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Kidney Abscess Segmentation and Detection on Computed Tomography Data

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Abstract: In this paper, a novel kidney segmentation method for Computed Tomography patient data with kidney cancer is proposed. The segmentation process is based on Hybrid Level Set method with elliptical shape constraints. Using segmentation results, a fully automated technique of kidney region classification is introduced. Identification of the kidney, tumor and vascular tree is based on RUSBoost and the decision trees technique. This approach enables to resolve main problems connected with region classification: class imbalance and the number of voxels to classify. The classification is based on 64-element feature vectors calculated for the kidney region that consist of 3D edge region, orientation and spatial neighbourhood information. The proposed methodology was evaluated on clinical kidney cancer CT data set. Segmentation effectiveness in Dice coefficient meaning was equal to 0.85≠0.04. Overall accuracy of the proposed classification model amount to 92.1% presented results confirm usefulness of the solution. We believe that this is the first solution which allow to segment (divide) kidney region into separable compartments, i.e. kidney, tumor and vascular trees.

Keywords: Segmentation, Computed Tomography, Neural Network, SVM, Decision Tree.

I. INTRODUCTION

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image. Usually Image Processing system includes treating images as two dimensional signals while applying already set signal processing methods to them. It is among rapidly growing technologies today, with its applications in various aspects of a business. With increasing use of Computed topography (CT) and Magnetic resonance (MR) imaging for diagnosis, treatment planning and clinical studies, it has become almost compulsory to use computers to assist radiological experts in clinical diagnosis, treatment planning. Reliable algorithms are required for the delineation of anatomical structures and other regions of interest (ROI).

II. RELATED WORK

Hong Song et al [1]. They described Accurate kidney segmentation in abdominal computed tomography (CT) sequences is an essential and crucial task for surgical planning and navigation in kidney tumor ablation. In this paper, a coarse-to-fine method was applied to segment kidney from CT images, which consists two stages including rough segmentation and refined segmentation. The SKFCM algorithm introduces a kernel function and spatial constraint into fuzzy c-means clustering (FCM) algorithm. The IGC algorithm makes good use of the continuity of CT sequences in space which can automatically generate the seed labels and improve the efficiency of segmentation. The experimental results performed on the whole dataset of abdominal CT images have shown that the proposed method is accurate and efficient. The method provides a sensitivity of 95.46% with specificity of 99.82% and performs better than other related methods.

Mahdi Marsousi et al [2]. They described all internal organs, diagnosing the kidney has a paramount importance for rapid bedside treatment of trauma and kidney stone patients using ultrasound images. computer aided automated kidney diagnosis becomes very essential. Then, we proposed a shape-based method to segment the detected kidneys. A preprocessing step is utilized to overcome the ultrasound challenges. . Based on a set of 14 ultrasound volumes, we have evaluated the detection rate of our proposed kidney detection approach which is 92.86%.they utilized 4 manually segmented kidneys to create the probabilistic kidney shape model. Our segmentation results confirm the superiority of our proposed method, compared to MRF-AC.

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Srimadevi et al [3]. They described kidney image requires proper motion correction and it produce less accuracy and loss of reproducibility. It is not available in clinical modeling due to loss of reliability. The proposed method is to attain accuracy and to efficiently detect kidney disease using DCE-MRI kidney image from the MRI moving kidneys and edge detection algorithm are used to detect edges from MRI kidney image. The GFR value can be calculated as quantity of the volume of the filtered fluid per unit time from the blood pool in the glomerular capillaries to the tubular space in the Bowman's capsule. The proposed system is experimentally evaluated using real time input image from MRI moving kidneys and it is very useful to analyze doctors to know patients prostate disease and related treatments. Keywords - Glomerular Filtration Rate, segmentation, magnetic resonance imaging. The problem of registration of MRI kidney image requires proper motion correction for combined registration and segmentation, applicable to 4D DCE-MRI acquisitions of the moving human kidney images. They conclude that our segmentation driven registration approach has a great potential for further development into a full-blown pharmacokinetic GFR model driven segmentation of the kidneys and its useful method to detect kidney diseases in medical image processing.

III. PROPOSED WORK

The kidney malfunctioning can be life intimidating. Hence early detection of kidney stone is essential. Precise identification of kidney stone is vital in order to ensure surgical operations success. The ultrasound images of kidney comprise speckle noise and are of low contrast which makes the identification of kidney abnormalities a difficult task. As a result, the doctors may find identification of small stones and the type is difficult and challenging for identify the small kidney stones and their type appropriately. To address this issue, a reaction diffusion level set segmentation is proposed to identify location of the stone; it is implemented in real time on Vertex-2Pro FPGA with VerilogHDL using Xilinx System Generator blocks from Matlab 2012a which is compatible with xilinx13.4 ISE and lifting scheme wavelets subbands are employed for extraction of the energy levels of the stone. The results are analyzed using MLP-BP ANN algorithms for classification and its type of stone.

Dataset
The synthetic kidney function test (KFT) dataset have been created for analysis of kidney disease. This dataset contains five hundred and eighty four instances and six attributes are used in this comparative analysis. The attributes in this KFT dataset are Age, Gender, Urea, Creatinine and Glomerular Filtration Rate (GFR). This dataset consists of renal affected disease information.

IV. ALGORITHM

Support Vector Machine (SVM)
SVMs can be used for prediction along with classification. They have been applied to a several areas, including handwritten digit recognition, object recognition, and speaker identification and also benchmark time-series prediction tests.
Require: A linear separable set S, learning rate + η ∈ℜ
Step 1: w0 = ;0 b0 = ;0 k = ;0
Step 2: max || || 1 i li R x ≤≤ =
Step 3: while at least one mistake is made in the for loop do
Step 4: for i = 1 l do
Step 5: if 0 yi (< wk , xi > +bk) ≤ then
Step 6: k k ii w = w +η xy +1
Step 7: 2 bk +ηyiℜ (updating bias1)
Step 8: k = k +1
Step 9: end if
Step 10: end for
Step 11: end while
Step 12: Return k k w b where k is the number of mistakes

Neural network
Pseudo code for Neural Network:
Step 1: Initialize the weights in the network (often randomly)
Step 2: Repeat * For each example e in the training set do 1. O = neural-net-output (network, e); forward pass 2. T = output for e

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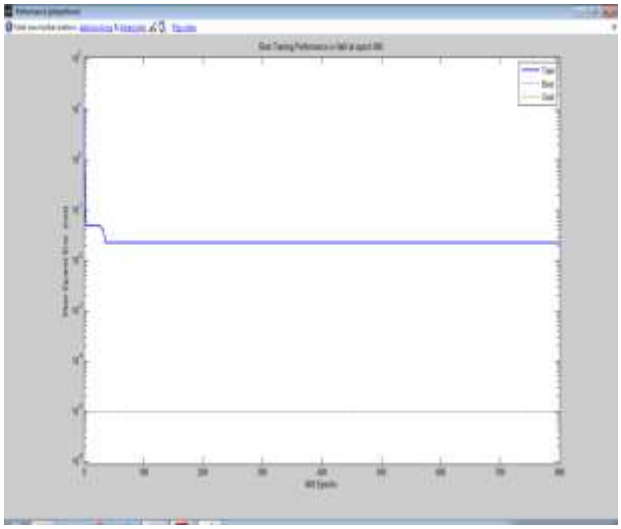
3. Calculate error (T - O) at the output unit
4. Compute delta_wi for all weights from hidden layer to output layer; backward pass
5. Compute delta_wi for all weights from input layer to hidden layer; backward pass continued
6. Update the weights in the network * End Step 3: until all examples classified correctly

Step 4: return (network).

V. EXPERIMENTAL RESULTS

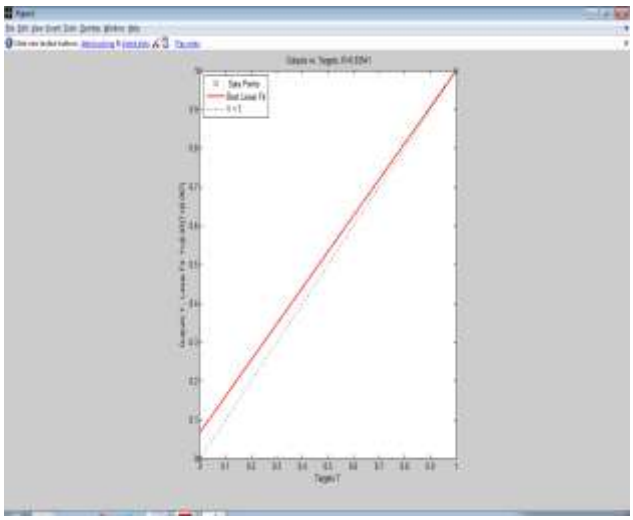
Experiments on original images that the proposed method results in successfully kidney disease prediction images

- **Neural Network**
- **Performance classification**
- **Classification Accuracy**



Kidney dataset

The dataset of diagnosis for kidney stone disease is purely real set data. The data set used in this work is collected from different medical laboratories which test the patients of kidney stones. In this work the 1000 patients data have been used i.e. 1000 instances and has 7 attributes. The attributes are actually symptoms of kidney stone on the basis of which we trained neural networks for diagnosis.



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The attributes taken for diagnosis are Lymphoctyes, Monocytes, Eosinophis, Neutrophil, S. Creatinine, Blood Sugar, and U.Acid. The dataset are divided into two classes to facilitate their use in experimentally determining the presence or absence of kidney stone disease. The class 1 is containing yes value mean presence of disease and class 2 containing No value means absence of disease.

Medical diagnosis by neural network is the blackbox approach. A network is chosen and trained with examples of all classes. After successful training, the system is able to diagnose the unknown cases and to make predictions. In this experiment work we applied three neural networks on kidney stones disease for classification and diagnosis of patients. The results of experiments are shown below in tables. Table II shows neural networks are trained with 1000 instances or data items and testing of neural networks is done with 150 data instances. The numbers of hidden layers used are 2 which are sufficient for any kind of classifications. Learning rate and momentum used for training and testing is 0.3 and 0.2 respectively, this particular value is chosen because of maximum accuracy is achieved with these parameters. Validation threshold has value 20 and value of error per epoch is 0.013.

VI. CONCLUSION

New intrusion detection system that improves the detection accuracy and time efficiency for building the intrusion detection systems. For this purpose, we proposed a LAICRF model which is developed by combining an ICRFFSA and LA based classification algorithm for effective intrusion detection. In this work, rule and LA based classification methods have been used that significantly reduce the detection time and hence it increases the detection accuracy. An intrusion detection system is proposed in this paper for detecting novel internet attacks. Moreover, a new Incremental Feature Selection Algorithm (IFSA) is also proposed and implemented for effective feature selection. The proposed feature selection algorithm is the combination of Cuttle Fish Feature Selection algorithm and the Extended Chi-square algorithm. The experimental result shows the performance of the proposed system which is achieved detection accuracy in all types of attacks.

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