SEGMENTATION OF KIDNEY STONE REGION IN ULTRA SOUND IMAGEBY USING REGION PARTITION AND MOUNTING SEGMENTATION ALGORITHM (RPM)

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ABSTRACT

One of the safest techniques for disease diagnosis which can be used in any part of the body is ultrasound imaging. The cost when compared with MRI, PET etc are higher than using ultra sound images is the one of the major reason. Further, it is an efficient technique for initial diagnosis and it is free from any radiation exposure. This paper concentrates on segmentation of kidney from abdominal ultrasound images. There are many common ailments affecting kidney. Hence conducting study on this segmented image becomes easy with an efficient segmentation technique. In this paper Various algorithms to pull out kidney regions from abdominal ultrasound images which are discussed by many researchers are also investigated. Due to the complicated internal organs of the abdominal region, extraction of only the kidney region is very challenging and is the major drawback of ultrasound imaging. a new technique where the collected abdominal ultrasound image is cleaned, to remove unwanted noise produced due to various interferences has been processed by this paper, the kidney region is segmented after applying the filtering technique. the subjected to Region indicator contour segmentation method to extract the renal calculi which is the region of interest in this study is this extracted kidney image. with a reasonable number of dataset and applied the statistical performance test to check for the accuracy , the method is experimented .

Keywords*:* Segmentation, Ultrasound Image, Image processing, Kidney Image, Stones,

INTRODUCTION

In almost all image analysis system the image segmentation is an indispensable step [1]. Subdividing the image into various regions and thus extracting the required ROI from it is known as image segmentation. Many Segmentation techniques were evolved which were mainly based on similarity or dissimilarity principle. It is a crucial part in image analysis and object recognition. In literature,there are different segmentation algorithms available. Thresholding, region growing, region splitting and merging etc are some of the basic methods. due to the interference of artifacts and great care should be given for edges the segmentation of medical images is very complicated [2]. The results of intensity based image processing methods and can be affected by the occurrence of the artifacts. To put forth an automated detection of kidney stones for diagnostic assistance for physicians since Computer vision seems sharper than Human vision, several works were focused.

A popular and advanced imaging technique that uses high-frequency sound waves to view the body's internal organs and blood flow through the blood vessels and the images are recorded by sonographer in real-time for

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medical analysis is ultrasound imaging (sonography). Unlike X-ray imaging, ionizing radiation exposure is not associated its side-effects and complexity with ultrasound imaging.

A prominent role in inculcating various levels of human perceptions and basic understanding of the captured images are done by the skills of human operator. Different operators with respect to the relative expertise could interrupt an ultrasound image of kidney differently. The underlying novel techniques didn't pay-off the desired performance since the human intervention makes more prone to deliver a trivial result more often. a new yet demanding area of research that aims to more appropriately distinguish the actual symptoms from the artifacts which plays a crucial role in identifying the stones as features in the later parts of diagnosis process has been opened by it.

EXISTING METHODS

An active area of research is segmentation of medical images. The major motive of any segmentation algorithms is Accuracy of segmentation with powerful edge detection. In segmentation of kidney from other complicated organs of the abdomen a lot of research work has happened . Jun Xie, Yifeng Jiang and Hung-tat Tsui presented a novel texture and shape based method for kidney segmentation in ultrasound (US) images. To test images through two-sided convolution strategy a variety of Gabor filters were used. a texture model is developed by approximating the parameters, utilizing half-planed Gaussians by using expectation-maximization method. Similar texture areas around the segmenting locality is measured With the help of this model. By using this energy function the intention of partitioning the test image is achieved . The segregation of two regions-the inside one with high texture similarity and low texture variance, and the outside one with high texture variance [3] is the outcome of this work.

There are several existing approaches were made to detect the suspicious region in ultrasonic 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 [2].

Texture segmentation, which makes use of statistical textures analysis to label regions based on their different textures, has attracted our attention, Since intensity based methods have met with limited success for abdominal segmentation.low-level features based on texture information, that 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 investigated by [3] in this approach.

Among various image segmentation methods, the Seeded Region Growing (SRG) algorithm, originally proposed by [4], is a fast, robust, parameter-free method for segmenting intensity images given initial seed locations for each region. if their attributes, such as intensity or texture, are similar enough In SRG, individual pixels that satisfy some neighborhood constraint are merged . The seed location, an optimal threshold value and a similarity measure need to be determined either manually or automatically. An important aspect of the segmentation process missed with point based techniques Region-based methods focus attention . There a pixel is classified as an object pixel judging solely on its gray value independently of the context. This meant that isolated points or small areas could be classified as object pixels, disregarding the fact that an important characteristic of an object is its connectivity. If we use not the original image but a feature image for the segmentation process, the features represent not a single pixel but a small neighborhood, depending on the mask sizes of the operators used. At the edges of the objects,

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however, where the mask includes pixels from the object and the background, any feature that could be useful cannot be computed. The correct procedure would be to limit the mask size at the edge to points of either the object or the background [5].

The region-growing method was applied from the center of the selected seed region as the starting point For kidney tumor segmentation . Generally, the homogeneous test from the start pixel to the neighbor pixel using gray-level, texture, and color as acceptance criteria, and included or excluded the neighbor pixel according to the homogeneous test result until termination condition was satisfied [6] was performed the region growing method.

However, a difficult task for noisy images such as B-scan ultrasound images, because the boundaries of the tumors of interest can be fuzzy and has low contrast is effective segmentation. A study of quantitative evaluation of (semi)-automated segmentation of US images and showed that even manual segmentation of noisy US images is not straight forward. On the other hand, reliable semi-automatic segmentation methods offer the potential advantage of making the measurement process more consistent [8]

IMAGE SEGMENTATION

The process of splitting or dividing the image into smaller parts is known as segmentation. the partitions that are made through segmentation are meaningful that reveals the relevant information about the partition. As the images irrespective of their size they are partitioned into smaller parts as they enhance the performance of the problem identification much easier. Though segmentation is necessary step that has to be carried out in the problem, the extent to which the image has to be segmented is thoroughly dependent on the problem. Segmentingthe images has to be stopped once the required region is extracted from the original image. The sole purpose of performing segmentation in the image is to extract the infected region from the original image of kidney. There are multiple ways to segment the infected portion from the infected region. The background images from the infected images can be removed by utilizing the background subtraction technique, which is one of the efficient methods in eliminating the background.This section also discuss the segmentation and its types that used by various researcher to segment the image. Some of them are region based, thresholding based, clustering based, and classifier.

Region based

In this method based on the common property image is divided into various region. There are two logics: i. fusion the pixel based on their property like histogram,color, threshold value. ii. second one focused on non-uniform area are broken into smaller areas which may be identical. Assimilation starts from an identical region. Main drawback of this method is computation time will be long[6].

Threshold based

This is exceptionallystraightforward method. It is used to create a binary image. Binary image is created by using gray image thresholding. To split the image into smaller area or portion threshold value is used. Converting pixel to two or more classes from source image is called segmentation. If more than two classes then the result will be several binary images. The binary images will help to reduce the complexity of data and processing time.[7,8,11&15]

Classification based

It is based on supervised method. It classify the pixel based on predefined patterns. It segment the image based on predefined pattern. Nearest neighbor classifier is simple classifier. In which each pixel is classified based on closest intensity. K-nearest neighbor is a common approach in the segmentation. But it needs training process. [9,10,11]

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Clustering based

Clustering technique uses the region segmentation to arrive at sets or clusters of pixels having similarity in existence with respect to the feature space [12,13,14]

There are two approaches used in Clustering-based techniques

i. K-means clustering-It is used to solve the low-level segmentation tasks. This algorithm is convergent and computationally efficient.

ii. Fuzzy Clustering-It is effectively used in image processing pattern recognition and fuzzy modelling.

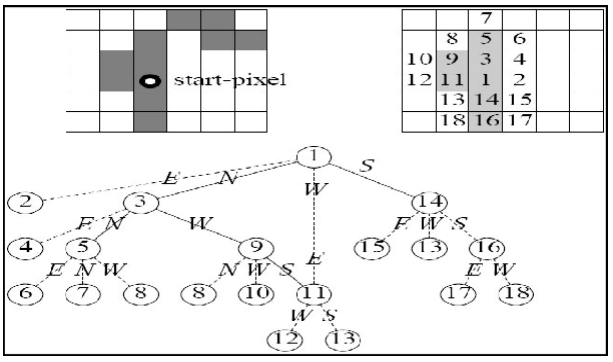
PROPOSED METHOD

This research proposed a new segmentation method Region Partition And Mounting Segmentation Algorithm(RPM). The RPM carrying out may either depth-first or breadth-first traversal. For implementation to test take 6x6 image with single seed pixel. The algorithm starts by visiting nearest neighbours of seeds in a predefined orientation which could be $EAST-NORTH-WEST-SOUTH (clockwise direction) or $WEST-SOUTH-EAST-NORTH (anticlockwise direction). The difference between present pixel's gray level and seed pixel is calculated . Then the decision of insertion of that pixel into the region is made accordingly. Once a pixel is added, then the mean of the region is updated. Next nearest neighbourpixel will be chosen for the decision of its insertion in the region as shown in Figure. 1 and Figure 2.

Pixel labeled 1 (seed pixel) has 4-neighbors 2, 3,11, and 14. Since pixel 2 and seed pixel gray level differs entirely; it is analyzed but not labelled neither included in for the growing of region. Such visits need an instantaneous backtrack during traversal. Let the difference between pixel 3 gray levels and seed pixel gray level is minimum and hence it will be labelled and become part of the growing region, the immediate neighbors of pixel 3 i.e. 4,5 and 9 are analyzed as its nearest neighbourpixel 1 (seed pixel) is already labeled. This time pixel 4 exclude for insertion, pixel 5 succeed (but its neighbour causes back-tracking), and pixel 9 is also included.

Figure:1

Proposed Region Partition And Mounting Segmentation Algorithm(RPM).



Region Partition And Mounting Segmentation Algorithm(RPM).

Step 1: Read the pre-processed kidney stone ultra sound image (7x7)

Step 2: choose either depth first or bread first traversal.

Step 3: start the visiting in $EAST-NORTH-WEST-SOUTH (clockwise direction) to remove the foreground pixels

Step4:start the visiting in to remove the foreground pixels $WEST-SOUTH-EAST-NORTH (anticlockwise direction) to remove the background pixels.

Step 5:The difference of current pixel's gray level and seed pixel is measured and the decision of inclusion of that pixel into the region is made accordingly.

Step 6: Once a pixel is added, the mean of the region is updated and next nearest neighbor will be chosen for the decision of its inclusion in the region as shown in Figure. 1.

Step 7: compared threshold value to predict shape.Now find the mask of (x, y) using the threshold value If $((x, y)$

The proposed algorithm exactly segments the stone region from the kidney. The proposed method exactly removes background than other existing methods. It is represented in figure.

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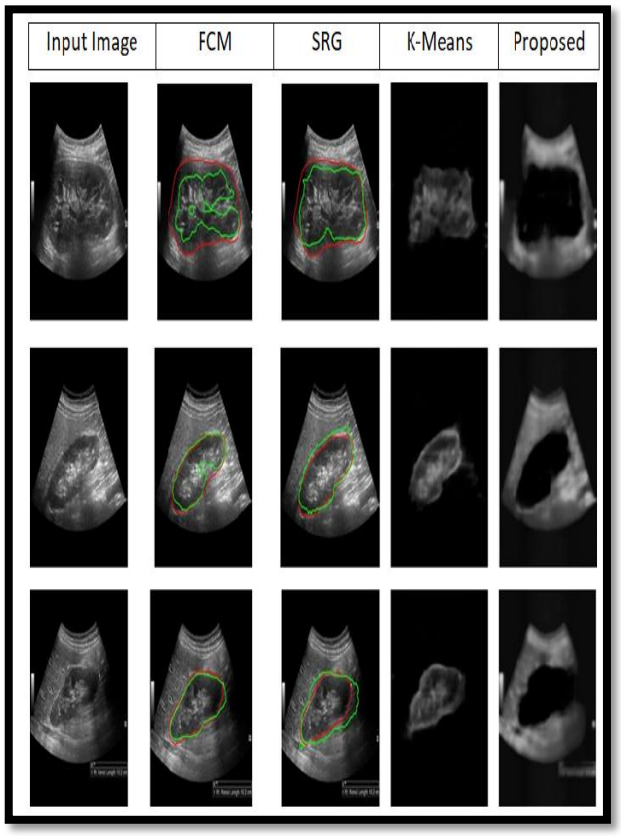
Figure:1I
Performance of Proposed Algorithm



RESULT AND DISCUSSION

The proposed method Region Partition And Mounting Segmentation Algorithm(RPM) is evaluated by 6 metrics. They are Dice coeeficient, precision, F measure, Jaccrd Index, Sensitivity and specificity.

To compute these metrics need to estimation the following parameters: True Negative (TN), False Positive(FP), False Negative(FN) and True Positive(TP).

True positive (TP) : pixels acceptably segmented as foreground

False positive (FP) : pixels incorrectly segmented as foreground

True negative (TN) : pixels acceptably detected as background

False negative (FN) : pixels incorrectly detected as background

Accuracy: (TP+TN)/(TP+FP+TN+FN)

In general, Positive = recognized and negative = rejected. Therefore:

- True positive = properlyrecognized
- False positive = wronglyrecognized
- True negative = properly rejected
- False negative = wrongly rejected

i. Sensitivity

It refers to the test's ability to properly detect defected pixels, which have the fulfill the condition. It is a statistical method. It deals the proportion of concrete positives values which are suitably accepted. It is also known as True Positive Rate* (TPR). The following equation is used to calculate the sensitivity.

Sensitivity=

$$\frac{NumberofTruePositive}{NumberofTruePositive \quad +num\ beroffalsenegative} \rightarrow (1)$$

ii. Specificity

It refers the quantity of negative values which are properly recognized. This is known as True Negative Rate (TNR). The following equation is used to calculate the specificity.

Specificity=

$$\frac{Num\ berofTrueNegative}{numberoftruenegatives \quad +numberoffalsepositives} \rightarrow (2)$$

iii. Dice coefficient

It refers the association between sets of neighbor pixels X and Y. If the two sets of pixels are identical, then the coefficient is equal to 1.0, while if X and Y have no elements in common, it is equal to 0.0. The following equation (3) is used to calculate the same.

$$\text{Dice} = \frac{2TP}{2TP+FP+FN} \rightarrow (3)$$

iv. Jaccard similarity coefficient

It evaluate two sets of segmented image to find difference. It's a calculate of relationship for the two sets of data, with a range from 0% to 100%. The maximum percentage specify the more similarity between two segmented image. The following equation (4) is used to calculate the

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same

$$\text{accard similarity coefficient} = \frac{TP}{TP+FP+FN}$$

v. Precision

It is used to estimate level to which the same result would be created over different segmentation sections. The equation (5) is used to calculate precision.

$$PPV = \frac{TP}{TP+FP} \quad \rightarrow (5)$$

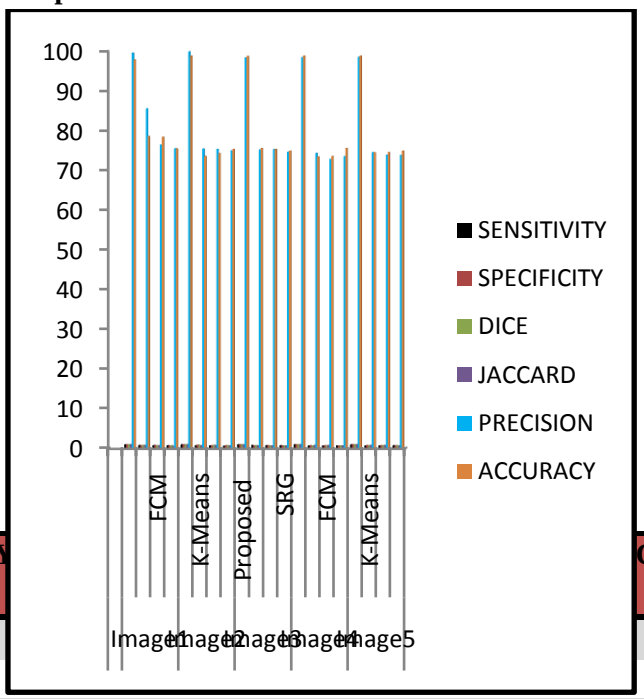
Table 1

Evaluation of metric values

Test image	Method	SENSITIVITY	SPECIFICITY				CY
Image1	**Proposed**	**0.988**	**0.987**				
	K-Means	0.785	0.756				
	FCM	0.744	0.789	0.756	0.756	76.33	78.27
	SRG	0.734	0.683	0.723	0.654	75.37	75.32
Image2	**Proposed**	**0.968**	**0.997**	**0.958**	**0.966**	**99.77**	**98.68**
	K-Means	0.723	0.831	0.776	0.744	75.31	73.43
	FCM	0.678	0.743	0.789	0.767	75.22	74.21
	SRG	0.627	0.712	0.745	0.674	74.87	75.23
Image3	**Proposed**	**0.985**	**0.978**	**0.988**	**0.987**	**98.23**	**98.65**
	K-Means	0.783	0.679	0.756	0.687	75.09	75.43
	FCM	0.756	0.756	0.698	0.657	75.22	75.21
	SRG	0.726	0.685	0.653	0.673	74.53	74.78
Image4	**Proposed**	**0.989**	**0.997**	**0.979**	**0.982**	**98.34**	**98.67**
	K-Means	0.688	0.721	0.697	0.768	74.22	73.34
	FCM	0.685	0.745	0.686	0.782	72.68	73.45
	SRG	0.702	0.698	0.689	0.696	73.45	75.45
Image5	**Proposed**	**0.988**	**0.996**	**0.975**	**0.986**	**98.37**	**98.68**
	K-Means	0.667	0.765	0.743	0.787	74.45	74.34
	FCM	0.698	0.745	0.747	0.774	73.76	74.45
	SRG	0.743	0.721	0.734	0.687	73.67	74.78

The prove the efficiency of proposed method the statistical tests is summarized in Table 1 with accuracy, precision, specificity, sensitivity, Dice Coefficient, Jaccard Index.

Graph 1



CONCLUSION

This paper introduced the new image segmentation method to kidney stone region. Further this paper also shows the efficiency of new method by comparing the results. Efficiency can be checked by applying statistical test. This statistical test calculate the following parameters accuracy, precision, sensitivity, specificity, Dice Coefficient, Jaccard Index to measure the effectiveness of the new method and it achieved high value than FCM, K-Means and SRG. The proposed method achieved 98% sensitivity, 99% of specificity, 98% of Dice coefficient, 98% of Jaccard Index and 98% of accuracy than the existing methods.

REFERENCE

[1]Websiteon Imaging-Modalities: http://www.medicalimaging.org/about-mita/medical-imagingprimer

[2] E. Koss, F. D. Newman, T. K. Johnson, D. L. Kirch, "Abdominal organ segmentation using texture transform and a Hopfield neural network", IEEE Trans. Medical Imaging, Vol.18, 640-648, 1999.

[3] R. Susomboon, D. S. Raicu, and J.D. Furst,

SSN (Print): 2204-0595
ISSN (Online): 2203-1731

"Pixel-Based Texture Classification of Tissues in Computed Tomography", CTI Research Symposium, Chicago, April 2006

[4] R. Adams, L Bischof, "Seeded region growing". IEEE Transaction Pattern Analysis Machine Intelligence, 16, 641- 647, 1994.

[5] Krishna Kant Singh, Akansha Singh., A Study Of Image Segmentation Algorithms For Different Types Of Images, IJCSI International Journal of Computer Science Issues, Vol. 7, Issue 5, September,414-417,2010.

[6] D.Y. Kim & J.W. Park," Computer-Aided Detection of Kidney Tumor on abdominal Computed Tomography Scans", ACTA Radiologica, Taylor & Francis health sciences, 2004. [8] William Mark Morrow, Raman BhalachandraPranjape, Rangaraj M. Rangayyan, Joseph Edward Leo Desautals, "Region-Based Contrast Enhancement of Mammograms", IEEE Trans. on Medical Imaging Vol. 11,3, September 1992.

[9] S. P. abd, V. Chalana, and Y. Kim, "Interactive automatic fetal head measurements from ultrasound images using multimedia computer technology," Ultrasound Med. Biol., vol. 23, p. 665C673, 1997.

[10]G. Gonzalez, E. Woods, "Digital Image Processing", Second Edition, Prentice Hall, 2002.

11.Dr.RenukaDevi,Suganyadevi.S".Scrutiny Of Prophecy Chronic Kidney Diseases Through Data Mining Techniques".International Journal Of Scientific & Technology Research,Volume 9, Issue 02, February 2020, ISSN 2277- 8616

12..Sahana B J &DrMinavathi,"Kidney Disease Prediction Using Data Mining Classification TechniquesandANN",International Journal of Innovative Research in Computerand Communication Engineering.

13.J. Serrat, F. Lumbreras, F. Blanco, M. Valiente, and M. López-Mesas, "myStone: A system for automatic kidney stone classification," Expert Systems with Applications, vol. 89, pp. 41-51, 2017.

14.Rady, E. H. A., & Anwar, A. S. (2019). Prediction of kidney disease stages using data mining algorithms. Informatics in Medicine Unlocked, 100178

15..Dr.RenukaDevi,Suganyadevi.S."DE-NOISING OF KIDNEY STONE ULTRASOUND IMAGE USING PREWITTSMOOTH CONVOLUTION FILTER (PSCF)",JOURNAL OF CRITICAL REVIEWS,ISSN- 2394-5125, VOL 7, ISSUE 10, 2020,pp-1779-1787

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