Segmentation of medical texture images

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Abstract- In this paper an algorithm is suggested for automatic edge enhancement and detection in medical images. The characteristics of medical images justify the importance of an edge enhancement step prior to edge detection. The main aim is to suppress unwanted noise and to enhance the image features. The texture feature based technique is selected for analysis of medical images. The suggested algorithm is based on a combination of wavelet coefficients at different scales. Stationary wavelet transform is used for edge enhancement

Keywords- Edge enhancement; edge detection; mother wavelet; multiplicative speckle; stationary wavelet transform.

I. INTRODUCTION

Today, there is almost no area of technical endeavour that is not impacted in some way or another by digital image processing. The area of digital image processing is a dynamic field and new techniques and applications are reported routinely in professional literature and in new product announcements. Digital images are subject to a wide variety of distortions which may result in visual quality degradations.Image enhancement is crucial for many image processing applications. The ultimate goal of image enhancement techniques is to improve the visual information of a degraded image in a subjective process.

Image sharpening is a classic problem in the field of image enhancement. The principal objective of image sharpening is to highlight fine details in an image or to enhance details that have been blurred, either in error or as a natural effect of a particular method of image acquisition. Usages of image sharpening vary and include applications ranging from document and medical imaging to industrial inspection and autonomous guidance in military systems [1].

Edge detection techniques are mostly based on the following two steps: edge enhancement and detection. Unlike optical images, in medical data, which is highly heterogeneous, a robust edge enhancement phase is essential in getting required detection rate. This phase is generally performed through techniques that are related to derivation, like, simple differences, Sobel filter[2], Prewitt filter[3], morphological gradients ,etc., possibly combined with smoothing.

For medical CT and MR images, many methods were recently employed for segmentation, for instance interactive thresholding aided by morphological information [4], region growing and region splitting and merging [5,6], active contours [7,8,9,10], the use of cluster analysis methods [11,12,13], or watershed transformation [14,15].

X-rays are the oldest and the most frequently used form of medical imaging. X-ray is a painless medical test, which helps physicians diagnose and treat medical conditions. This medical test involves exposing a part of the body to a small dose of ionizing radiation with the objective of producing pictures for the inside of the body. The bone X-ray makes images of any bone in the body, including the hand, wrist, arm, foot, ankle, knee, leg or spine. X-ray images are maintained as hard film copy or, more likely, as a digital image that is stored electronically. These stored images are easily accessible and are sometimes compared to current X-ray images for diagnosis and disease management .

When using wavelet tools for signal processing purposes, it is critical to choose conveniently the type of transform as well as the mother wavelet according to the nature of the signal to be analyzed and according to the type of characteristic to be highlighted [16]. In the framework of this paper, a discrete stationary wavelet transform(SWT)will be employed. In order to select the appropriate mother wavelet, the size of its support both in time and in frequency, as well as its number of vanishing moments, has to be taken into account, the Haar wavelet . with two coefficients, a single vanishing moment, and a linear phase has been selected for the addressed application.

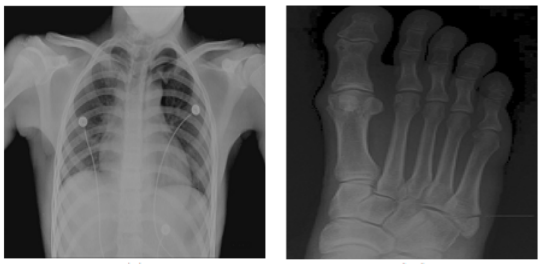


Figure 1. Medical images

A.*medical image processing*

Processing of medical images is done in four steps: image filtering, segmentation, feature extraction and analysis of

extracted features .In this paper segmentation is the step which will be dealt with.

B.Segmentation

Segmentation subdivides an image into its constituent regions or objects. Segmentation algorithms are based on two basic categories dealing with properties of intensity values- discontinuity and similarity. In the first category ,the assumption is that boundaries or regions are sufficiently different from each other and from the background to allow boundary detection based on local discontinuities in intensity. Edge based segmentation belongs to this category. Region based segmentation approaches in the second category are based on partitioning an image into regions that are similar according to a set of predefined criteria.

C.Edge detection

Edge detection is a fundamental tool, which is commonly used in many image processing applications. This process detects boundaries between objects and background in the image. Since edge detection has been an active area for more than 40 years, many effective methods have been proposed such as gradient edge detectors (1st derivative), zero crossing (2nd derivative), Laplacian of Gaussian (LOG) and Gaussian edge detectors .

D.Edge enhancement

The wavelet transform is interpreted as a multiscale differential operator, for the purpose of edge enhancement. More over, if the wavelet ψ has a compact support and n vanishing moments ,i.e.,

$$\int_{-\infty}^{+\infty} t^k \psi(t)\, dt = 0, \qquad \text{for } 0 \le k < n \tag{1}$$

there exists a function θ having decay such that

$$\psi(t) = (-1)^n \frac{d^n \theta(t)}{dt^n}. \tag{2}$$

Then,the wavelet transform of a signal f can be expressed as

$$Wf(u,s) = s^n \frac{d^n}{du^n}(f * \overline{\theta}_s)(u) \tag{3}$$

where

$$\overline{\theta}_s(t) = s^{-1/2}\theta(-t/s),\ u \tag{4}$$

the time or space coordinate, and s is the scale. As a consequence , under these conditions, the wavelet transform $W_{f(}u,s)$ is an nth-order derivative of an averaging of f, with θ_s over a domain proportional to s[16].

II. EDGE ENHANCEMENT ALGORITHM

A.Principles

The algorithm for edge enhancement in medical images, which is proposed in this paper, relies on the difference of behavior along the wavelet scales of the speckle in front of the edges. On the other hand, the discontinuities tend to persist over scales and are highlighted by the wavelet transform .

The speckle is progressively smoothen, and it is almost spatially uncorrelated between scales.

The wavelet transform can be expressed as (5)

$$Wf(u,s) = \int_{-\infty}^{\infty} f(x)\frac{1}{\sqrt{s}}\psi^*\left(\frac{x-u}{s}\right) dx.$$

The Haar wavelet can be expressed as

$$\psi(t) = \begin{cases} 1, & 0 \le t < \frac{1}{2} \\ -1, & \frac{1}{2} \le t < 1 \\ 0, & \text{otherwise.} \end{cases} \tag{6}$$

With this,

$$Wf(u,s) = \frac{1}{\sqrt{s}} \int_{u}^{s/2+u} f(x)\, dx - \frac{1}{\sqrt{s}} \int_{s/2+u}^{s+u} f(x)\, dx \tag{7}$$

In the framework of medical processing,it is useful to take the logarithm of the original signal inorder to manage the multiplicative speckle

Flow Chart of the proposed algorithm is shown in Figure 2

B.Algorithm

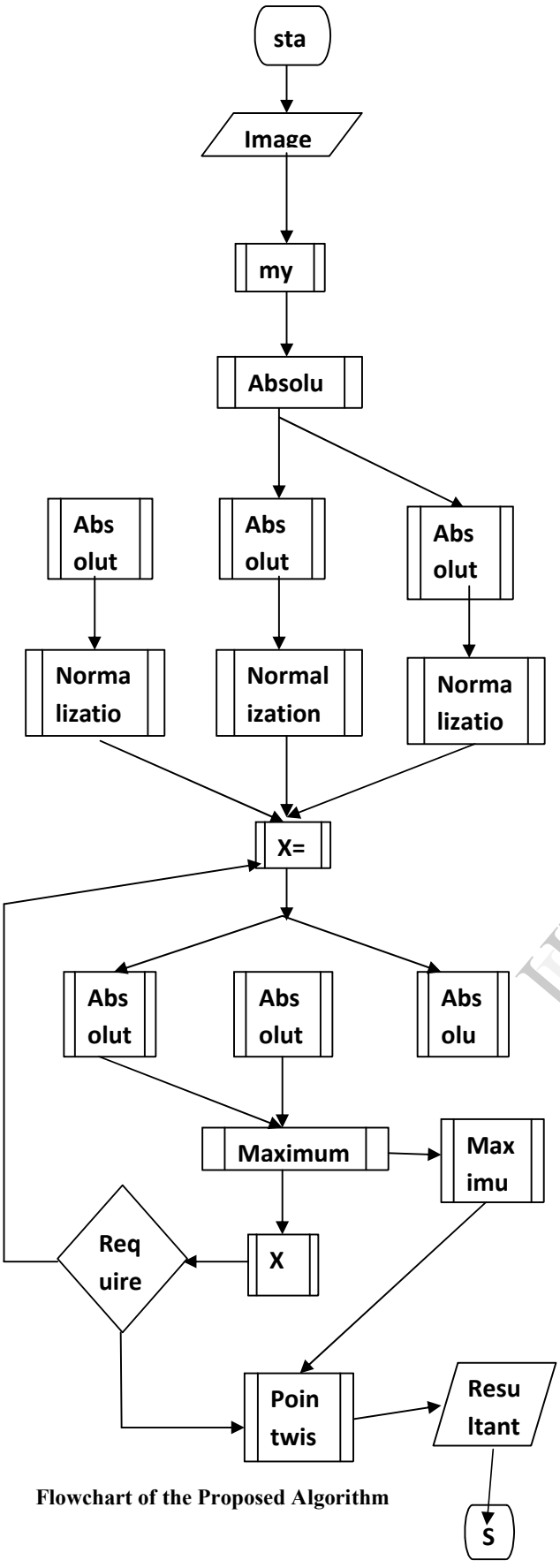
1. Read the image .

2. Stationary wavelet transform (myswt) ie.2D that creates 4 subbands of same size as that of original image.

3. Absolute value of each band except A band ie. H,V and D bands.

4. Normalizing each band to the maximum.

5. Taking H,V and D bands at different levels and calculating pointwise maximum



Flowchart of the Proposed Algorithm

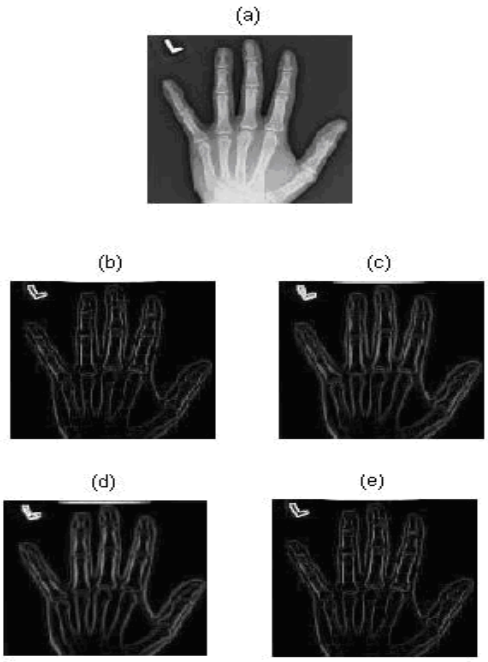


Figure 2. Medical Images showing edge detection a. Original Image, b- d. Intermediate images, e. Resultant Image

CONCLUSION

This paper introduced a new edge detection and enhancement method for medical images using wavelet transforms . In the proposed scheme, Stationary wavelet transform with haar wavelet as the mother wavelet is being used ,as a result the edge detected is better than other morphological filter which are not that efficient in handling the multiplicative speckle. Edge enhancement before edge detection has been successful in identifying the edges in a better manner. Future enhancement to the present work is possible by using some other wavelets like Daubechies. The proposed method is applied on some medical images and commendable results have been obtained

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