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Increasing Precision of Edge Recognition in Static Renal

KEYWORDS crumb rubber, utilization, compressive strength, low cost, sustainable

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ABSTRACT *A region of interest (ROI) technique of renal scintography is a portion of an image that filter by using some algorithm. In dynamic tests of kidney, the segmentation of the kidneys performed using edge detection and basic morphology tools in MatLab image processing program. The gradient image calculated and a threshold applied to create a binary mask containing the segmented liver. First, I used Sobel edge technique. I then tuned the threshold value and used edge again to obtain a binary mask that contains the segmented kidney. Finally, in order to make the segmented kidney look natural, I smoothened the kidney by eroding the image twice with a diamond-structuring element. Less than 3% of cases (50 cases). The effectiveness of the segmented images with use of these kidney borders was arbitrated by a nuclear medicine physician as being comparable to other segmentation techniques created with manual editing. This technique showed potentials to precisely detect the liver with nuclear medicine images.*

INTRODUCTION

Two types of radioactive tracers are used for renal studies: tracers cleared from plasma by glomerular filtration and those cleared by tubular secretion. The first class comprises ^{99m}Tc-DTPA, ^{125}I-iothalamate and ^{51}Cr-DTPA. Glomerular filtration is a passive mechanism through which plasma is cleared from water and solutes. The glomerular filtration (GFR) rate represents 20% of renal plasma flow and is ideally reflected by the clearance of (non-radioactive) inulin. Renal clearance of the listed radioactive tracers approaches the clearance of inulin indicating almost complete glomerular filtration without significant tubular reabsorption and extrarenal clearance. ^{99m}Tc-DTPA is commonly used for both imaging studies and clearance measurements while ^{125}I-iothalamate and ^{51}Cr-EDTA do not produce adequate photons for imaging and are therefore less widely used. Furthermore, although it is recognized as the tracer of choice for GFR measurements because its clearance is virtually identical to that of inulin, ^{51}Cr-EDTA is not available in the US [1]. ^{99m}Tc-DTPA is minimally bound to plasma proteins resulting in a small error (<5%) in the measurement of the GFR [2]. ^{99m}Tc-DTPA is widely used because it not only allows the measurement of absolute renal function but also imaging in a variety of renal disorders. Furthermore, it is inexpensive, stable and has a low radiation dose. Renal cortical scintigraphy was initially used as a morphological tool. The development of ultrasonography and CT scanner along with refinements of intravenous pyelography provided clinicians with excellent anatomical information so that renal scintigraphy, especially with ^{99m}Tc-DMSA, has evolved to a more functional assessment of the renal parenchyma. Although ^{99m}Tc-DMSA scanning can occasionally be useful in assessing congenital abnormalities (e.g. evaluation of horseshoe kidney) or space-occupying lesions, the major indications now include the diagnosis of urinary tract infection (UTI), renal scarring especially in vesicoureteric reflux (VUR), as an alternative to nephrographic agents, and measurement of split renal function[3]. The diagnosis of upper UTI is usually easy in adults, based on clinical signs, elevated erythrocyte sedimentation rate and C-reactive protein, urine analysis and culture. It remains, however, a challenge in children sometimes due to the paucity of the clinical picture. Furthermore, when present, symptoms are rather non-specific and fever may be the only sign. Prompt diagnosis is necessary because of the potentially significant long-term sequelae. Adequate management of UTI can prevent scarring which can lead to hypertension, loss of functional cortex and, in extreme cases, chronic renal failure [4]. A large prospective study showed that a normal DMSA scan in acute UTI was predictive of a normal follow-up course whereas an abnormal scan was related to VUR in one third of the cases and suggestive of a less indolent course [5]. Although the clinical presentation of UTI and VUR may be different, it is impossible not to establish links between UTI, VUR and scarring. In children, scarring is usually associated with VUR and was found in 12% of children with UTI and 25% of those with recurrent episodes [6]. The role of ^{99m}Tc-DMSA scintigraphy has been well established in identifying potentially reversible defects in acute pyelonephritis and permanent functional damage in scarring [7-10]. It must however not be considered a necessary method for establishing the diagnosis of acute pyelonephritis which is usually based on clinical and biological data. Although it has been a common procedure for almost 20 years, interpretation of ^{99m}Tc-DMSA scintigraphy is far from easy. Gacinovic et al. (1996) reported a lack of inter-observer consistency though this was not confirmed by two subsequent studies using more definite evaluation criteria [11]. The key question is to define whether a DMSA scan is normal or abnormal. In a study by Clarke et al. (1996), images were considered equivocal in 68/496 children. Of interest is the fact that the sensitivity – or more precisely the prevalence of abnormalities – of ^{99m}Tc-DMSA scanning is relatively low in UTI. This is not due to an intrinsic weakness of the method but to the fact that abnormalities can only be detected when significant damage to the renal cortex has occurred. This was nicely shown in animal experimental studies in which correlation with histopathology was obtained [12] Thus, the role of DMSA scintigraphy is not only to help in the diagnosis of UTI but mainly to assess the functional consequences of UTI on the integrity of the parenchyma. Normal images demonstrate fairly uniform distribution in the cortex with centrally located relatively photopenic defects, corresponding to the

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calices and papillary pyramids. Activity is not visible in the collecting system except in obstruction. In acute pyelonephritis, three patterns are observed: a focal defect without loss of organ contour, multiple focal defects and diffuse involvement of an entire kidney, characterised by reduced uptake and often enlargement due to oedema. In chronic pyelonephritis and scarring, focal retraction(s) of the cortex with loss of organ contour are the most common abnormalities whereas atrophy of either one or both kidneys is found in 10%–20% of cases [13-15]. Better delineation of the lesions can be obtained using pinhole scintigraphy; some authors have proposed the use of high-resolution SPECT. Despite experimental evidence that SPECT is more accurate than planar imaging in the diagnosis of acute pyelonephritis, its benefit in patients looks rather marginal and it seems mainly useful in assessing scarring (Williams 1992). Furthermore, a study in normal volunteers demonstrated abnormalities on SPECT images with entirely normal planar images: systematic use of SPECT carries the risk of over-diagnosing either acute cortical defects or scars. In clinical practice, in children younger than 5 years, ^{99m}Tc-DMSA scanning should be performed following UTI, regardless of the result of ultrasound, to exclude scarring. The decision to proceed to direct or indirect isotopic cystogram or to micturating X-ray cystogram will depend on the age and gender. Finally, it must be stated that an abnormal scan at the time of acute infection is not predictive of scarring and some defects may take time to resolve. Therefore, repeat scanning is required in the follow-up (2 to 6 months after infection) to identify scarring. DMSA scan is a better predictor of VUR if performed within 2 months of infection [16].

MATERIALS AND METHODS

The toolbox supports a set of functions that could be used for texture analysis. Texture analysis refers to the characterization of regions in an image by their texture content. Texture analysis attempts to quantify intuitive qualities described by terms such as rough, smooth, silky, or bumpy as a function of the spatial variation in pixel intensities. In this sense, the roughness or bumpiness refers to variations in the intensity values, or gray levels. Texture analysis used in a variety of applications, including remote sensing, automated inspection, and medical image processing. Texture analysis could be used to find the texture boundaries, called texture segmentation. Texture analysis can be helpful when objects in an image were more characterized by their texture than by intensity, and traditional thresholding techniques cannot use effectively.

Texture segmentation is the identification of regions based on their texture. This study goal is to segment two kinds of fabric in an image using texture filters. The function entropyfilt returns an array where each output pixel contains the entropy value of the 9-by-9 neighborhood around the corresponding pixel in the input image I. Entropy is a statistical measure of randomness. Threshold the rescaled image Eim to segment the textures. A threshold value of 0.8 is selected because it is roughly the intensity value of pixels along the boundary between the textures. Compare the binary image rough Mask to the original image I. Notice the mask for the bottom texture is not perfect because the mask does not extend to the bottom of the image. However, we could use roughMask to segment the top texture. Instead of entropyfilt, we could use stdfilt and rangefilt with other morphological functions to achieve similar segmentation results. The segmentation steps were shown in figure 1.

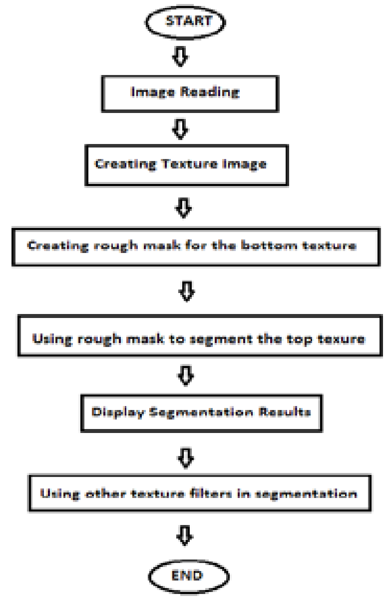

Figure 1. Steps of Kidney Segmentation

RESULTS

This is an experimental study deals with segmentation of l Static Renal Scintography images using edges recognition filters using image processing technique (MatLab version R2009a). The segmentation of image started firstly by reading image as shown in (Figure 2).

Figure 2. Original image

Two kidneys were present in this image and they can be seen in them entirety. I detected or segmented those lungs. The kidneys segmented differs greatly in contrast from the background image. Operators that calculate the gradient of an image in contrast can detect changes. The gradient image could calculate and a threshold could apply to create a binary mask containing the segmented cell. First, we use edge and the Sobel operator to calculate the threshold value. I then tune the threshold value and use edge again to obtain a binary mask that contains the segmented lungs as shown in (Figure 3).

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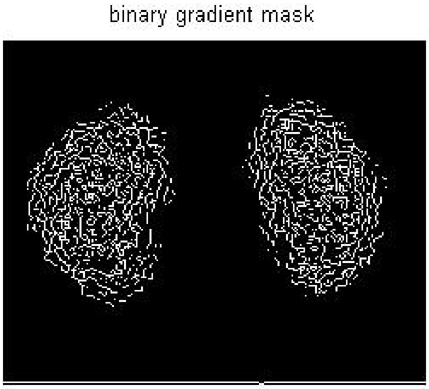

Figure 3. Binary gradient mask

The binary gradient mask shows lines of high contrast in the image. These lines do not quite delineate the outline of the object of interest. Compared to the original image, we can see gaps in the lines surrounding the object in the gradient mask. These linear gaps will disappear if the Sobel image is dilated using linear structuring elements, which we can create with the strel function. The binary gradient mask is dilated using the vertical structuring element followed by the horizontal structuring element. The imdilate function dilates the image as shown in (figure 4).

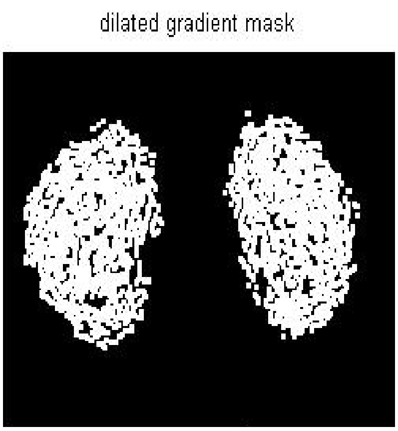

Figure 4. Dilated Gradient Mask

The dilated gradient mask shows the outline of the thyroid quite nicely, but there are still holes in the interior of the kidneys. To fill these holes we use the imfill function as shown in (figure 5).

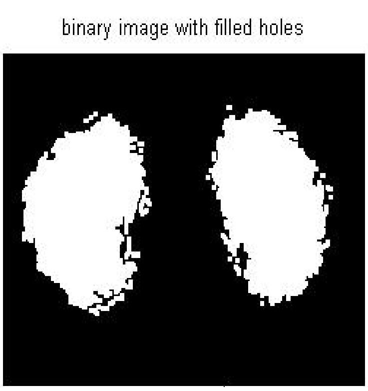

Figure 5. Binary Image with filled holes

The kidneys have been successfully segmented, but it is not the only object that has been found. Any objects that are connected to the border of the image can be removed using the imclearborder function. The connectivity in the imclearborder function was set to 4 to remove diagonal connections as shown in (figure 6).

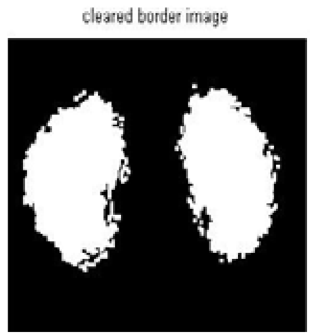

Figure 6. The Cleared Border Image

Finally, in order to make the segmented object look natural, we smoothen the object by eroding the image twice with a diamond-structuring element. We create the diamond structuring element using the strel function as shown in (figure 7).

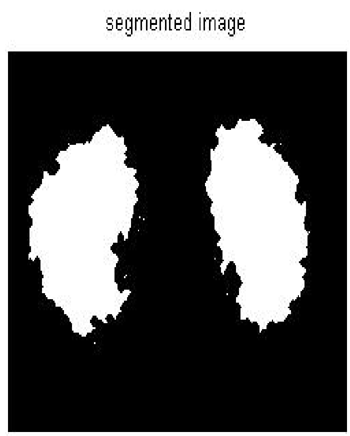

Figure 7. The segmented Image

An alternate method for displaying the segmented object would be to place an outline around the segmented; kidneys. The outline is created by the bwperim function (figure 8).

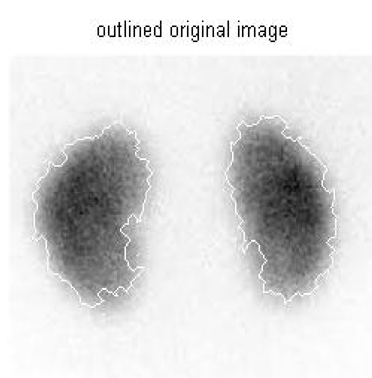

Figure 8. The outlined original image

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CONLCUSION

Segmentation used to identify the object of image that we are interested. The static renal scintography has become a common way to study kidney morphology disorders. Most images that created renal images were not completely clear and some had high signal noise ratio, which affected kidney borders detection. The main objective of this research was to increase the precision of edges recognition in Static Renal Scintography. In addition to detect the border of entire kidneys using segmentation, filter technique. These techniques help in preservation of the image's overall look, detected of small and low contrast details in the diagnostic content of the image, and highlighted the role of using image-processing technique in nuclear medicine. The result of edge detection now closely matches the original in-memory result. These were due to the different methods of padding used by the canny edge detector. Currently, blockproc only supports zero padding along the image boundaries. The smoothing of the object by eroding the image twice with a diamond-structuring element using the strel function will create the diamond-structuring element, which is useful of natural look of segmented object. So conclusion of this paper that edge detection and basic morphology tools are best tools to detect kidneys. The detection of the noise is a complex procedure, which is difficult to detect by naked eye so that image analysis should perform by using powerful image processing. A Texture segmentation Algorithm kidney proposed in this study. Proposed method is able to determine the kidneys boundaries accurately. It is able to segment lungs and improves radiological analysis and diagnosis.

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