Detection of kidney tumor for Computed Tomography images using Region Growing Segmentation

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Abstract: **In this paper implementation of Region growing segmentation method for detection of kidney tumor for computed tomography images is proposed. Region growing is an approach to image segmentation in which neighbouring pixels are checked and added to region growing if no edges of affected area are detected. With this algorithm it is possible to do kidney computed tomography image segmentation with reasonable speed and accuracy. This method is tested for segmentation on test images like MRI and CT images and found that this method is reliable whereas the model is simple and roboust with good accuracy.**

I.INTRODUCTION

Cancer is a term used for diseases in which abnormal cells divide without control and are able to invade other tissues. Cancer cells can spread to other parts of the body through the blood and lymph systems. There are more than 100 different types of cancer [1]. Most cancers are named for the organ or type of cell in which they start - for example, cancer that begins in the colon is called colon cancer; cancer that begins in melanocytes of the skin is called melanoma[1][2]. Human body is made up of many types of cells. Each type of cell has special functions. Most cells in the body grow and then divide in an orderly way to form new cells as they are needed to keep the body healthy and working properly. When cells lose the ability to control their growth, they divide too often and without any order[3]. The extra cells form a mass of tissue called a tumor. Identification of tumor involves test like CT and MRI. CT plays vital role in identifying location, size and type of kidney tumor.

There are many modalities of medical imaging that can be used to evaluate the human kidneys parameters, for example magnetic resonance imaging (MRI), x-ray computed tomography (CT), ultrasound imaging (US), and many others. This is important for the clinician to determine the health of the kidneys and also to visualize any abnormalities present in the kidneys. The MRI gives accurate and clear images of the kidney but it is not affordable as US [2]. While CT scan can show the scanning image less than five minutes but it contributed high dose of radiation to the patient, and it also more costly than US.

The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. Segmentation could be used for object recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing, or image database[3].cancer is the most deadly disease in both men and women there are several types of cancer like kidney cancer, lung cancer, Prostrate cancer, Breast Cancer, Uterus Cancer etc these diseases can cause of death Hence diagnosis of the cancer in the early stages is crucial.CT imaging is a widely used technology for diagnosing and treatment of cancer. Segmentation of images aims at dividing areas corresponding to different objects. There are two approaches for image segmentation, one is based on discontinuities and other is based on similarities [4]. These approaches can be used for enhancing and extracting the tumor area in CT images. It is noticed that the CT images contain unwanted portions that make segmentation difficult. If such images are segmented without any preprocessing for removal of the unwanted portions, it results into over segmentation [5].

In this paper, it is found that CT images are not processed to the more extend using image processing for detection of kidney diseases [6]. We propose to use Preprocessed CT image for the segmentation by using region growing segmentation for detecting affected part of kidney by using CT images of kidney. Results of the methods on original images are displayed. It is observed that, the appropriate preprocessing of CT images helps to significantly reduce the problem of over segmentation of these images still retaining the tumors.

II.RELATED WORK

If an image has been pre-processed appropriately to remove noise and artifacts, segmentation is often the key step in interpreting the image. CT is very important in order to improve the diagnosis and

treatment of kidney tumor, by detecting tumor at its early stage. Segmentation of medical images is first important step in their analysis, the segmentation gives organ detection and variation of growth of tissues as a output in medical images. In this paper Region growing segmentation techniques are discussed as below.

A range of image segmentation algorithms are based on region growing. We review some relevant studies that have used region-growing algorithms. Region growing algorithms take one or more pixels, called seeds, and grow the regions around them based upon a certain homogeneity criteria. If the adjoining pixels are similar to the seed, they are merged with them within a single region. The process continues until all the pixels in the image are assigned to one or more regions.

D.-Y.Kim& J.-W.Park[12] worked on Abdominal CT images were digitized with a film digitizer, and a gray-level threshold method was used to segment the kidney. Based on texture analysis performed on sample images of kidney tumors, a portion of the kidney tumor was selected as seed region for start point of the region-growing process. The average and standard deviations were used to detect the kidney tumor. Starting at the detected seed region, the region-growing method was used to segment the kidney tumor with intensity values used as an acceptance criterion for a homogeneous test. This test was performed to merge the neighboring region as kidney tumor boundary. These methods were applied on 156 transverse images of 12 cases of kidney tumors scanned using a G.E.Hispeed CT scanner and digitized with a Lumisys LS-40 film digitizer.

III.REGION GROWING METHODS

Region-based techniques rely on common patterns in intensity values within a cluster of neighboring pixels[7]. The cluster is referred to as the region, and the goal of the segmentation algorithm is to group regions according to their anatomical or functional roles.

Region-based segmentation methods attempt to partition or group regions according to common image properties. These image properties consist of :[8]

- Intensity values from original images, or computed values based on an image operator.
- Textures or patterns those are unique to each type of region.
- Spectral profiles that provide multidimensional image data.

The algorithm of region growing technique can be stated as follows [9].

1. In the first step pixel or group of pixels which belongs to the region of interest called seeds are formed.

2. In the next step pixels in the region of interest are examined and added to the growing region in accordance with the homogeneity criteria. Until no more pixels can be adjoined to the growing regions, this step continues.

3. And in last step the object illustration is done by all added pixels to the growing regions.

In the medical image segmentation field region growing technique can be applied in kidney segmentation, cardiac images, extraction of kidney surface etc. The key advantage of region growing technique is, these methods can correctly separate the regions that have the same properties that are define. One of the drawbacks of this method is, noise or variation of intensity may result in over segmentation.

We briefly conclude the advantages of region growing.

1. Region growing methods can correctly separate the regions that have the same properties we define.

2. Region growing methods can provide the original images which have clear edges the good segmentation results.

3. The concept is simple. We only need a small numbers of seed point to represent the property we want, then grow the region.

4. We can determine the seed point and the criteria we want to make.

5. We can choose the multiple criteria at the same time.

6. It performs well with respect to noise.

IV. METHODOLOGY

The developed software can working in optimum condition using computer that equipped with 4 GB RAM, Intel Core Duo 2.40GHz CPU processor and installed with MATLAB versions 7.10. The software still can operate in good performance if the specification of the computer were lower than stated above, but it may take longer time to process the final result. The average time taken to process a one second video in optimum condition is one minute. This system is about a software that can do image processing automatically to find kidney's tumor from CT images. The CT image was saved in .GIF/.JPG/.JPEG format before it will be uploaded into the software. Next, the image processing was done by the software for tumor detection.

Steps to be followed:

- Step1: Input Image

- Step2: Image Resizing
- Step 3: Seed Selection
- Step 4: Region Growing
- Step 5:Check Pixel Homogeneity

  No: go to step 3

  Yes: go to step 6
- Step 6: Check Full image is covered

  No: go to step 3

  Yes: go to step 7
- Step 7:

  No: Tumor not found

  Yes: tumor found and Calculate area of tumor.

The flowchart of the system was shown in Figure . First, the user needs to upload the kidney CT scanning image into the developed software. After scanning image will be save as jpeg or GIF format picture. Next, image processing for tumor detection will be applied on every image. The explanations on the image processing techniques will be discussed later.

Basic concept of seed points:

Region growing is a simple region-based image segmentation method. It is also classified as a pixel-based image segmentation method since it involves the selection of initial seed points. This approach to segmentation examines neighboring pixels of initial "seed points" and determines whether the pixel neighbors should be added to the region.

The first step in region growing is to select a set of seed points. Seed point selection is based on some user criterion (for example, pixels in a certain gray-level range, pixels evenly spaced on a grid, etc.). The initial region begins as the exact location of these seeds.

The regions are then grown from these seed points to adjacent points depending on a region membership criterion. The criterion could be, for example, pixel intensity, gray level texture, or color.

Since the regions are grown on the basis of the criterion, the image information itself is important. For example, if the criterion were a pixel intensity threshold value, knowledge of the histogram of the image would be of use, as one could use it to determine a suitable threshold value for the region membership criterion.

Some important issues:

Then we can conclude several important issues about region growing are:

1. The suitable selection of seed points is important.

2. More information of the image is better.

For region growing we need a rule describing a growth mechanism and a rule checking the homogeneity of the regions after each growth step.

A simple approach to image segmentation is to start from some pixels (seeds) representing distinct image regions and to grow them, until they cover the entire image.

The growth mechanism – at each stage k and for each region Ri(k), i = 1,…,N, we check if there are unclassified pixels in the 8- neighbourhood of each pixel of the region border.Before assigning such a pixel x to a region Ri(k),we check if the region homogeneity:

P(Ri(k) U {x}) = TRUE , is valid

The arithmetic mean m and standard deviation *sd* of a class Ri having n pixels:

M = (1/n)(r,c)€R(i) ∑ I(r,c)

$$s.d = \sqrt{((\frac{1}{n})(r,c) \in R(i) \sum [I(r,c) - M]^2) s.d}$$

Can be used to decide if the merging of the two regions R1,R2 is allowed,

if |M1 – M2| < (k)s.d(i) , i = 1, 2 , two regions are merged

Homogeneity test: if the pixel intensity is close to the region mean value,

$$|I(r,c) - M(i)| <= T(i)$$

Threshold Ti varies depending on the region Rn and the intensity of the pixel I(r,c).It can be chosen this way:

$$T(i) = \{ 1 - [s.d(i)/M(i)] \} T$$

Kidney Segmentation:

Image segmentation is the process by which a digital image is partitioned into separate connected sets of pixels corresponding to an object or region. Image segmentation algorithms are generally based on two basic properties of intensity values: discontinuity and similarity. In the first category, the approach is to partition an image based on abrupt changes in intensity, and in the second to partition an image into regions that are similar according to a set of predefined criteria.

V.RESULT AND DISCUSSION

The workflow of the system was shown in Figure C. First, the user needs to upload the kidney CT scanning image into the developed software. Thresholding is a process for classifying the pixels of a given image into two classes: those pertaining to objects and those pertaining to background. In analysis of the transverse image (Fig.2), three regions were identified by gray-level threshold: 1) a

dark region outside the patient's abdomen (background region), 2) the patient's abdominal region, and 3) the kidney regions, which are a little brighter than the patient's abdominal region.

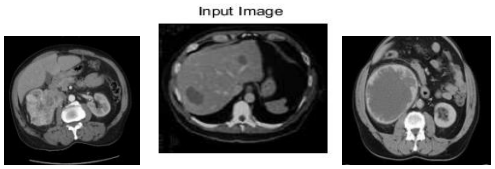

Fig 2: Input image for image processing

CT scanning is one of the most useful tests for finding and looking at a tumor inside our kidney. It is also useful in checking to see if a cancer has spread to organs and tissues beyond the kidney. The CT scan will provide precise information about the size, shape, and position of a tumor, and can help find enlarged lymph nodes that might contain cancer. The computed tomography (CT or CAT) scan is an x-ray that produces detailed cross-sectional images of our kidney. Before any pictures are taken, you may be asked to drink 1 to 2 pints of a liquid called oral contrast. This helps outline the intestine so that certain areas are not mistaken for tumors. An x-ray machine linked to a computer takes a series of detailed pictures of your kidney. You may receive contrast material, The contrast material makes abnormal areas easier to see.

Median filtering:

These filters are used for blurring and for noise reduction. These filters are also used for bridging small gaps in lines or curves prior to image segmentation. Smoothing filters used in this study are averaging and median filters. In the case of averaging filters, the centre pixel value is replaced by the average of its neighbourhood. In the case of median filter, a filtering method is needed that removes these tiny regions while preserving image structure. Median filter is used to eliminate small regions that appear isolated in the area of the filter mask.

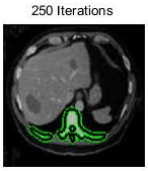

Fig3:Iterated Output Fig4: Region Growing Segmentation Output

Fig 3 shows segmented output of input image after that fig 4showss output of region growing segmentation which is detected tumor of kidneyRegion growing is a simple region-based image segmentation method. It is also classified as a pixel-based image segmentation method since it involves the selection of initial seed points. This approach to segmentation examines neighboring pixels of initial "seed points" and determines whether the pixel neighbors should be added to the region. The process is iterated on, in the same manner as general data clustering algorithms. The fundamental drawback of histogram-based region detection is that histograms provide no spatial information (only the distribution of gray levels). Region-growing approaches exploit the important fact that pixels which are close together have similar gray values.

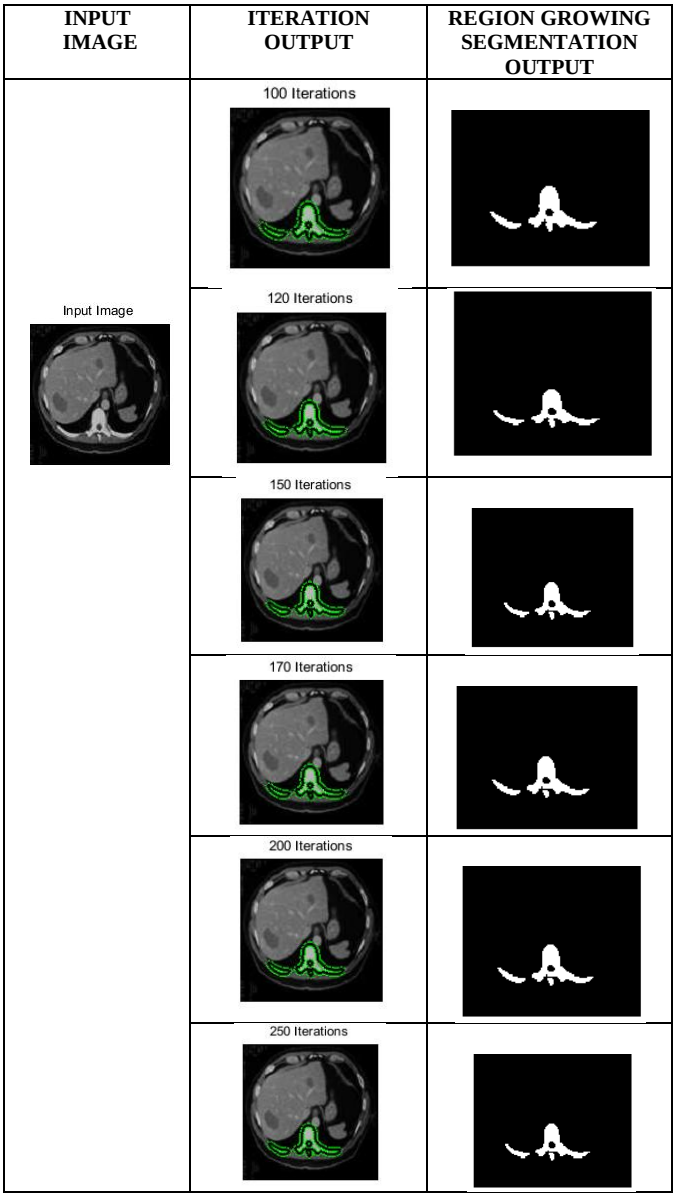

Fig 7: Results for different Iterations

Figure shows kidney segmentation based on the gray level region growing technique with a prior knowledge of the anatomical structure. Input figure also presents accurate delineation of the kidney's boundary without spine. Region based segmentation shows kidney tumor detection as tumor seed after the acceptance test with discriminating features

value. Above table shows kidney tumor segmentation using the detected tumor based on the region-growing technique

From Above Result We have seen that gray scale image is converted into portable gray map file format using film digitizer.This segmentation method gives higher speed And accuracy for detection of kidney tumor at 250 Iterations.

Area calculation:

Area of an image is the total number of the pixels present in the area which can be calculated in the length units by multiplying the number of pixels with the dimension of one pixel. To calculate the number of pixels in the cropped image the function Bwarea() is used. This function calculates the number pixels present in the image. A right click on the image and exploring the detail property will provide the following detail of the image:

1.Size of image, e.g., 600X400

2. Horizontal resolution, e.g., 96 dpi.

3. Vertical resolution, e.g., 96 dpi

From the horizontal and vertical resolution one can find the dimension of a single pixel. The algorithm used is follows:

There are 96 pixels in one inch. Hence vertical dimension of a pixel is 1/96 inch. Similarly horizontal dimension of a single pixel is 1/96 inch.

Area of single pixel is equal to (1/96)*(1/96) square inch.

A = (1/96)*(1/96)

Area of the tumor = A*total

Image Number	**Region Growing Method**	
	Total No of pixel in tumor	**Area**
Image1	515.2500	0.1420
Image2	622	0.1714
Image3	396.7500	0.1093

Table I : Calculation of Area

Above table shows result for different parameter like pixels of tumor and total area of kidney tumor by using Region Growing segmentation method.

5. CONCLUSION :

Computed Tomography image usually full with noise and sometimes caused difficulties to clinician to measure the kidney's parameters. Due to this problem, human errors and time taken for completing the scanning procedure will be increased. So, a segmentation tool with automatic detection system was needed to help the clinician or sonographer do their job in shorter time. a new technique and software to detect human kidney tumor automatically has been developed.

Median filter is used to reduce noise in CT image and morphological operators were used for image Segmentation. All these image processing techniques were built using MATLAB image processing tools. Test results show that the software could be used to detect the kidney tumor automatically by giving great accuracy. this software only produces outline, which is the kidney tumor. This is very important for the future automatic kidney stone and tumor detection.

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