EFFICIENT METHOD OF NOISE REDUCTION AND SEGMENTATION OF MEDICAL IMAGES

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Abstract: Automated segmentation of fine objects details in a given image is becoming of crucial interest in different imaging fields. In this work, we will propose a new variation level-set model for both global and interactive selective segmentation tasks, which can deal with intensity in homogeneity and the presence of noise. We will work on histopathological medical images. In this work, we will propose a new variation level-set model for both global and interactive\selective segmentation tasks, which can deal with intensity in homogeneity and the presence of noise. First we will check the presence of noise in input medical image. If the noise are present in given image then we will removed this noise using filtrations techniques. In addition, by using machine learning approach using Image segmentation using fuzzy entropy technique to segment the medical image. After that we will get the segmentation result in histopathological images.

Keywords: *Image segmentation, Median filter, Image noise, fuzzy entropy technique, machine learning;*

I. INTRODUCTION

A. BACKGROUND

Various models for image segmentation have been extensively studied and successfully implemented in image analysis, pattern recognition, image understanding, computer vision, etc. There are two different segmentation classes: 1) global segmentation, where the contour of all the objects in a given image is required to be segmented, and 2) interactive\ selective segmentation where the task of segmentation is to segment a particular object\ feature of the given image.

Medical imaging is the approach and process of creating visual representations of the indoors of a frame for medical evaluation and scientific intervention, as well as visible illustration of the characteristic of a few organs or tissues (physiology). Medical imaging seeks to reveal inner systems hidden via the skin and bones, in addition to to diagnose and deal with disease. Medical imaging additionally establishes a database of regular anatomy and physiology to make it viable to identify abnormalities. Although imaging of removed organs and tissues can be completed for clinical reasons, such procedures are usually considered part of pathology in place of medical imaging.

Images with intensity in homogeneity with or without noise are a challenge for all the global segmenting models. An early attempt to segment images with intensity in homogeneity was an extension of the 2-phase Chan-Vese (CV) model to a multi-phase model, where several level set functions were employed to increase the number of regions of distinct objects. The drawback of the multi-phase model for objects with intensity in homogeneity is that one object can be segmented by different level sets and recognized as two different objects.

In this work we propose a new variation region-based active contour model for both tasks of segmentation, global and selective, for intensity in homogeneity images with or without noise. To handle high image noise we will filtration techniques. Also this work deals with the concept for image segmentation. In this work the histopathological image is taken for the entire process.

In this work, one algorithm is used for segmentation, fuzzy entropy technique. So it gives the accurate result for image segmentation. In this work we will focused on segmentation of image with the help of histopathological images.

B. MOTIVATION

A reliable method for segmenting medical image would clearly be a useful tool. Fuzzy entropy based segmentation method is a useful kind of segmentation method. Compared with the traditional fuzzy entropy-based image segmentation method, the proposed method segments an image using the threshold with membership degree m ($0<m<1$), and increases the opportunity of choosing appropriate thresholds. Also, we will de-noise the histopathological images and segmenting medical images which is useful for medical practitioners.

C. OBJECTIVES

- Improved noise reduction in histopathological images using Median filtration technique.
- To make efficient segmentation on medical images using Fuzzy Entropy Technique.

II. LITERATURE SURVEY

This Paper has proposed the Image de-noising and image segmentation are the fundamental task in image processing. The aim in a de-noising process is to recover a clean image *in a* noisy image This work implemented the new variation global and selective segmentation model suitable for segmenting a range of images that have intensity in homogeneity, noise and a combination of both [1].

Meena and Raja proposed an approach of Spatial Fuzzy C means (PET-SFCM) clustering algorithm on Positron Emission Tomography (PET) scan image datasets. Proposed algorithm is incorporated the spatial neighborhood information with traditional FCM and updating the objective function of each cluster. This algorithm is implemented and tested on huge data collection of patients with brain neuro degenerative disorder such as Alzheimer's disease. It has demonstrated its effectiveness by testing it for real world patient data sets. [2].

Proposed system look at three algorithms namely K Means clustering, Expectation Maximization and the Normalized cuts and compare them for image segmentation. This project addresses the problem of segmenting an image into different regions. We analyze two unsupervised learning algorithms namely the K-means and EM and compare it with a graph based algorithm, the Normalized Cut algorithm. The K-means and EM are clustering algorithms, which partition a data set into clusters according to some defines distance measure [3].

Funmilola et al proposed the Fuzzy K-C-means method, which carries more of Fuzzy C-means properties than that of K-means. This work has mainly focused attention on Clustering methods, specifically k-means and fuzzy c-means clustering algorithms. These algorithms were combined together to come up with another method called fuzzy k-c-means clustering algorithm, which has a better result in terms of time utilization. The algorithms have been implemented and tested with Magnetic Resonance Image (MRI) images of Human brain. Results have been analyzed and recorded [4].

Wilson and Dhas used K-means and Fuzzy C-means respectively to detect the iron in brain using SWI technique. An accurate assessment of iron accumulation is required for diagnosis and therapy of iron overload in various neurodegenerative diseases. Susceptibility Weighted Imaging (SWI) offers information about any tissue that has a different susceptibility than its surrounding structures. [5].

Proposed dip study of brain tumor. It describes different type of diagnosis approaches. This paper presents a systematic Type-II fuzzy expert system for diagnosing the human brain tumors (Astrocytoma tumors) using T1-weighted Magnetic Resonance Images with contrast. The proposed Type-II fuzzy image processing method has four distinct modules: Pre-processing, Segmentation, Feature Extraction, and Approximate Reasoning. [6].

In the field of pattern recognition due to the fundamental involvement of human perception and inadequacy of standard Mathematics to deal with its complex and ambiguously defined system, different fuzzy techniques have been applied as an appropriate alternative [7].

Proposed work has suggested a synergistic and an effective algorithm for the detection of brain tumors based on Median filtering, K Means Segmentation, FCM Segmentation, and finally, threshold segmentation. In this proposed approach we enhance the quality of the tumor images acquired by the aid of MRI and then to detect the size of the tumors, approximate, reasoning are applied. [8].

Proposed work, the author gives a study of the various algorithms that are available for color images, text and gray scale images. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture [9].

In this work proposed k-means and C-mean to extract the features from the images [10].

Proposed system of image registration and data fusion theory adapted for the segmentation of MR images. Propose a system of image registration and data fusion theory adapted for the segmentation of MR images. This system provides an efficient and fast way for diagnosis of the brain tumor. This system provides an efficient and fast way for diagnosis of the brain tumor called K-means algorithm [11].

III. PROPOSED METHODOLOGY

Image de-noising and image segmentation are the fundamental tasks in image processing. The aim in a de-noising process is to recover a clean image. We will work on histopathological medical images. First we will check the presence of noise in input medical image. If the noise are present in given image then we will removed this noise using filtrations techniques. To remove the noise from image for further processing, we will use median filter technique.

After that additionally, the image segmentation is carried out by fuzzy entropy technique. I.e. finally implement a system to remove noise from histopathological image and also segment the histopathological image which is easier, cost reducible and time savable.

Advantages of Proposed System

1. This system will use median filter for noise removal so will get accurate clear image.
2. It consist algorithm for segmentation which effectively able to segment the histopathological image and gives the actual final result.
3. This proposed system effectively able to extract all the spatial characteristics of an Image.

A. Architecture

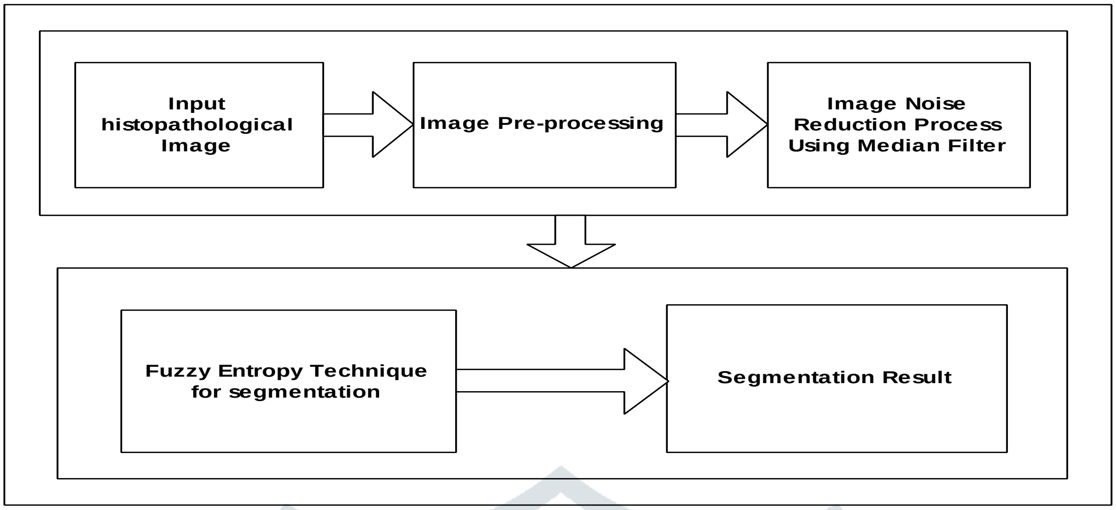

Fig: System Architecture

Explanation:

1. Input:

In this proposed system, we take histopathological image as a input for processing.

2. Image Pre-processing:

In this step, check the size of input image and then the input image is converted into grayscale image.

3. Image Noise Reduction:

In this step, we remove the noise of image using noise reduction technique that i.e. here we use the median filter for noise reduction for accurate image segmentation.

4. Image Segmentation:

In this step, for image segmentation, we use the fuzzy entropy method to segments an image using the threshold with membership degree m (0<m<1), and increases the opportunity of choosing appropriate thresholds.

5. Result:

This step displays the final segmentation result.

B. Algorithms

1. Fuzzy Entropy Technique:

Image segmentation using fuzzy entropy is an important and common segmentation method.
Fuzzy entropy describes the fuzziness of a fuzzy set. It is a basic concept in fuzzy set theory and widely used in image processing. The threshold of fuzzy entropy is mostly selected at the gray value with fuzzy membership degree 0.5. It is a limitation in some cases. In order to solve this problem, we present a new definition of generalized fuzzy entropy and apply it to image segmentation. Compared with the traditional fuzzy entropy-based image segmentation method, the proposed method segments an image using the threshold with membership degree m (0<m<1), and increases the opportunity of choosing appropriate thresholds.

2. Median Filter Technique:

Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges. It is particularly effective at removing 'salt and pepper' type noise. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighboring pixels. The pattern of neighbors is called the "window", which slides, pixel by pixel over the entire image 2 pixels, over the entire image. The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value.

C. Mathematical Model

1. Fuzzy entropy-based thresholding

Fuzzy entropy-based thresholding method has become one of the frequently used segmentation technique during these years.
Let Q denote an image of size $M \times N$ with L levels, and q_{xy} is the gray level of (x, y) pixel in Q.
Let $\boldsymbol{\mu}_{\varrho}(q_{xy})$ denote the membership value which represents the degree of brightness of (x, y) pixel in Q.
In the notation of fuzzy set, the image set Q can be written as $Q = \{(q_{xy}, \boldsymbol{\mu}_{\varrho}(q_{xy}))\}$, where $0 \leq \boldsymbol{\mu}_{\varrho}(q_{xy}) \leq 1$.

$$S(x, a, b, d) = \begin{cases} 0, & x \leq a \\ \frac{(x-a)^2}{(b-a)(d-a)} & a \leq x \leq b \\ 1 - \frac{(x-a)^2}{(d-b)(d-a)}, & b \leq x \leq d \\ 1, & x \geq d \end{cases}$$

Where x is the gray level in Q, and a, b, d are the parameters determining the shape of S-function. Parameter b can be any point between a and d.

Fuzzy entropy-based segmentation method always regards the maximum fuzzy entropy as the threshold selecting principle. The shape of S-function is determined by parameter *a*, *b* and *d*. Therefore, the threshold selecting problem becomes to find a combination of the parameters such that the corresponding event has the maximum fuzzy entropy.

After obtaining the best combination of the parameters (*a**, b*, d*), the gray level with membership value 0.5 is selected as the threshold. We use $G = \{g(x, y)\}$ to denote the segmented image, then the optimal threshold value is selected at

$$(a^*, b^*, d^*) = \text{Arg}_{\,0 \le a < b < d \le L-1} \max e(a, b, d)$$

$$T^* = t, \text{ iff } \mu_0(t) = 0.5$$

$$g(x, y) = \begin{cases} 0 & q(x,y) \le T^* \\ 1 & q(x,y) > T^* \end{cases}$$

In fuzzy entropy-based threshold method, the optimal threshold value is selected at

$$(a^*, b^*, d^*) = \text{Arg}_{\,0 \le a < b < d \le L-1} \max e_m(a, b, d)$$

$$T^* = t, \text{ iff } \mu_0(t) = m$$

$$g(x, y) = \begin{cases} 0 & q(x,y) \le T^* \\ 1 & q(x,y) > T^* \end{cases}$$

2. Median Filter

The best known order-statistics filter is the median filter, which replaces the value of a pixel by the median of the gray levels in the neighborhood of that pixel

$$f(x, y) = \text{median}_{(s,t) \in S_{xy}} \{g(s, t)\}$$

The original value of the pixel is included in the computation of the median. Median filters are quite popular because, for certain types of random noise they provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size.

IV. RESULT AND DISCUSSION

The 8-bit images of dimensions Ml x M2 (= 512 x 512) pixels is used for simulations. The pixels s (i, j) for $1 \le i \le M1$ and $1 \le j \le M2$, of the image is corrupted by adding impulse noise, with noise density ranging from 0.1 to 0.8. In all the simulations, square windows of dimensions N x N pixels and with different values of width N (= 3, 5, 7) are used. The Peak signal to noise ratio (PSNR) is used to compare the relative filtering performance of various filters. The PSNR between the filtered output image y (i, j) and the original image s (i, j) of dimensions Ml x M2 pixels is defined as:

$$\text{PSNR} = 20 * \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right)$$

Where MAX_I is max pixel value of the image and MSE is defined as

$$\text{MSE} = \frac{\sum_i^{M1}\sum_j^{M2}[y(i,j) - s(i,j)]^z}{M1 \; x \; M2}$$

It can be seen that Peak signal to noise ratio (PSNR) is closely related to mean square error (MSE).

Table1: PSNR at different noise density for Histopathological image

Filter	Noise Density								
	10%	20%	30%	40%	50%	60%	70%	80%	90%
Mean	24.24	21.20	19.24	17.73	16.47	15.40	14.43	13.68	12.86
Median	30.84	29.34	27.71	26.07	24.08	20.54	17.04	12.91	9.01
Improved Median	28.23	27.12	26.92	24.53	23.77	21.76	18.94	15.78	11.87

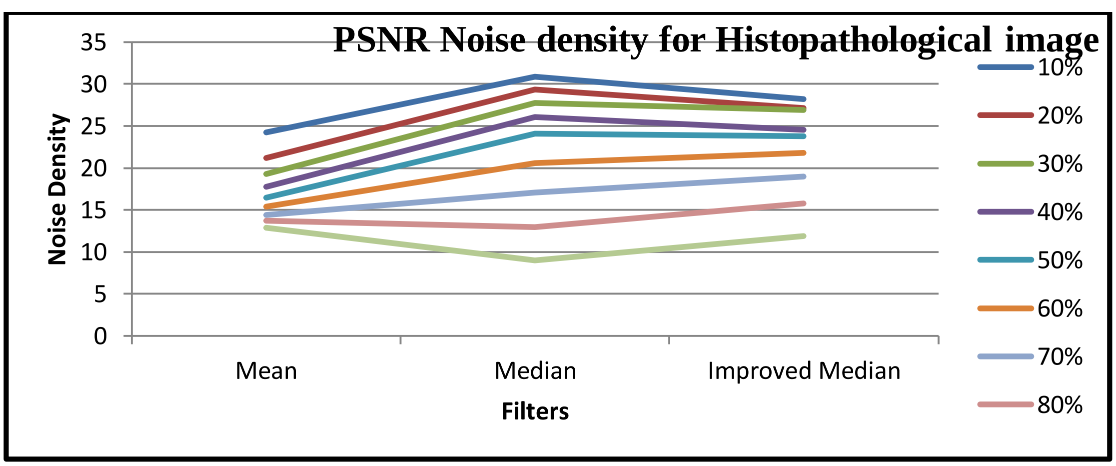

Fig2: Plot for PSNR values of Histopathological image

V. CONCLUSION

We propose a new variation global and selective segmentation system suitable for segmenting a range of histopathological images. We remove the noise of images using median filter technique. We propose a new variation global and selective segmentation system suitable for segmenting a range of histopathological medical images. This technique is very effective to remove the noise from image. The noise free image is given as an input to the fuzzy entropy method for the image segmentation Finally show the segmentation result which is easier, cost reducible and time savable.

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