good CT image segmentation and classification method needs to make use of all task-specific constraints or priors. The main objective of the proposed system in the paper is to make contributions to a CAD system which can provide a “second opinion” to radiologists/urologist on a routine clinical BIOPSY. CAD [17] (computer aided diagnosis) helps in detection of kidney diseases and also in early detection of kidney cancer which is based on segmentation and categorization of kidney images with cancer cell sizes.
The developed prototype in this study can helps in 1)Improving the diagnosis quality 2) Increasing therapy success by early detection of cancer 3) Avoiding unnecessary radiotherapy by chemotherapy 4) Avoiding unnecessary biopsies by radiotherapy 4) Reduction of radiotherapist interpretation time 5)Improvement in the accuracy and reliability of the detection system.

A. Design an enhanced filtering algorithm to increase the intensity in CT kidney image. Therefore proposed image enhancement is based on the process of digitization and preprocessing the kidney images to increase the better visual quality.
B. To design and implement kidney cancer localization and detection system by contour segmentation method.
C. Design a mathematical model of extracting the texture features from the extract renal cancer
D. To design and implement a Fuzzy classifier approach to classify the types of cancer from normal to medium to larger size.
E. To validate the Performance of the prototype based on accuracy, correctness and completeness.
F. The complete prototype is run for validation. It is aphysical experimental of the prototype. Task is based on the Comparison results of urologist and the imaging boundary and classification with the diagnosis given by the clinical biopsies. At the end we will have percentage of accuracy of the system in all aspect of renal cancer observation the percentage of number of false positive detections, missing data percentage and uncertainties, confidence percentage of the classifiers respect to the data.

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IV. BACKGROUND STUDY

A. Ultrasonic Image

Ultrasound (ultrasonography) is the use of sound waves to create an image on a video screen. It is a screening test for the patient. only the trained experts' clinician only handle the ultrasound A kidney ultrasound uses a handheld probe called a transducer that sends out ultrasonic sound waves at a frequency too high to be heard. When the transducer is placed on the abdomen at certain locations and angles, the ultrasonic sound waves move through the skin and other body tissues to the organs and structures of the abdomen. The rate of change of velocity at which the waves are returned to the transducer, as well as how much of the sound wave returns, is translated by the transducer as different types of tissue. By using an additional mode of ultrasound technology during an ultrasound procedure, blood flow to the kidney can be assessed.

B. Computed tomography (CT) scans

The CT scan is a x-ray procedure that produces detailed cross-sectional images of your body. Instead of taking one picture, like a conventional x-ray, a CT scanner takes many pictures as it rotates around you. A computer gives the combined slice image form of pictures of our body. The machine will take pictures of multiple slices of the part of your body that is being studied. CT scans do not show complete kidney structure well, but they can see interior of tumors, and may be able to see if the tumor is growing into nearby structures. A CT scan may also find enlarged lymph nodes, signs of cancer spread to liver or other organs, or signs that a cancer is affecting your kidneys or bladder .

C. Magnetic resonance imaging (MRI) scans

MRI scans use radio waves and strong magnets instead of x-rays. The radio waves are absorbed and then released in a pattern form by the tissue and by certain diseases. A computer translates the pattern of radio waves given off by the tissues into a very detailed image of parts of the body. It can produce slices that are parallel with the length of the body, apart from cross sectional slice information. A contrast material might be injected into a vein (same as with a CT scan). MRI scans are not used often to look for kidney cancer.

D. Research Background on Machine Vision

The most commonly used CAD systems detect cancer by analyzing a single view of the medical images [12]. Most of the CAD programs have a two-step procedure to accomplish this. The first step detects suspicious locations inside the urinary tract area by machine learning techniques such as kidney cancer cell of image enhancement contour techniques which include global approach &local approach. In the second step the image at these locations is segmented into regions [11] and several features are calculated for each region. These features are being used to determine whether a lesion is benign or malignant. They are also used to eliminate true negative detections. There were related research performed in segmentation includes Global thresholding, Local thresholding, and Edge detection, region growing, morphological operation by erosion &dilation & fuzzy techniques. The third step includes features extraction and selection where tumor detection and classification is performed, most of the work performed in feature extraction includes global and local features such as GLCM, shape, density, size are calculated. Final step is performed through classification; some of them are based on BIOPSY on tumor descriptions provided by radiologists or on features extracted by image processing [14]. Other classifying techniques that are used for the diagnosis of kidney cancers are Support Vector Machines, Artificial Neural Networks and Fuzzy Rule based classifiers.

V. EXISTING WORKS

Daw-Tung Lin and Siu -Wan Hung proposed an effective method of model based approach of computer–aided kidney segmentation of abdominal CT images with anatomic structure [2]. Qingsong Zhu and Zhan song proposed a segmentation method of video with dynamic block diagram has been an importance research topic in intelligent surveillance and human-machine interface technologies [3]. Kang and Yang performed an approach of color images are due to the grey level [4]. Zhang proposed a method Based on image segmentation evaluation techniques [5]. Kobashi and Shapiro described a knowledge-based procedure for identifying and extracting organs from normal CT imagery [6]. Kobashi and Shapiro described a knowledge-based procedure for identifying and extracting organs from normal CT imagery [6]. The detection result was rated 85% grade A from testing of 75 images from three patients. Tsagaan and Shimizu proposed a deformable model approach for automatic renal segmentation [7]. They used a deformable model represented by the grey level appearance of renal and its statistical information of the shape. They tested 33 abdominal ACT images. The degree of regularity between automatic segmentation and manual positioning was 86.9%.

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There are several existing approaches were made to detect the suspicious region in CT images. Medical image segmentation, a critic step for most subsequent image analysis tasks, is to delimit the image areas representing different anatomies. Segmentation of the abdomen, in particular, is often a challenging task due to the considerable overlap of soft tissues by. Since intensity based methods have met with limited success for abdominal segmentation, texture segmentation, which makes use of statistical textures analysis to label regions based on their different textures, has attracted our attention. In this method, low-level features based on texture information, is expected to be homogenous and consistent across multiple slices for the same organ, are mostly used to perform automatic image analysis in the medical imaging field investigation. Computer-Aided Diagnosis (CAD) for classification of focal liver tumors in CT requires segmentation as a preprocessing step for successive texture analyses of the tumors [8]. Therefore only a few researches have directly examined video images. In this study, automated segmentation and classification scheme performs the function, without the need for an interaction from the user to diagnosis kidney cancer presence, absence and early detection

A. Related Research Works on Machine Vision Techniques

1) Image Enhancement

a) Global Approach: Assigning the intensity values of pixels to make the new distribution of the intensities uniform to the extreme

b) Local Approach: Feature-based or using non-linear mapping locally (example: Weiner filtering)

2) Image Segmentation

a) *Global Thresholding:* Based on global information, such as histogram of the kidney image.

b) *Local Thresholding:* Based on determining thresholding value locally and it can refine the results of global thresholding, and is better for cancer detection than global thresholding.

c) Boundary Detection: Traditional method for image segmentation and it detects the discontinuity in CT images.

3) Feature Extraction: Feature space can be divided into 3 sub-spaces: Intensity features, Shape features & Texture features.

4) Classification

a) Fuzzy Rule Based: Based On Image data collection in database, it mines the data set by applying the membership functions in the input layer

b) Support Vector Machine: SVM takes a set of input data and predicts, for each given input, which of two possible classes the input is a member of, which makes the SVM a non-probabilistic binary linear classifier.

VI. PROPOSED METHODS

The methodology has five distinct steps: pre-processing, segmentation, boundary detection, and feature extraction and classifier development as shown in figure 2 below:

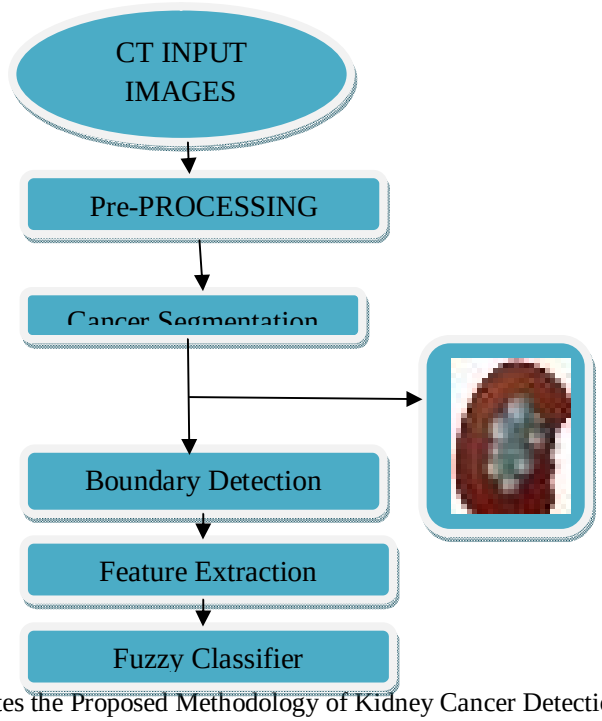


Fig 2 illustrates the Proposed Methodology of Kidney Cancer Detection

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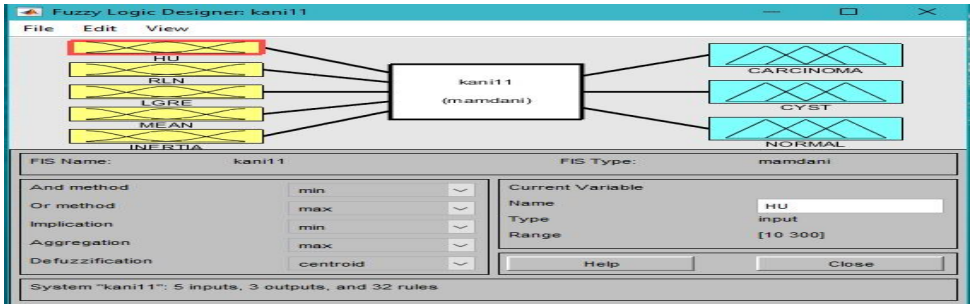


Figure 3 Fuzzy logic inference system of kidney tumor

In fuzzy system the rule based system designing is done to implement the extracted features from the segmentation of contour. Totally 34 features of gray level co-occurrence matrix and added the third moment features are also extracted additionally with area features of left and right kidney [18]. Mostly the male ratio is of 2:1 in tumor diagnosis. Similarly the diagnosis of left kidney with respect to right kidney is very high. In fuzzy system the features which are distinct are selected as input, whereas the target i.e. output as three states. one is carcinoma (Tumor) second one is cyst (Benign) and the third one is Normal (Healthy) is clearly shown in the figure 3.

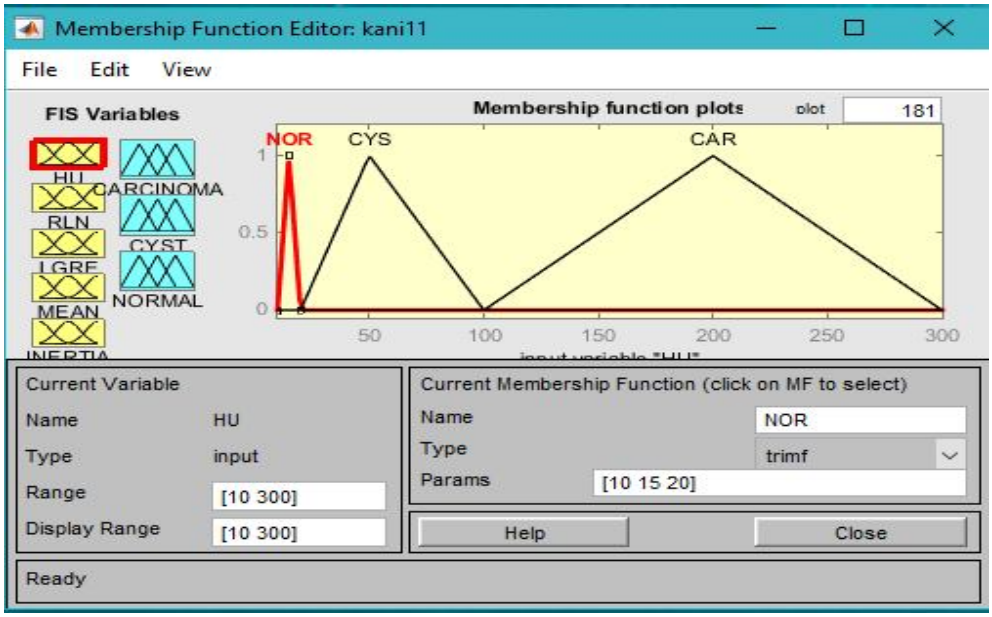


Figure 4 (a) Membership function plot of first input

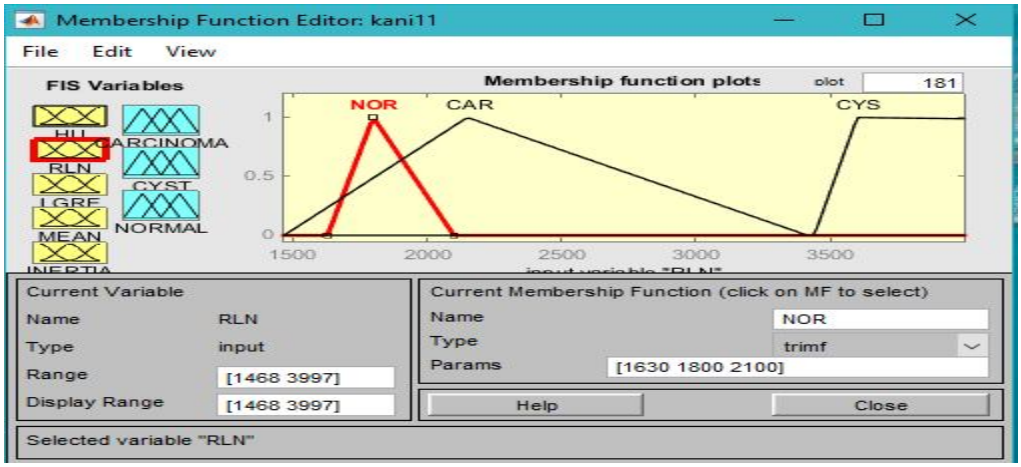


Figure 4 (b) Membership function plot of second input

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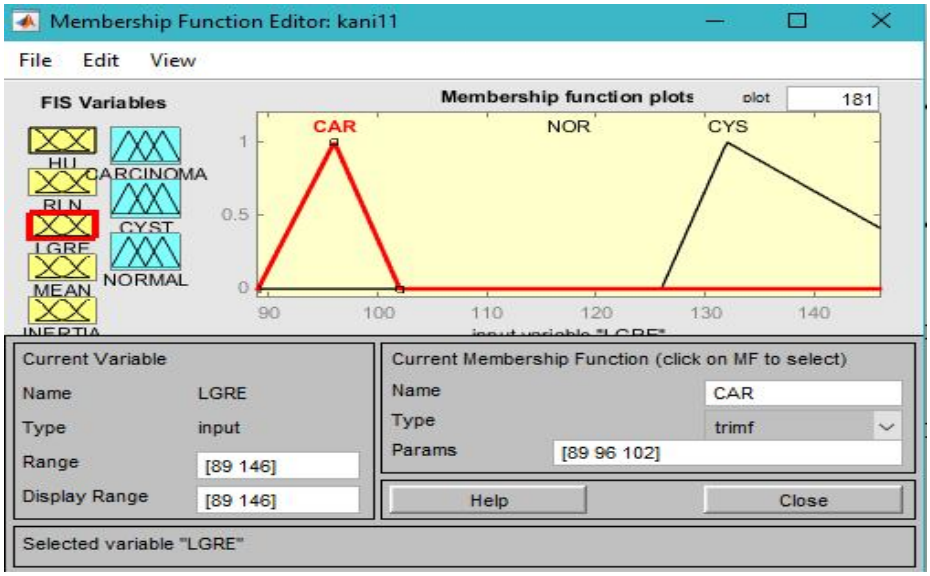


Figure 4 (c) Membership function plot of third input

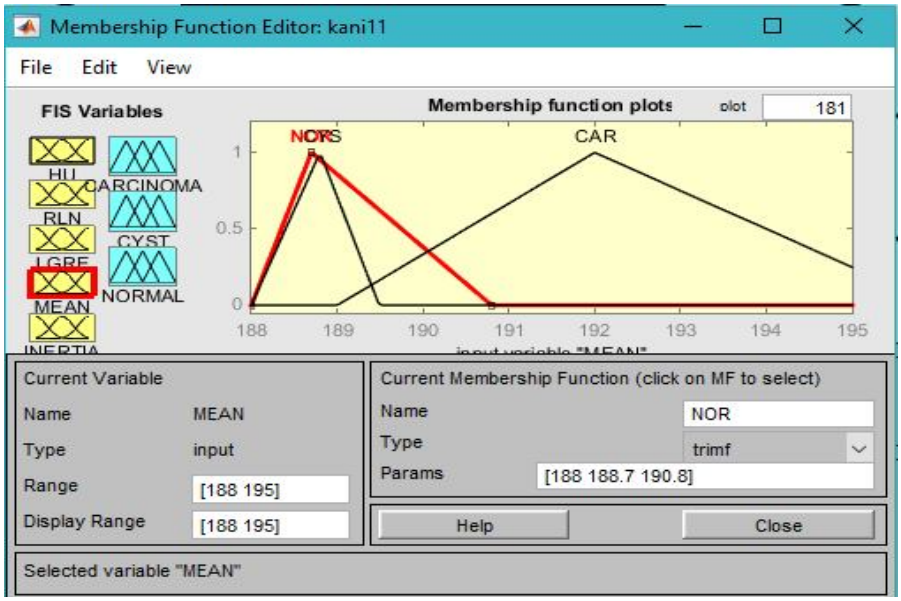


Figure 4 (d) Membership function plot of fourth input

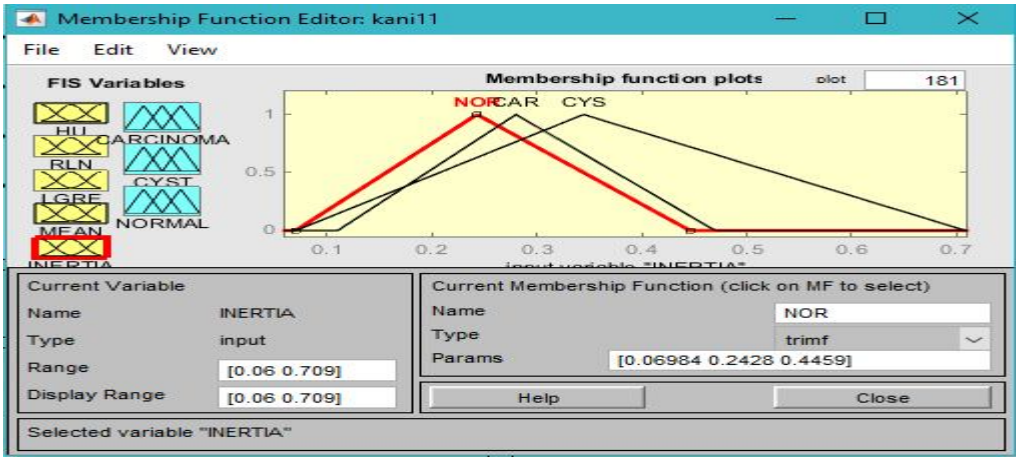


Figure 4 (e) Membership function plot of fifth input

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There are two types of .fis file system in fuzzy are mamdani and sugeno.Mamdani is selected because of range of values. For each input and output the range of values is given in their respective module. Sugeno is utilized only for the constant values of input and output states[19].The input of each is selected with three membership function (mf) of car (carcinoma),cyst(cyst) and nor(normal) indications. The range of values obtained in the feature extraction for each input is displayed in the plot of figure 4 (a),(b),(c),(d),(e) with three mf. Similarly, each output the range of values selected for the target carcinoma, cyst and normal with three mf of LOW ,HIGH AND MEDIUM. respective ploy is shown in the figure 5 (a),(b) &(c)..

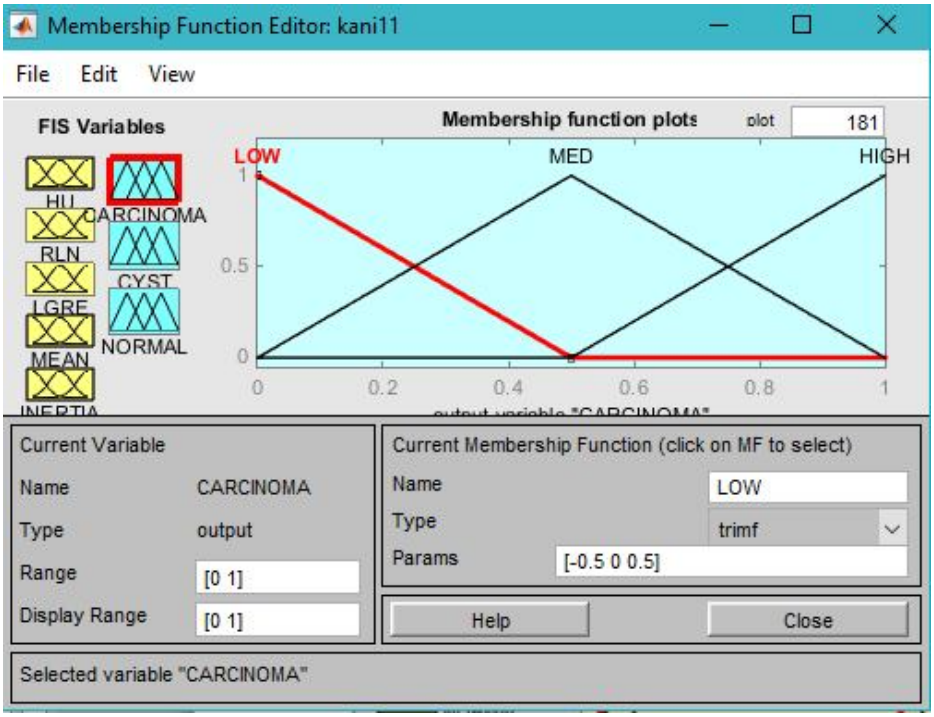


Figure 5 (a) Output of Carcinoma

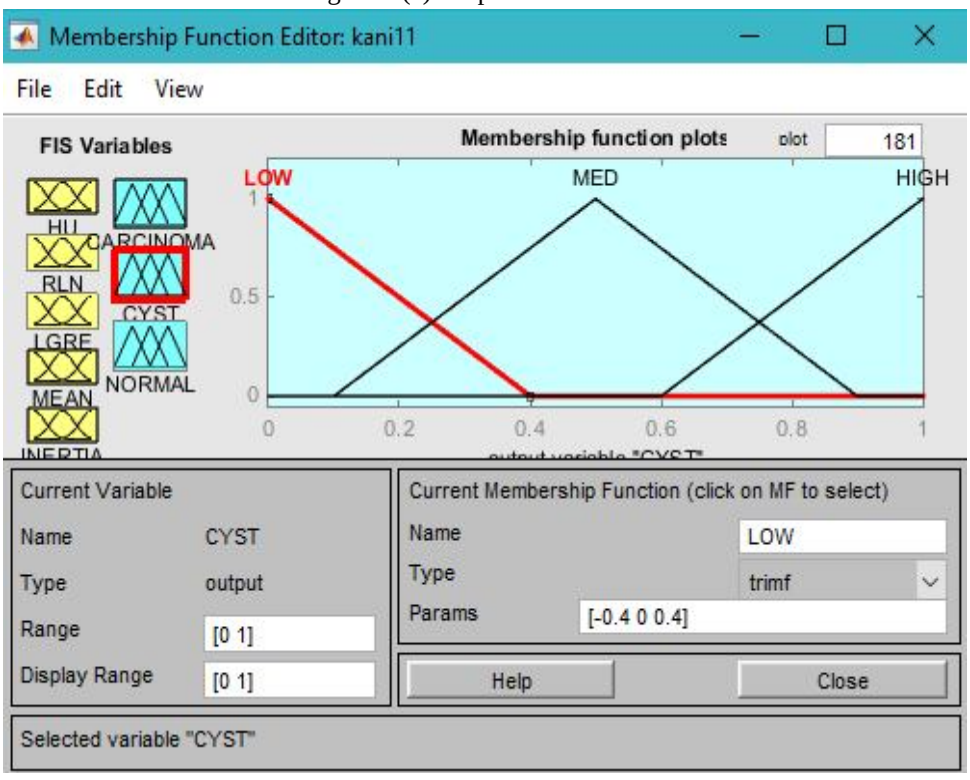


Figure 5 (b) Output of Cyst

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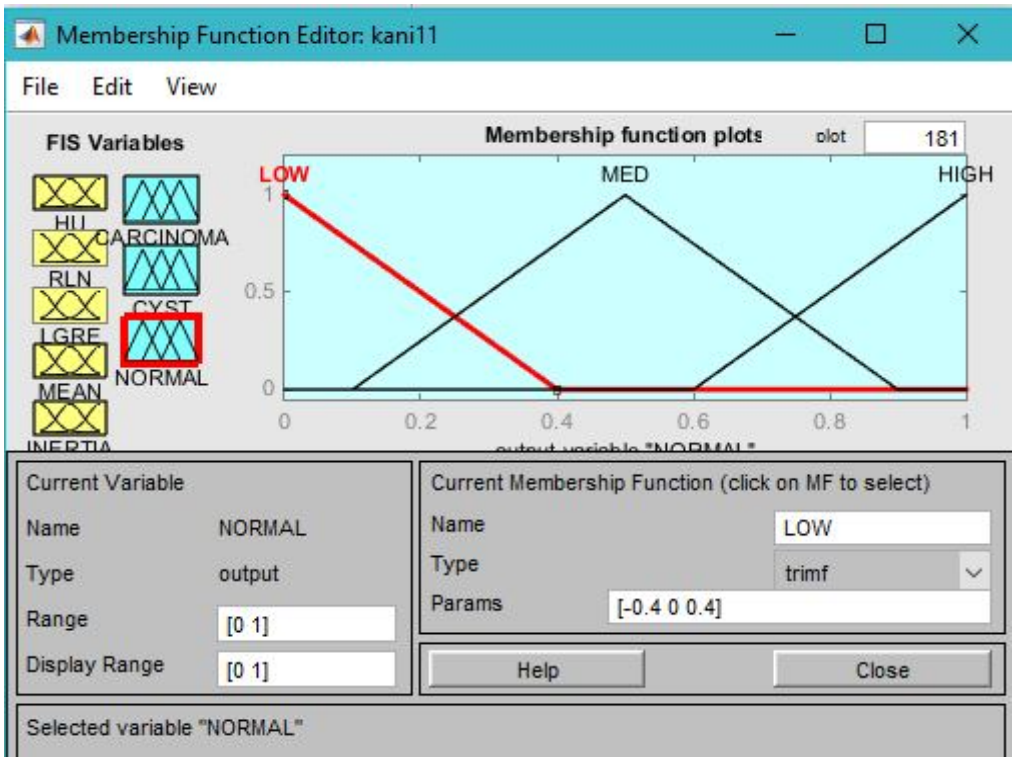


Figure 5 (c) Output of Normal

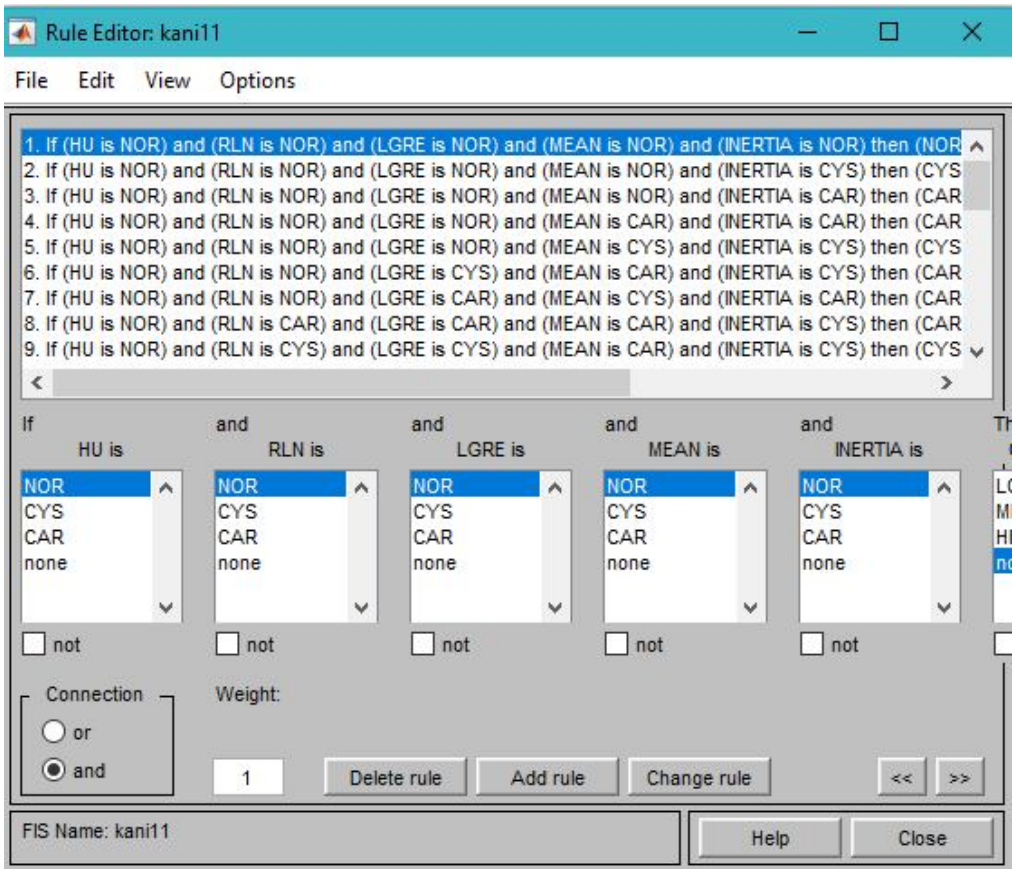


Figure 6 (a) Rule based system Design

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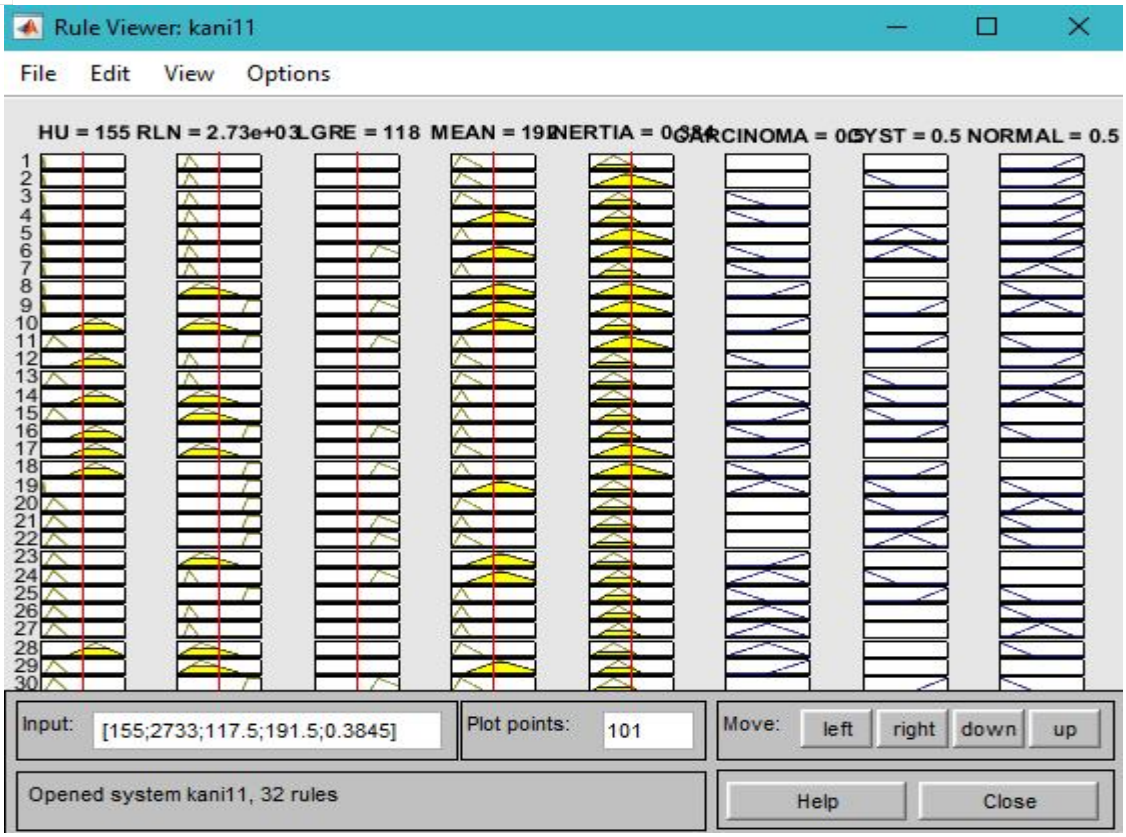


Figure 6 (b) Rule viewer of Target carcinoma

Nearly 32 rules were designed for each five inputs is shown in figure 6(a) and plot is illustrated in figure 6 (b)The surface viewer of Target carcinoma is 100% is clearly viewed in figure 7. The efficiency of fuzzy depends on the designing of rules.

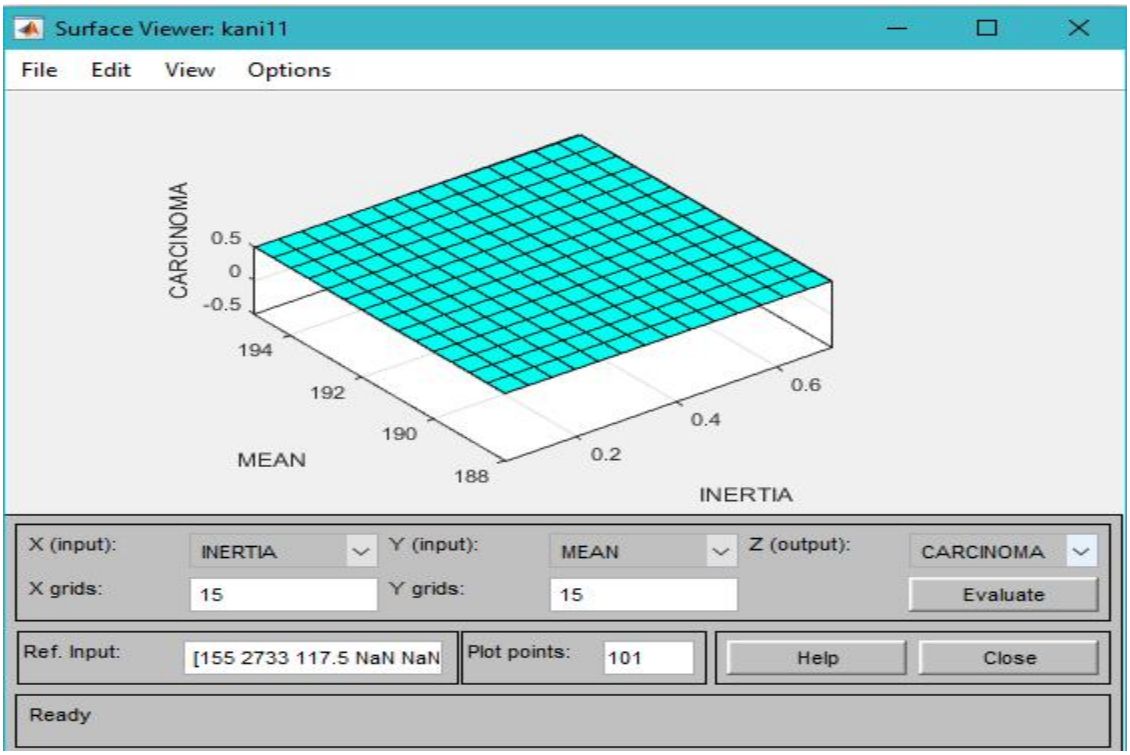


Figure 7 surface view of Target Tumor

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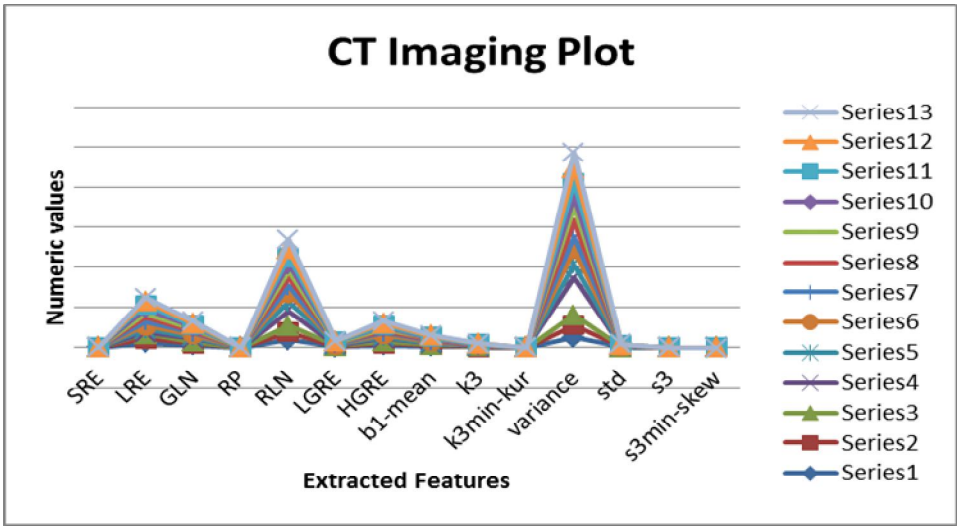


Figure 8 (a) Plot characteristics of CT imaging Modality

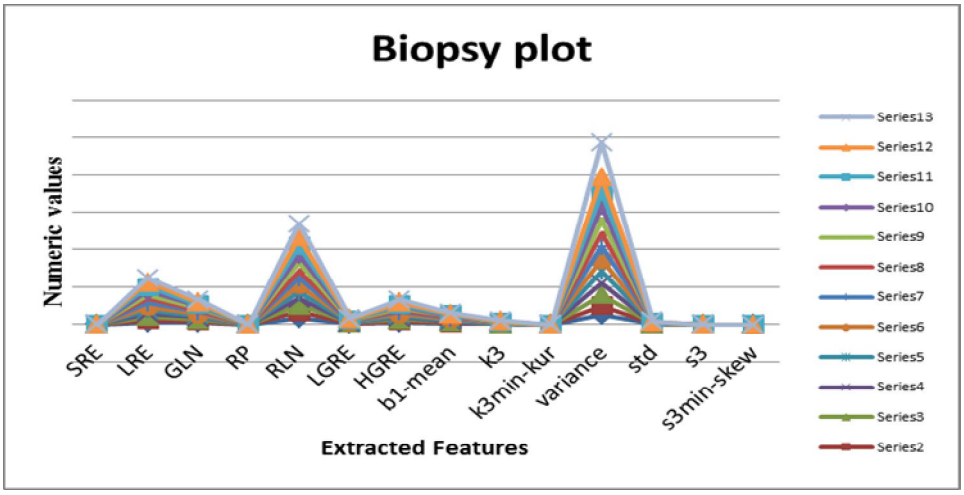


Figure 8(b) Plot characteristics of Biopsy Method

Figure 8 (a), (b) illustrates the Feature extraction characteristics of CT imaging and Biopsy. The extracted features are more or less similar in their range of values of CT imaging and biopsy. The plot gives the similar curve form of each other.

Initially the CT image of kidney bladder is acquired and preprocessed by enhancement techniques, then system extracts texture features for each pixel in the Region of Interest. The proposed system uses the texture features, i.e. texture features are computed for pixels in each slice of

Kidney CT image. The kidney region to be segmented by the snake model. By comparing all unallocated neighboring pixels to the regions iteratively grows the regions. The similarity measures used are the difference between a pixel's intensity value, region's texture and local threshold. This technique is presented as, first preparation of lookup table of local statistics of all pixels to be used for initial region growing procedure, second grouping of pixels (satisfying a specify homogeneity criteria and produce the homogeneous region, and finally merging the neighboring regions), which have similar intensity values with the tolerance level. The pixel are allocated to the respective region with the minimum difference .This process is repeated until all pixels are allocated to a region. The Next step in the recognition system design cycle is feature extraction [15]. Features were calculated based on first order statistics, spatial gray-level dependence matrices, and spatial-frequency content. Two sets of features: statistical and spatial-frequency based. To determine the optimal subset of features, a third set was concocted by merging the two sets into a combined set of 32 features. It was necessary to normalize them prior to feature selection which have different physical units, and substantial difference in variances,. The normalized features were used in all subsequent analysis. Feature selection schemes are related to the type of classifier that will be used. Next features are feeded in to proposed hybrid classifier which combines Fuzzy classifier. The output of the SPSS statistics is a reduced feature vector composed of seven features, providing the best classification performance.

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Statistics eliminates features contributing to more than 7% of the total variation of the original feature set. Those normalized features met to zero mean and unit variance. Gradient decent, resilient back propagation, conjugate gradient and quasi-Newton methodologies were employed for the fuzzy best classification ability. The accuracy of renal cancer attained by the proposed method is enough for using in various medical fields in future. The performance of the proposed method is evaluated by comparing the result of the expert's detection process.

VII. CONCLUSION

The expected outcome of proposed study in this paper will be as follows:

A. Enhanced Algorithm

The machine learning algorithm will be designed and enhanced by contour detection, Texture Feature Extraction, Fuzzy classifier and improved methodology is developed in a single line for boundary detection for kidney cancer.

B. Prototype

The experimental set up and software implementation will be developed in MATLAB. The proposed framework when it is developed into prototype, will act as second reader for radiologist for comparing the results of the cancer cell with the diagnosis given by the clinical biopsies. Percentage of accuracy is increased and number of true negative detections is increased.

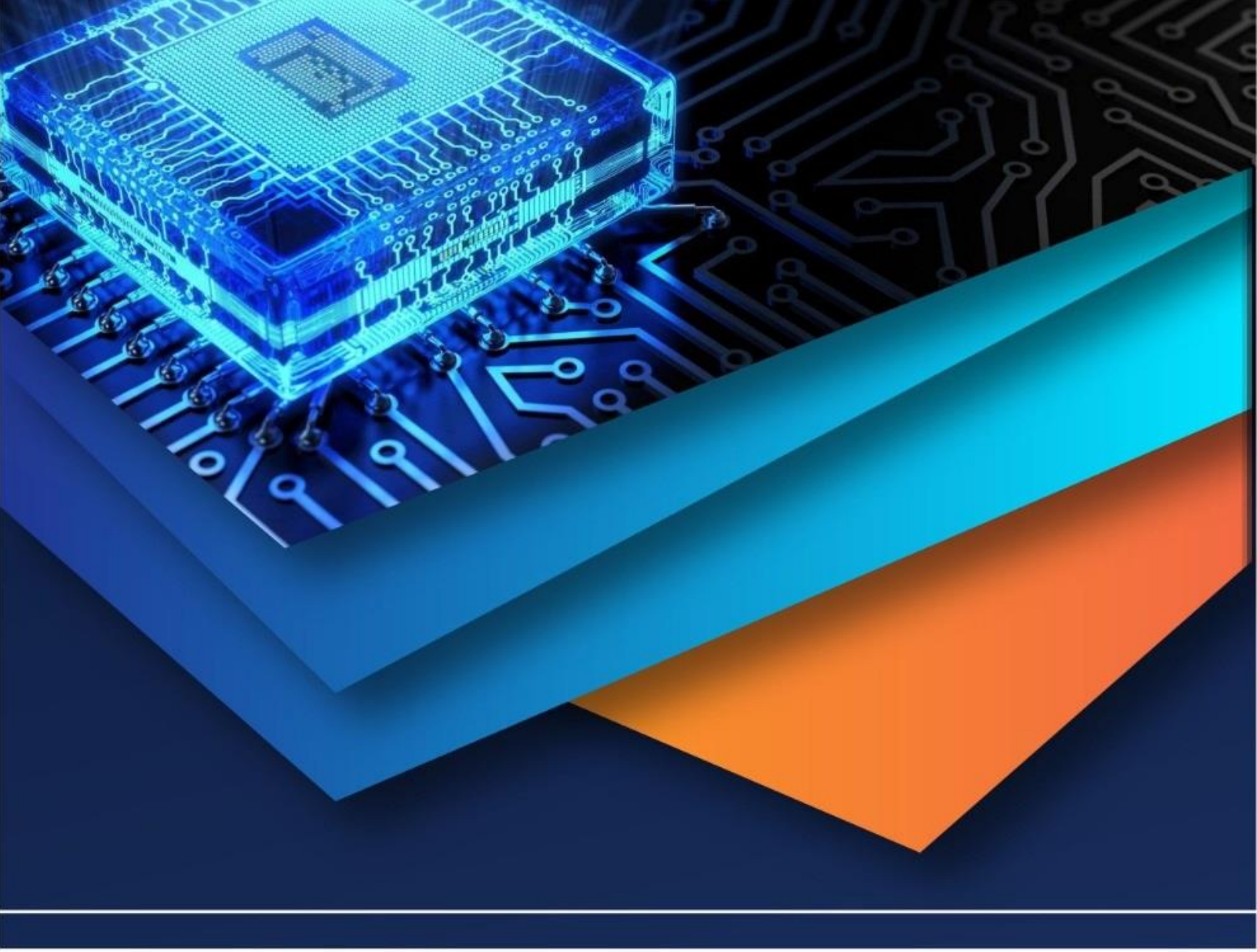
C. Fuzzy rule Based

In this paper, emphasis has been to develop a very simple & small but a very efficient, fuzzy rule based edge detection algorithm to abridge the concepts of artificial intelligence and digital image processing. The played results exposed the accuracy of the edge detection using the fuzzy rule based algorithm over the other algorithms. The fuzzy rule based algorithm has been successful in obtaining the edges that are present in an image after the implementation and execution with various sets of images. A sample output determines the readers to have the knowledge of accuracy algorithm. Thus developed algorithm exhibits tremendous scope of application in various areas of digital image processing.

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