Novel Development of Patient Assistive Tool For Detection of Abnormalities In Kidney Using SVM Classification Technique

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Abstract- *Kidney stone disease is one of the major life threatening ailments persisting worldwide. The stone diseases remain unnoticed in the initial stage, which in turn damages the kidney as they develop. A majority of people are affected by kidney failure due to diabetes mellitus, hypertension, and so forth. Since kidney malfunctioning can be menacing, diagnosis of the problem in the initial stages is advisable. The detection of kidney stones using ultrasound imaging is a highly challenging task as they are of low contrast and contain speckle noise. This challenge is overcome by employing suitable image processing techniques. The ultrasound image is first pre-processed to get rid of speckle noise using the image restoration process. The restored image is smoothened using Gabor filter and the subsequent image is enhanced by histogram equalization .The pre-processed image is achieved with level set segmentation to detect the stone region. Segmentation process is employed twice for getting better results; first to segment kidney portion and then to segment the stone portion, respectively. In this work, the level set segmentation uses two terms, namely, momentum and resilient propagation (Rprop) to detect the stone portion. They are trained by SVM techniques.*

I. INTRODUCTION

Kidney stones form when your urine contains more crystals-forming substance such as calcium, oxalate, uric acid than the fluid in your urine can dilute. At the same time your urine may lack substance that prevent crystals from sticking together, creating an ideal environment for kidney stone to form. Kidney stone, also known as a renal calculus is a solid piece of material which is formed in the kidneys from minerals in urine. Kidney stones typically leave the body in the urine stream, and a small stone may pass without causing symptoms. Kidney stone detection is challenging because of having low resolution image quality which is difficult to analysis by human as well as machine. As we all know that medical cannot afford low accuracy that is why we choose to improve classification technique in order to analyse best kidney stone detection. The proposed techniques start with image acquisition which is used to take image from the External source of system. After first step we move to the median filter which is actually used to remove noise for the image. Sharpening of the image is done with the help of un-sharp masking. Generally medical images are poor quality especially in contrast form. Therefore it is required to enhance the image. Image enhancement (IE) is essential for improving the perception of image information. IE transforms images to provide better representation of the subtle detail about the images. Also a classifier based on distance and dimension seems to be a very good approach for ultrasound kidney images classification but for the sake of better performance we used two more classifier in order to acquire good accuracy.

II. METHODOLOGY

The work proposed here uses three classification techniques to predict the presence of chronic kidney disease in humans. The classifiers used are Support vector machine and KNN classifier. The data set for chronic kidney disease was gathered and applied on each classifier to predict the disease and the performance of the classifier is evaluated based on accuracy, precision and F measure. The working of the architecture is as follows: The dataset for CKD patients have been collected and fed into the classifier named SVM and KNN.

2.1 Data set

The dataset is collected from several medical labs, centres and hospitals. From this the mock kidney function test (KFT) dataset have been formed for study of kidney disease. This dataset contains four hundred instances and twenty five attributes are used in this comparative study. The attributes in this KFT dataset age, blood pressure, specific gravity, albumin, sugar, red blood cells, pus cell, pus cell clumps, bacteria, blood glucose random, blood urea, serum creatinine, sodium, potassium, haemoglobin, packed cell volume, white blood cell count, red blood cell count, hypertension, diabetes mellitus, coronary artery disease, appetite, pedal edema, anaemia, class. This dataset consists of renal affected disease information. This is binary classification, as we have used two classes for predicting CKD and NOT CKD.

2.2 Support Vector Machines

Support Vector Machines (SVM) is a powerful, state-of-the-art algorithm based on linear and nonlinear regression. Oracle Data Mining implements SVM for binary and multiclass classification. The advantage of the SVM is that, by use of the so-called ‘‘kernel trick’’, the distance between a molecule and the hyper plane can be calculated in a transformed (nonlinear) feature space, lacking of the explicit transformation of the original descriptors.

III. PROPOSED SYSTEM

To investigate and implement the proposed method publicly, the available dataset and MATLAB computing is used for implementation. Principal Component Analysis is used for feature reduction. Classification is carried out using Multilayer Perceptron with different learning rate and Momentum. The proposed design consists of three sections.

- PREPROCESSING
- SEGMENTATION
- CLASSIFICATION & ANALYSIS

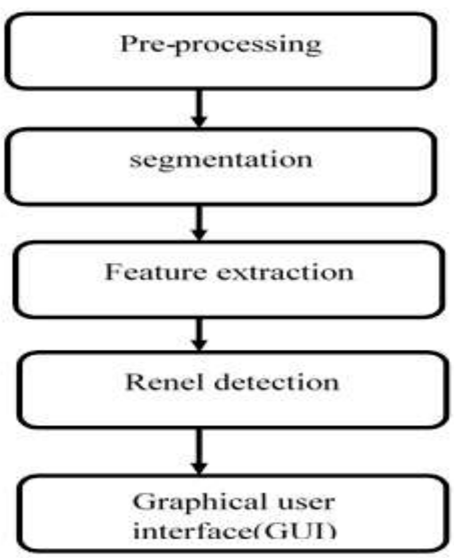


Figure:1 Flow diagram of proposed method

3.1 PREPROCESSING

The aim of pre-processing is to improve the acquired low contrast ultrasound image with speckle noise. It suppresses the undesired distortions and enhances certain image features significant for further processing and stone detection. Without pre-processing, the image quality may not be good for analysing. For surgical operations, it is essential to identify the location of kidney stone accurately. Pre-processing helps to overcome this issue of low contrast and speckle noise reduction.

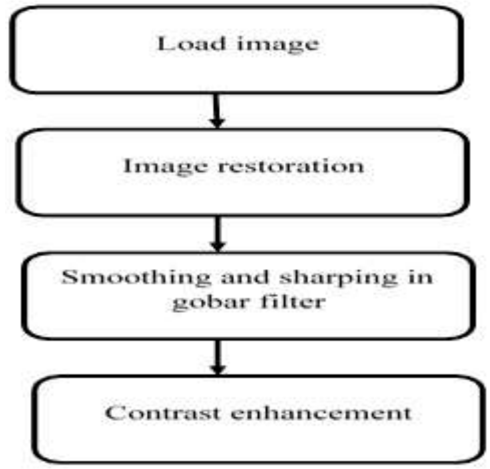


Figure: 2 Flow diagram of Pre-Processing

3.2 SEGMENTATION

The level set segmentation method used first to segmented the location of kidney from us scanned image and the segmented kidney portion output is applied again for level set segmentation to segment only stone portion so that processing time will be reduced and image storage memory utilization is also reduces. There are two modified gradient descent methods. First sing a momentum term and second is based on resilient propagation (R_{PROP}) term. The intention of the segmentation is to overcome difficulties involved in energy function. The energy function depends on properties of the images such as gradients, curvatures, intensities and regularization terms, example: smoothing constraints.

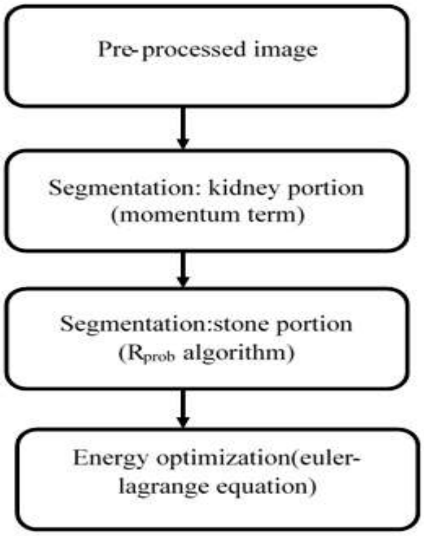


Figure:3 Flow diagram of Segmentation

3.3 CLASSIFICATION & ANALYSIS

ANN classification two architectures are used namely multilayer perceptron and back propagation which are described in the following sections.

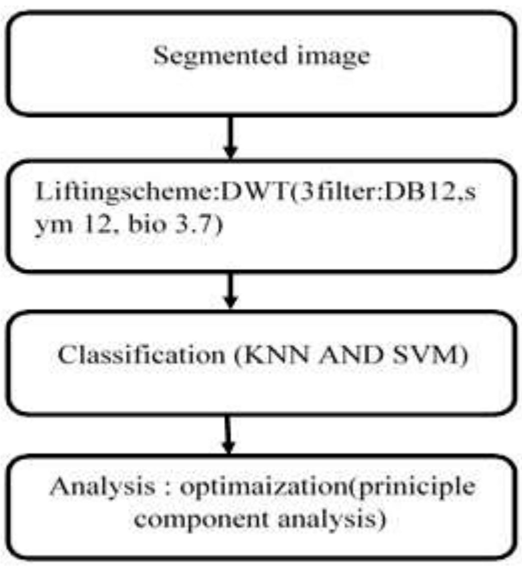


Figure:4 Flow diagram of classification and analysis of pre-processing

3.3.1 Multilayer perceptron (MLP)

A multilayer perceptron is a feed forward artificial network algorithm that maps sets of energy values obtained from wavelets sub-bands energy extraction. These energy values are fed to input layer and multiplied with initial weights. The back propagation is modified version of linear perceptron in which it uses three or more hidden layer with nonlinear activation function. There are two phases.

- Forward phase
- Backward phase

Forward phase:

$$X_j^{(t)}=\theta\varepsilon_j^{(t)}=\theta[\sum x_j^{(t)}w_j^{(t)}+w_j^{(t)}]$$

Where D(L-1)is the number of neutrons in layer (L-1),$X_j^{(t-1)}$output of the j^{th} neutron in the (l-1)th layer, $W_{ij}(i)$ synaptic weight contained in the current neuron, $w_{ij}(i)$ current neuron's bias weight , $X_j^{(t)}$ output of the current neuron.

Backward phase:

In this phase the weights and biases are updated according to the error gradient-descent vector. After an input vector is applied during the forward computation phase, a network output vector is obtained. A target vector t is provided to the network, to drive the network the expected target.

$$ej(i)=\begin{cases}(1-X(i)) & \text{for } l=L\\ \sum W_{ij}^{(l+1)}s_j^{(l+1)} & \text{for } l=1,2,3....L-1\end{cases}$$

Where e_j^l is the error term for j^{th} neuron in the l^{th} layer.

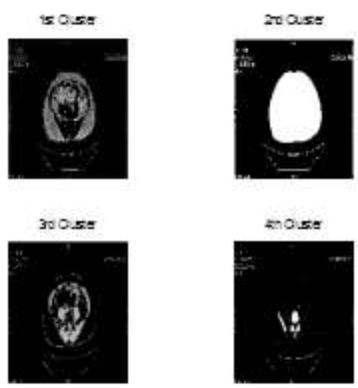
$$s_j^{(l=1)}=e_j^{(l+1)}\theta(s_j^{(l)}) \quad \text{for } l=1,2......$$

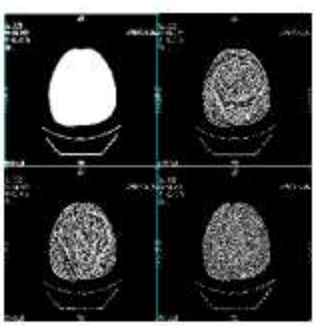
where $\theta(s_j^{(l)})$is the derivative if the activation function.

IV. RESULT & CONCLUSION

Medical related information is highly voluminous in nature in the healthcare industry. It can be derived or retrieved from various sources which are not entirely applicable in this feature. In this work, kidney disease prediction system was developed using classification algorithms (SVM) through Mat lab data mining tool to predict effective and better accurate results regarding whether the patient is suffering from kidney disease or not. we use image enhancement, morphological operation, feature extraction, region of interest using segmentation techniques and finally classify the image dataset with kidney stone detection or without stone. Because of training of the machine for both the type of image, now machine will able to predict the new kidney image that whether it is an ABNORMAL KIDNEY IMAGE that has stone or NORMAL KIDNEY IMAGE having no stone. Therefore, it reduces medical work for many check-up and all. Its time taken(in ms)=5.0370

ABNORMAL CASES:





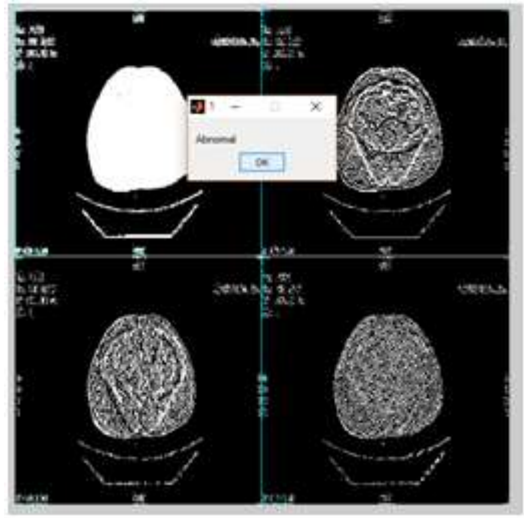


Figure:5 kidney stone CT scan image

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